Republic of Côte d'Ivoire
Ministry of Construction, Housing, Sanitation and Urban Development (MCLAU)

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SCHEMA
DIRECTEUR
d' URBANISME
du GRAND
ABIDJAN

REPUBLIC OF COTE D'IVOIRE

THE PROJECT FOR THE DEVELOPMENT OF THE URBAN MASTER PLAN IN GREATER ABIDJAN (SDUGA)

FINAL REPORT

VOLUME III

URBAN TRANSPORT MASTER PLAN FOR GREATER ABIDJAN

MARCH 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
Oriental Consultants Global Co., Ltd.
Japan Development Institute
International Development Center of Japan
Asia Air Survey Co., Ltd.

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Abbreviations

English		French	
AAD	Abidjan Autonomous District	DAA	District Autonome d'Abidjan
AAGR	Average Annual Growth Rate	TCAM	Taux de Croissance Annuel Moyen
AAP	Abidjan Autonomous Port	PAA	Port Autonome d'Abidjan
ADS	Activity Diary Survey	EAJ	L'Enquête Relative aux Activités Journalières
AERIA	Felix Houphouet Boigny International Airport in Abidjan	AERIA	Aéroport International Felix Houphouet Boigny d'Abidjan
AFD	French Agency for Development	AFD	Agence Française de Développement
AfDB	African Development Bank	BAD	Banque Africaine de Développement
AFTU	Association for Financing of Professionals of Dakar Urban Transport	AFTU	Association de Financement des Professionnels du Transport Urbain
AGEROUTE	Road Management Agency	AGEROUTE	Agence de Gestion des Routes
AGETU	Urban Transport Agency	AGETU	Agence des Transports Urbains
ANAC	National Civil Aviation Agency	ANAC	Agence Nationale de l'Aviation Civile
ANDE	National Environmental Agency	ANDE	Agence Nationale de l'Environnement
ANPR	Automatic Number Plate Recognition	ANPR	Reconnaissance Automatique de Plaques Minéralogiques
ASECNA	Aviation Security Agency	ASECNA	Agence pour la Sécurité de la Navigation Aérienne
ATC	Area Traffic Control	SCC	Système de Contrôle de la Circulation
AUPA	Agency of Urban Planning and Exploration in Abidjan	AUPA	Agence d'Urbanisme et de Prospection d'Abidjan
BEIE	Office of Environmental Impact Assessment	BEIE	Bureau d'Etudes d'Impact Environnemental
BHLS	Bus with High Level of Service	BHLS	Bus à Haut Niveau de Service
BNETD	National Bureau of Technical Studies and Development	BNETD	Bureau National d'Etudes Techniques et de Développement
BOO	Build-Own-Operate	BOO	Construction-Possession-Exploitation
BOOT	Build-Own-Operate-Transfer	BOOT	Construction-Exploitation-Transfert
BOQs	Bills-Of-Quantities	BOQs	Devis-Quantitatifs
BOT	Build - Operate - Transfer	BOT	Bâtir Opérer Transférer
BRT	Bus Rapid Transit	SRB	Service Rapide par Bus
CBD	Central Business District	CA	Centre d'Affaires
CETUD	Executive Council of the Urban Transport of Dakar	CETUD	Conseil Executive des Transports Urbains de Dakar
CI	Côte d'Ivoire	CI	Côte d'Ivoire
CI-PAST	Transport Sector Adjustment Credit Project	CI-PAST	Programme d'Ajustement Sectoriel des Transports
DBFM	Design Build Finance Maintain	DBFM	Conception Financement Gestion Entretien
DGAMP	Directorate General for Maritime Affairs and Port	DGAMP	Direction Générale des Affaires Maritimes et Portuaires
DGMT	Department for Sea and Transport	DGMT	La Direction Générale de la Mer et des Transports
DGTTC	Directorate General of Land Transport and Traffic	DGTTC	Direction Générale des Transports Terrestres et de la Circulation
DOE	Department of Environment	DOE	Direction de l'Environnement

Abbreviations

English		French	
DWT	Deadweight Tonnage	TPL	Port en Lourd
ECOWAS	Economic Community of West African States	CEDEAO	Communauté Economique des Etats de l'Afrique de l'Ouest
EDF	European Development Fund	FED	Fonds Européen de Développement
EIA	Environmental Impact Assessment	EIE	Etude d'Impact Environnemental
EIRR	Economic-Rate-of-Return	TREI	Taux Economique de Rentabilité Interne
EIS	Environmental Impact Statement	CIE	Constat d'Impact Environnemental
ETC	Electric Toll Collection	SPE	Systèmes de Péage Electronique
EU	European Union	UE	Union Européenne
FC	Foreign Cost	CE	Coûts Etrangers
FCFA	African Financial Community Franc	FCFA	Francs de la Communauté Financière Africaine
FDI	Foreign Direct Investment	IDE	Investissements Directs Etrangers
FER	Road Maintenance Fund	FER	Fonds d'Entretien Routier
FHB	Felix Houphouet Boigny	FHB	Félix Houphouët-Boigny
FHBIA	Felix Houphouet Boigny International Airport	AIFHB	Aéroport International Félix Houphouët Boigny
FM	Frequency Modulation	FM	Modulation de Fréquence
FS	Feasibility Study	EF	Etude de Faisabilité
GBP	Great Britain Pound	GBP	Grande Bretagne Livre
GdG	General de Gaulle	GdG	Général de Gaulle
GDP	Gross Domestic Product	PIB	Produit Intérieur Brut
GIS	Geographic Information System	SIG	Système d'Information Géographique
GPS	Global Positioning System	SPG	Système de Positionnement Global
GRDP	Gross Regional Domestic Product	PIB Régional	Produits Intérieurs Bruts Régionaux
HBE	Home-Based Education	HBE	Entre Domicile et Education
HBO	Home-Based Other	HBO	Entre Domicile et Autres
HBW	Home-Based Work	HBW	Entre Domicile et Travail
HGV	Heavy Goods Vehicles	PL	Poids Lourds
HIS	Household Interview Survey	EMD	Enquête Ménages Déplacements
HKB	Henri Konan Bedie	HKB	Henri Konan Bédié
HOV	High-Occupancy Vehicle	VOM	Véhicules à Occupation Multiple
HS	Harmonized Commodity Description and Coding System	SH	Système Harmonisé
IC	Integrated Circuit	IC	Circuit Intégré
ICT	Information & Communication Technology	TIC	Technologies de l'Information et de la Communication
IDA	International Development Association	IDA	Association Internationaile de Développment
IDB	Islamic Development Bank	BID	Banque Islamique de Développement
IEE	Initial Environmental Examination	EEI	Examen Environmental Initial
INS	National Statistic Office	INS	Institut National de la Statistique
ISEA	Integrated Strategic Environmental Assessment	EESI	Evaluation Environnementale Stratégique Intégré
ITS	Intelligent Transportation Systems	STI	Systèmes de Transport Intelligents
ITVS	Intersection Traffic Volume Survey	EVTC	Enquête sur le Volume de Trafic aux

Abbreviations

English		French	
			Carrefours
IZ	Industrial Zone	ZI	Zone Industrielle
JICA	Japan International Cooperation Agency	JICA	Agence Japonaise de Coopération Internationale
JST	JICA Study Team	JST	Mission d'Etude de la JICA
LC	Local Cost	CL	Coûts Locaux
LCC	Life Cycle Cost	CCV	Coût du Cycle de Vie
LCPC	Laboratoire Central des Ponts et Chaussees	LCPC	Laboratoire Central des Ponts et Chaussées
MCLAU	Ministry of Construction, Housing, Sanitation and Urban Development	MCLAU	Ministère de la Construction, du Logement, de l'Assainissement et de l'Urbanisme
MEC	Mixed Economy Company	SEM	Société d'Economie Mixte
MIE	Ministry of Economic Infrastructure	MIE	Ministère des Infrastructures Economiques
MINEME	Ministry of State, Ministry of Environment	MINEME	Ministère d'Etat, Ministère de l'Environnement
MINESUDD	Ministry of Environment, Urban Safety and Sustainable Development	MINESUDD	Ministère de l'Environnement, de la Salubrité Urbaine et du Développement Durable
MLIT	Ministry of Land, Infrastructure, Transport and Tourism	MLIT	Ministère du Territoire, des Infrastructures, des Transports et du Tourisme
MODERATO	Management by Origin-Destination Related Adaptation for Traffic Optimization	MODERATO	Adaptation de la Gestion Relative à la Provenance et à la Destination pour une Circulation Optimisée
MP	Master Plan	SD	Schéma Directeur
MT	Ministry of Transport	MT	Ministère du Transport
MTPCPT	Ministry of Public Works, Construction, Post and Telecommunication	MTPCPT	Ministere des Travaux Publics, Construction, Postes et Telecommunication
MV	Medium-Voltage Electricity Line	MT	Ligne Electrique de Moyenne Tension
MVF	Motorized Vehicle Fleet	MVF	Flotte de Véhicule Motorisé
NDP	National Development Plan	PND	Plan National de Développement
NHB	Non-Home-Based	NHB	Autres que le Domicile
NPV	Net-Present Value	VAN	Valeur Actuelle Nette
OD	Origin and Destination	OD	Origine et Destination
ODA	Official Development Assistance	APD	Aide Publique au Développement
OIC	Ivorian shippers Office	OIC	Office Ivoirienne des Chargeurs
OM	Operation and Maintenance	OM	Opération et Maintenance
OSER	Road Safety Office	OSER	Office de la Sécurité Routière
PACITR	Program of Community Actions Infrastructure and Road Transport	PACITR	Programme d''Action Communautaire de l'Infrastructure et des Transports Routiers
PASP	Autonomous Port of San Pedro	PASP	Port Autonome de San Pedro
PCU	Passenger Car Unit	UVP	Unité de Voiture Particulière

Abbreviations

English		French	
PFI	Private Finance Initiative	PFI	Private Finance Initiative
PFP	Privately Financed Projects	PFP	Projets à Financement Privé
PPI	Private Participation in Infrastructure	PPI	Participation du Secteur Privé dans le Développement des Infrastructures
PPP	Public-Private Partnership	PPP	Partenariat Public-Privé
PRICI	Project of Infrastructure Renaissance in Ivory Coast	PRICI	Projet de Renaissance des Infrastructures de Côte d'Ivoire
PSP	Private Sector Participation	PSP	Participation de Secteur Privé
PSU	Primary Sampling Units	UPE	Unités Primaires d'Echantillonnage
PT	Person Trip	PT	Déplacement de Personne
PTIS	Public Transport OD Interview Survey	PTIS	Enquête par Interview OD dans les Transports Collectifs
PTU	Urban Transport Scope	PTU	Périmètre des Transports Urbains
PUd	Detailed Urban Plan	PUd	Plan d'Urbanisme de détail
PUIUR	Emergency Program for Urban Infrastructure	PUIUR	Programme d'Urgence d'Infrastructures Urbaines
RAP	Resettlement Action Plan	RAP	Plan de Relogement des Populations
RGPH	General Census of Population and Housing	RGPH	Le Recensement Général de la Population et de l'Habitat
RIS	Road Inventory Survey	RIS	Enquête d'Inventaire du Réseau Routier
ROT	Rehabilitate-Operate-Transfer	ROT	Réhabilitation-Exploitation-Transfert
ROW	Right of Way	ROW	Emprise de Voie
RTG	Rubber Tired Gantry Crane	RTG	Grues Portiques sur Pneus
SCATS	Sydney Coordinated Adapted Traffic System	SCATS	Système d'Adaptation Coordonnée de Sydney
SCF	Standard Conversion Factor	SCF	Facteur de Conversion Normalisée
SCOOT	Split Cycle Offset Optimization Technique	SCOOT	Technique d'Optimisation des Cycles
SDUGA	Urban Master Plan for Greater Abidjan	SDUGA	Schéma Directeur d'Urbanisme du Grand Abidjan
SEK	Swedish Krona	SEK	Couronne Suédoise
SICF	Ivorian Railway Company	SICF	Societe Ivoirienne des Chemins de Fer
SICTA	Ivorian Automobile Technical Control Company	SICTA	Société Ivoirienne de Contrôle Technique Automobile et Industriel
SIGTU	Management System of Urban Transport	SIGTU	Système Intégré de Gestion des Transports Urbains
SIPF	Government Agency for Rail Management	SIPF	Société Ivoirienne de Gestion du Patrimoine Ferroviaire
SITARAIL	International Company of African Rail Transport	SITARAIL	Société Internationale de Transport Africain par Rail
SNCF	French National Railway Company	SNCF	Société Nationale des Chemins de fer Français
SODEXAM	Airport, Aeronautical and Meteorological Operation and Development Company	SODEXAM	Société Nationale de Développement et d'Exploitation des Aéroports
SOFRETU	French Company of Studies and Realizations of Urban Transport	SOFRETU	Société Française d'Etudes et de Réalisations de Transports Urbains
SONATT	National Land Transport Company	SONATT	Societe Nationale des Transports Terrestres

Abbreviations

English		French	
SOTRA	Abidjan Transport Company	SOTRA	Société des Transports Abidjanais
SOTU	Urban Transport Company	SOTU	Société des Transports Urbains
SP	Sub-Prefecture	SP	Sous-Préfecture
SPV	Special Purpose Vehicle	FCC	Fond Commun de Créance
SUV	Sport-Utility Vehicle	VUS	Véhicule Utilitaire Sport
SWOT	Strength, Weakness, Opportunities and Threats	SWOT	Force, Faiblesse, Opportunité, et Menace
TAZ	Traffic Analysis Zone	TAZ	Zones d'Analyse du Trafic
TCM	Transportation Control Measure	TCM	Mesures de Contrôle du Transport
TDM	Transport Demand Management	TDM	Gestion de la Demande de Transport
TEU	Twenty-foot Equivalent Unit	EVP	Equivalent Vingt Pieds
TIA	Traffic Impact Assessment	EIT	Etude Impact sur le Trafic
TIS	Traffic Impact Study	EIT	Etude Impact sur le Trafic
TOD	Transit-Oriented Development	DOT	Développement Orientés sur le Transit
TOR	Terms of Reference	TDR	Termes de Référence
TOS	Transport Opinion Survey	TOS	Enquête de Préférence Déclarée Relative aux Transports
TSS	Travel Speed Survey	TSS	Etude de la Vitesse de Déplacement
TTS	Travel Time Saving	TTS	Economies de Temps de Déplacement
UEMOA	West African Economic and Monetary Union	UEMOA	Union Economique et Monétaire Ouest-Africaine
UN	United Nations	ONU	Nations Unies
US$/USD	United States Dollar	US$/USD	Dollar US
US/USA	United States of America	US/USA	États-Unis d'Amérique
USAID	United States Agency for International Development	USAID	Agence des Etats-Unis pour le Développement International
VAT	Value-Added-Tax	TVA	Taxe sur la Valeur Ajoutée
VGE	Valery Giscard d'Estang	VGE	Valery Giscard d'Estang
VITIB	Village of Information Technology and Biotechnology	VITIB	Le Village des Technologies de l'Information et de la Biotechnologie
VMS	Variable-Message Signboards	PMV	Panneaux à Messages Variables
VOC	Vehicle Operating Cost	VOC	Coût d'Exploitation des Véhicules
WADB	West African Development Bank	BOAD	Banque Ouest Africaine de Développement
WAEMU	West African Economic and Monetary Union	UEMOA	Union Economique et Monétaire Ouest Africaine
WB	World Bank	BM	Banque Mondiale
WIM	Weigh-In-Motion	WIM	Pesage en Mouvement
WTP	Willingness to Pay	WTP	Disposition à Payer

Japan International Cooperation Agency (JICA)
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The Project for the Development of the Urban Master Plan in Greater Abidjan in the Republic of Côte d'Ivoire (SDUGA)

Final Report

March 2015

Volume III
Urban Transport Master Plan for Greater Abidjan

Part 5
Current Conditions and Planning Prerequisites for Urban Transport Master Plan

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1.0 Existing Conditions and Salient Findings

1.1 Road

1.1.1 Road Network

(1) History of Road Network Development

Once limited to Treichville and Plateau, Abidjan has been quickly expanding around the Ebrié Lagoon and now stands on several converging peninsulas and islands. The port and its industrial zones are now concentrated in Treichville, Marcory and Petit-Bassam while the living quarters, such as Yopougon, Cocody or Abobo are located in the northern part of the city.

The road network of Abidjan has been trying to expand in parallel to the development of the city. The road network of the two first communes of Abidjan, Plateau and Treichville, are now almost all paved whereas the road network of the latest expansion areas, such as Yopougon and Abobo have still lots of road unpaved (see Table 1.1).

Spatially, the road network of Abidjan District has been shaped by the presence of the Ebrié Lagoon and the Banco Forest around which the District has developed. In particular, the Ebrié Lagoon which cuts the District into two, created many problems as important infrastructures was needed to ensure communication between different areas of the District. Those problems still remain as only two bridges have been built over the lagoon.

As a result of this unique geographic aspect, the road network of the District could not assume a radial form, promoting the growth of a number of peripheral centers which was one of the reasons of the division of the District into communes. Yopougon, one of the main residential areas is still connected to the rest of the district by only one access road, the Autoroute du Nord or Northern Highway.

(2) Current Road Network

The District of Abidjan is now covered by almost 1800 km of roads of which around 850 km are paved as shown in the following table (Table 1.1).

Table 1.1 State of the Abidjan District Road Network (2011)

Communes	Length (km)	Paved Roads (km)	% of Paved Roads	Unpaved Roads (km)
Port-Bouët	55.2	40.0	72%	15.2
Koumassi	126.8	75.1	59%	51.8
Marcory	103.9	84.3	81%	19.6
Treichville	71.8	64.8	90%	7.1
Plateau	26.8	26.8	100%	0.0
Adjamé	120.0	84.6	71%	35.4
Attécoubé	50.0	30.0	60%	20.0
Yopougon	451.5	163.0	36%	288.5
Abobo	125.4	67.7	54%	57.7
Cocody	134.7	109.9	82%	24.8
Sub-Total	1266.3	745.8		520.4
Bingerville	91.1	15.3	17%	76.0
Anyama	276.4	71.1	26%	205.3
Songon	138.5	22.0	16%	116.5
Total	1772.1	854.6		917.5

Source: District of Abidjan, Directorate of Infrastructures and Equipment, Sub-Directorate of Urban Roads and Sanitation

Abidjan has an important road network with major roads such as boulevards, avenues and highways passing through most of the communes, such as:

- The Autoroute du Nord or Northern Highway that runs inside the District;
- The Boulevard Valérie Giscard d'Estaing connecting the District center to the Airport;
- The Boulevard de Vridi going through the industrial zone;
- The Boulevard François Mitterrand; and
- The Boulevard Général de Gaulle and the Boulevard de la Paix creating a ring road around Plateau.

In addition to those boulevards, avenues and highways, other major roads are running through Yopougon and Cocody.

The Général-de-Gaulle Bridge and the Félix-Houphouët-Boigny Bridge are the only link between the northern residential area including Cocody, Yopougon or Abobo and the southern industrial zone spreading from Treichville to Petit-Bassam. They have become major bottlenecks of the road network as those two infrastructures can no longer cope with the increasing traffic crossing every day the Lagoon and estimated at 200,000 vehicles. Additional infrastructure across the Ebrié Lagoon is thus required to provide a better traffic flow, allowing in particular goods arriving at the biggest port on the western part of Africa to be transported efficiently to the rest of the country and helping maintain the predominance of this international hub.

(3) Road Conditions

The road network is characterized by deteriorated road surfaces and missing links. Lots of areas lacked good access as roads are unpaved and vehicles are taking a lot of time to reach the arterial roads.

The military crisis has significantly increased the deterioration of roads, as the limited financial resources allocated for road maintenance during this period could not cope with the huge needs in road maintenance and repairs. While in 1985, 77% of the paved road network was below its estimated useful life of 15 to 20 years, today many road pavements need to be replaced or repaired. This situation has gotten worse by the growth of traffic in recent years which further damaged the road network, increasing drastically the resources required for the maintenance of the road network, while the budget allocated for such works are continuing to fall. Where sealing with bituminous could have prevented cracks from enlarging, the lack of maintenance has resulted in the increase of their size which now requires more intensive repairs. This has resulted not only in potholes (Figure 1.1) but also in pavement failures (Figure 1.2). The road network of Abidjan District has entered a vicious circle as repair works are more and more expensive once the road is deteriorated, increasing drastically the budget needed to restore the road network.

Figure 1.1 Potholes

Figure 1.2 Pavement Failure

Moreover, most of the ditches and storm drains are neither maintained nor cleaned, resulting in local flooding which maintains water in the pavement, sub-base and subsoil and further damage the road. Under these conditions, the network can only get worse if nothing is done to reverse this trend.

(4) Road Classification and Maintenance

1) The 1984 Classification

The latest official road classification was carried out in 1984 and was officially promulgated by the decree No.84-851. Under this classification, roads were divided into four categories: roads of national interest, roads of district interest, roads of communal interest and private roads. Roads of national interest are under the responsibility of the State and are thus managed by the State and its Road Management Agency, AGEROUTE.

Roads of District interest are under the jurisdiction of the District. However, the District Road Management Service has a limited budget and cannot intervene on all the roads under his responsibility, and some of the major roads of district interest are maintained and repaired by AGEROUTE. The District still receives the profits generated by billboards along the roads of district interest.

Finally, Roads of communal interest are under the responsibility of the Communes. It covers all the urban roads not classified in the previous two categories.

The n^{o} 84-851 decree dated July the 4th, 1984, Article 3, lists all the roads of national and district interest (Table 1.2 and Table 1.3). The roads that are not mentioned in those lists are either roads of communal interest or private roads. The Road of National Interest and District Interest are shown on the following maps (Figure 1.3 and Figure 1.4).

Table 1.2 List of Roads of National Interest

Roads of National Interest	
Order No.	Name of the Roads
1	The route de Grand Bassam, from the airport intersection to the limit of the City towards Grand-Bassam
2	The autoroute de l'aéroport between the carrefour de l'aéroport and the Abidjan - Port-Bouët airport terminal
3	The boulevard de Vridi, from the carrefour de l'aéroport to the rue Pasteur
4	The rue Pasteur and its extension up to boulevard Valéry Giscard d'Estaing
5	The boulevard Valéry Giscard d'Estaing
6	The Houphouët-Boigny bridge and its annexes
7	The Charles de Gaulle bridge and its annexes
8	The link, from the Charles de Gaulle bridge to the boulevard de Marseille through Marcory interchange
9	The boulevard de Marseille
10	The boulevard lagunaire ouest, from the Houphouët-Boigny bridge to the carrefour d'Agban
11	The link from the Attécoubé interchange to the voie express est-ouest
12	The boulevard Charles de Gaulle, from the Houphouët-Boigny bridge to the carrefour d'Agban included
13	The Indénié interchange
14	The rocade de Cocody, from the Indénié interchange to the boulevard Latrille
15	The boulevard François-Mitterand
16	The route du Zoo
17	The route Abobo-Alépé
18	The voie expres carrefour d'Agban – Abobo and its extensions towards Agboville
19	The voie de contournement du Banco
20	The voie express est-ouest and its interchanges
21	The autoroute du nord
22	The route de Dabou

Source: nº84-851 decree dated July the 4th, 1984

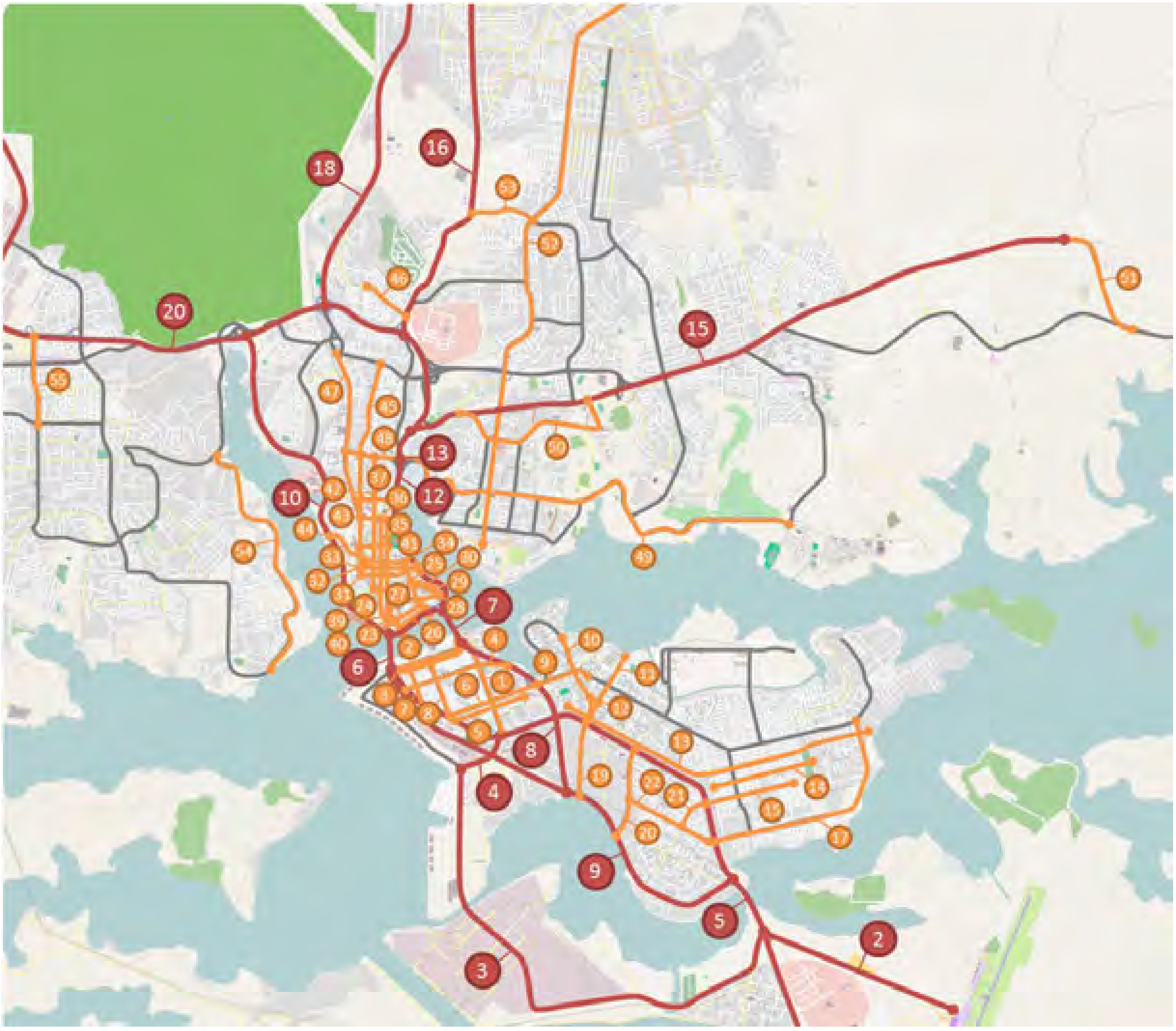
Table 1.3 List of Roads of District Interest

Roads of District Interest	
Order No.	Name of the Roads
1	The boulevard Nana-Yamoussou, from the boulevard Valéry-Giscard-d'Estaing to the Charles-de-Gaulle Bridge
2	The avenue Christiani
3	The avenue Victor-Biaka
4	The avenue Gabriel-Dabié
5	The avenue de la Reine Pokou
6	The avenue Ouézzin Coulibaly
7	The boulevard Delafosse
8	The rue du 6 février
9	The avenue de Marcory
10	The boulevard de Lorraine
11	The avenue de la TSF
12	The boulevard de Brazzaville, from the avenue de la TSF to the boulevard de Lorraine
13	The boulevard du Gabon
14	The boulevard du Caire
15	The boulevard du 7 décembre
16	The link from boulevard du Caire to the boulevard du 7 décembre
17	The boulevard Antananarivo
18	The link from boulevard du Caire to the boulevard Antananarivo
19	The rue du Chevalier de Clieu
20	The rue Pierre et Marie Curie
21	The link from boulevard Valéry-Giscard-d'Estaing to the rue Paul Langevin
22	The rue Paul Langevin
23	The avenue Treich-Laplène
24	The boulevard de la République
25	The boulevard Botreau-Roussel
26	The avenue du Général de Gaulle, from the boulevard Botreau Roussel to the avenue Treich-Laplène
27	The avenue Noguès, from the avenue Treich-Laplène to the boulevard Botreau-Roussel
28	The avenue Crosson-Duplessis
29	The avenue Delafosse
30	The avenue Franchet-D'Espérey
31	The avenue Chardy
32	The avenue Terrasson-de-Fougères
33	The link from the avenue Terrasson-de-Fougères to the boulevard Carde
34	The avenue Marchand
35	The avenue du Docteur Crozet
36	The avenue Jean-Paul II
37	The avenue de la Gendarmerie
38	The rue des Sambas
39	The avenue Binger
40	The avenue Van-Vollenhoven
41	The boulevard Clozel
42	The boulevard Angoulvant and its extension up to boulevard Latrille through the Corniche de Cocody
43	The boulevard Carde
44	The link from the the boulevard Card to the boulevard lagunaire Ouest
45	The avenue 13 at Adjamé
46	The avenue Jacob-Williams
47	The boulevard Nanguy-Abrogoua
48	The avenue Reboul
49	The boulevard de France and its extension up to Riviéra
50	The route de l'Université and its connection to the boulevard François-Mitterand
51	The route between the extension of the boulevard de France and the route de Bingerville
52	The boulevard Latrille
53	The link from the boulevard Latrille to the route du Zoo
54	The route de Locodjro
55	The route from Yopougon to the Yopougon Interchange

Source: nº84-851 decree dated July the 4th, 1984

Source: JICA Study Team

Figure 1.3 Roads of National Interest and District Interest



Road of National Interest   Road of District Interest

Source: JICA Study Team

Figure 1.4 Roads of National Interest and District Interest (Central Abidjan)

The following comments can be made:

- The roads of national interest are the ones connecting the District to all international roads. The road in front of the airport is also considered as a road of national interest as it connects the District to an international connection (airport).
- All the communes have a direct connection to a road of national interest. Most of them are designed with more than four lanes and are connecting the major areas of the District.
- The Treichville-Marcory-Koumassi Island is covered by many roads of national interest, which reflects the importance of the industrial area.

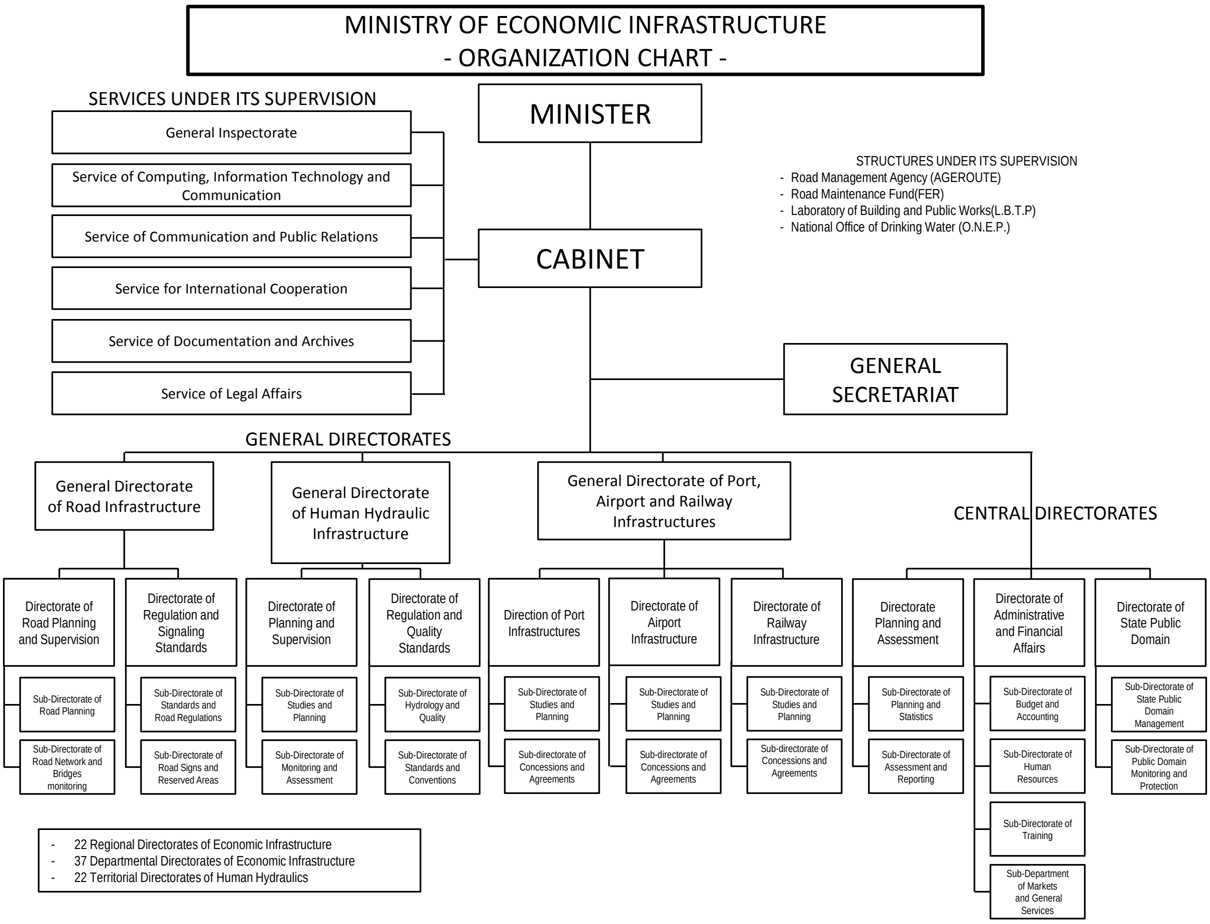
- The roads of urban interest are mainly concentrated in Plateau and on Treichville-Marcory-Koumassi Island, the Business and the Industrial Centers of the District. Most of the arterial roads are located in those two communes.
- On the other hand, Yopougon, Abobo and Cocody, which have seen its population grow exponentially in recent years, are almost without any roads of National or District interest. In 1984, those residential areas were still developing and were not considered as vital roads for the economy.
- Most of the roads in those communes are thus under the responsibility of the Communes, that do not have appropriate resources to carry out the maintenance of its road network.

According to AGEROUTE, a new classification is currently been prepared and could be approved soon. This new classification will mainly concentrate on the road network outside the District. AGEROUTE could not provide us this data as it has not been officially promulgated.

2) Ministry of Economic Infrastructure (MIE)

The Ministry of Economic Infrastructure is responsible for the implementation and monitoring of the government policy concerning infrastructure in the public works sector. As such, it is in charge of the following actions in conjunction with the various public agencies:

- Roads and Bridges: The MIE is in charge of project management, monitoring design, implementation of the infrastructure as well as their maintenance and regulating their management.
- Infrastructure for air, rail and water (sea, lagoon and river) transport: The MIE is in charge of project management, monitoring design and implementation of infrastructure such as airports, ports, railways and waterway infrastructure as well as their maintenance.
- Water infrastructure: The MIE is in charge of project management, monitoring design and implementation of public water supply and water points in village, as well as their maintenance, and regulating their management.



Source: Ministry of Infrastructure

Figure 1.5 Organization Chart of AGEROUTE

3) Road Maintenance Fund

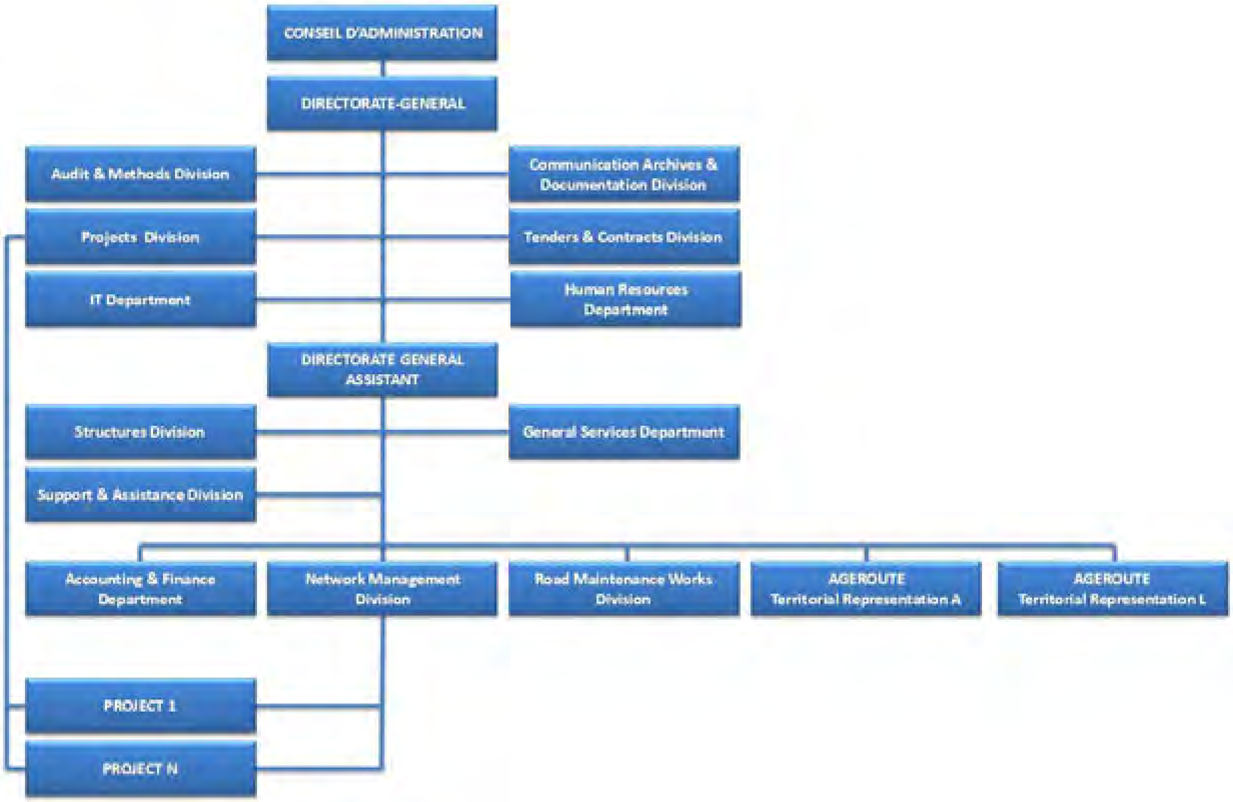
With the privatization of road maintenance in 1994 which led to the disappearance of the road maintenance authorities for the benefit of private companies in road construction, the level of service of the road has dropped considerably. Resources increasingly important were necessary to maintain in good practicability roads.

In order to restore and maintain a road network that was getting more and more degraded, the Côte d'Ivoire has undertaken reforms with the support of the World Bank in the road sector which resulted in the creation of the Ministry of Economic Infrastructure and two new structures in 2002:

- The Road Maintenance Fund (FER), established by Ordinance No. 2001-591du September 19, 2001 and by Decree No 2001 -593 of 19 September 2001, responsible for the mobilization of resources allocated to finance the national road maintenance program resources;
- The Road Management Agency (AGEROUTE), responsible for project management as representative of the State.

4) AGEROUTE

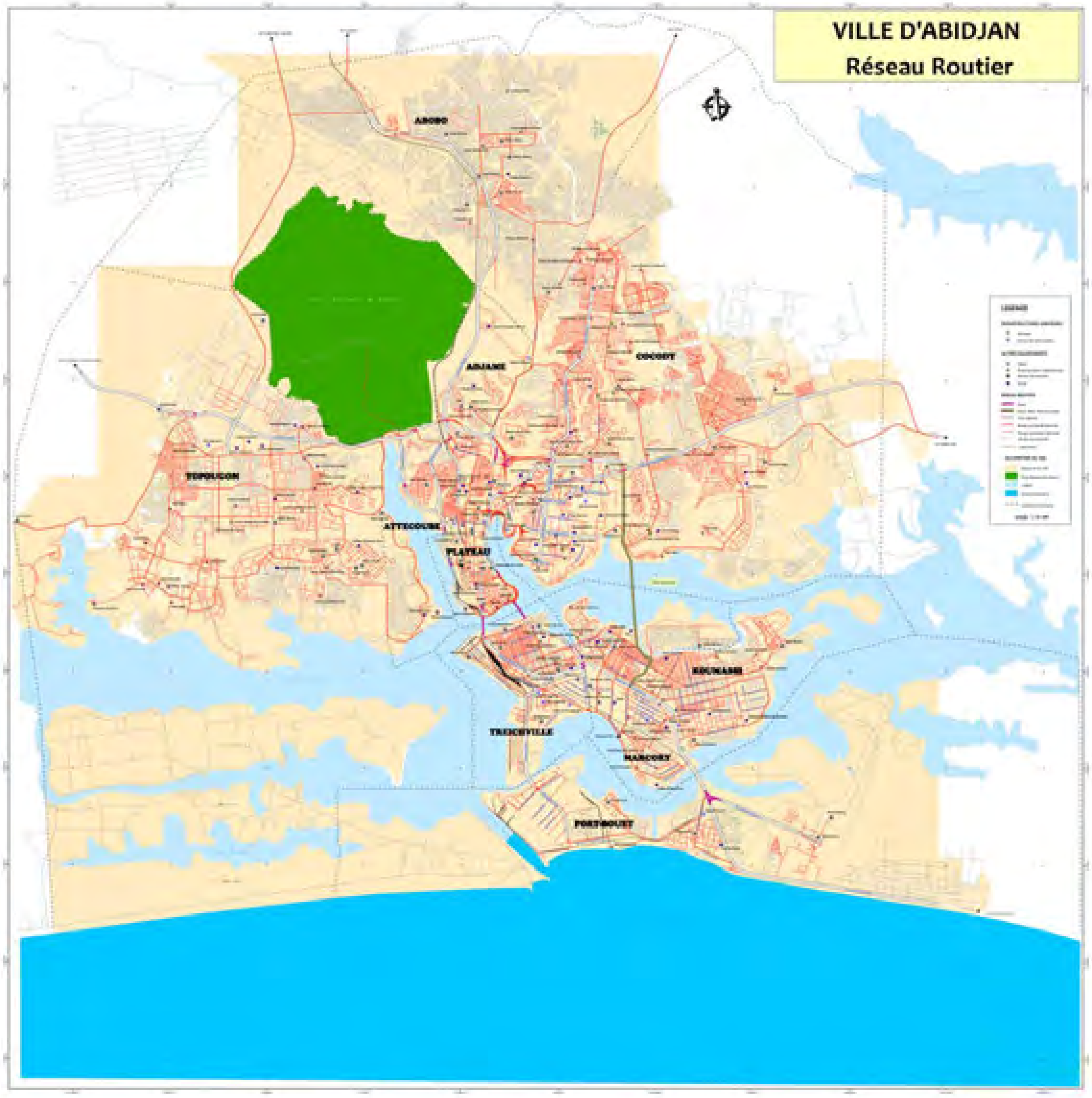
The Road Management Agency (Agence de Gestion des Routes - AGEROUTE) is the authority in charge of the management of the road network of national interest. In order to stop the degradation of the network and save the existing road network, a coherent strategy is required and AGEROUTE is in the center of this strategy. The organization chart of AGEROUTE is shown in Figure 1.6.



Source: AGEROUTE

Figure 1.6 Organization Chart of AGEROUTE

Although the 1984 decree has clearly divided the management of the existing road network between the State (and thus AGEROUTE), the District and the Communes, AGEROUTE has been involved in many road maintenance outside its scope. Indeed, roads of district interest, which should be managed by the District are not properly maintained due to the limited budget and capacity to carry out those works. AGEROUTE is thus carrying out the maintenance of the roads that they consider as primary (red bold line in Figure 1.7 below).



Source: AGEROUTE

Figure 1.7 Roads which are maintained by AGEROUTE (white and red bold lines)

5) PUIUR and PRICI

According to a study carried out by the AGEROUTE in 2003, 60 % of the road network in Abidjan inspected has a very high level of degradation, resulting in a negative impact on transport services.

Some actions have been carried such as the Projet d'Urgence d'Infrastructures Urbaines (PUIUR) and the Projet de Renaissance des Infrastructures de Côte d'Ivoire (PRICI) to try to upgrade the road conditions. The PUIUR was initiated in September 2008 by the Government and the World Bank, from an IDA Grant No. H3970-CI (amount: U.S. $ 94 million / about FCFA 44.8 billion) to intervene in five sensitive sectors: drinking water, urban sanitation, solid waste management, urban roads and local communities. In July 2010, the project received an additional IDA Grant No. H5910-CI (amount: U.S.

$ 50 million: about FCFA 23.8 billion), due to satisfactory performance by the World Bank. The project completion is scheduled for September 2013.

To follow the PUIUR, the PRICI was launched as a project co-financed by the World Bank and the Ivorian Government which has three components: rehabilitation of urban infrastructure, rehabilitation of rural infrastructure and management/coordination of projects. The total budget is close to 100 billion FCFA of which 54 billion will be spent on roads to restore the conditions of pavement.

1.1.2 Traffic Management

(1) Role of Traffic Management

Traffic management refers to a wide range of measures that are implemented to improve the efficiency of traffic flow, enhance traffic safety and create a better environment for both vehicles and pedestrians by maximizing or rationalizing the use of existing facilities. Therefore, traffic management can be defined as "Government activities to bring current traffic to an optimum functional status and to prevent obstacles to traffic".

Traffic management is becoming increasingly important in urban areas where scarce road space is already occupied by vehicles. Measures to enhance the attractiveness of public transport are also a part of traffic management to improve overall efficiency.

Traffic management is not only a combination of simple traffic regulations and traffic controls, the question "In the current road network, how do we create secure flows of traffic that are smooth and comfortable" must be answered, and aggressive introduction of the ITS becomes indispensable as a technique for traffic control.

(2) Organization

AGEROUTE is a government agency that supervises the construction of roads and their maintenance. There is a traffic management department that includes traffic signalization in AGEROUTE.

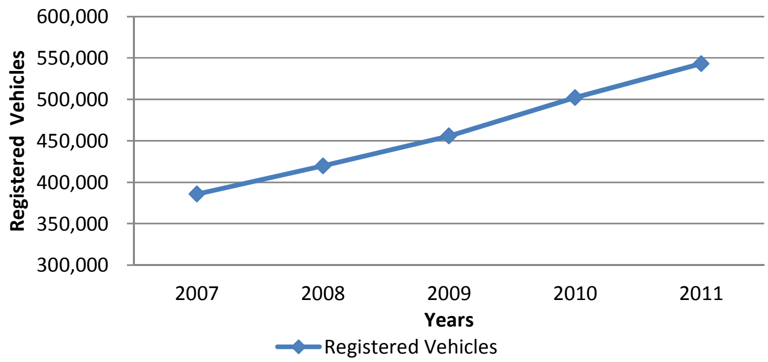
Abidjan Autonomous District (AAD) also takes charge of some functions on traffic management. Urban transport division in AAD treats traffic flow system and parking facilities and another division manages lagoon transport. They also have a duty to manage and build parking, where the capacity of parking under their jurisdiction is counted as 4,300 vehicles including commercial, private parking and parking inside or outside institutes. They intend to rehabilitate these parking since people do not prefer to use it due to insufficient condition, besides such improvement results in the increase of tax even though they are not collecting it as of now.

(3) Vehicle Registration

Formerly, SONATT[1] (Société Nationale des Transports Terrestres) took charge of vehicle registration in Cote d'Ivoire. Ministry of Transport handles driver's license and SICTA (Société Ivoirienne de Contrôle Technique Automobile et Industriel), private concessionaire company, treats car inspection.

[1] SONATT was dissolved on August 6, 2014, and now a Columbian group, Quipux S.A., which specializes in the development of integrated transportation management systems, has got a public service concession of issuing driving licenses with IC chips for six years.

Number of registered vehicles in Abidjan from 2007 to 2011 is summarized in Figure 1.8. On average, the annual growth rate of vehicles is 8 to 10% in these years.



Source: SONATT and SICTA

Figure 1.8 Registered Vehicles from 2007 to 2011

Registered vehicles by vehicle type in 2007 are shown in Table 1.4. 81.2% of registered vehicles are counted in Abidjan, where passenger cars are dominant, taking a share of 71.9%.

Table 1.4 Registered Vehicles by Vehicle Type in 2007

	Motorcycle	Passenger Car	Bus	Van	Truck	Special Vehicles	Tractor	Semi-Trailer	Tricycles	TOTAL	%
Abidjan	20,228	277,229	14,002	32,737	18,979	3,124	6,085	12,620	795	385,799	81.2%
%	5.2%	71.9%	3.6%	8.5%	4.9%	0.8%	1.6%	3.3%	0.2%	100%	
Total Côte d'Ivoire	37,196	314,165	17,512	42,723	27,382	4,287	8,470	22,230	909	474,874	100%
%	7.8%	66.2%	3.7%	9.0%	5.8%	0.9%	1.8%	4.7%	0.2%	100%	

Source : SICTA

(4) Traffic Accidents

OSER (Office de Sécurité Routière) takes charge of traffic accidents and road safety in cooperation with police to enforce traffic violation. Number of traffic accidents, injuries and deaths from 2002 to 2012 are shown in Table 1.5. It shows a 46% increase in the total number of these kinds of accidents from 2003 to 2012.

Table 1.5 Number of Accidents, Injuries and Deaths from 2003 to 2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Deaths	190	166	180	145	119	106	147	132	108	172
Serious Injuries	1,293	1,220	1,496	1,985	1,994	2,090	1,923	2,349	1,682	3,076
Minor Injuries	4,662	4,523	4,905	4,740	4,626	5,075	5,570	4,677	2,397	5,835
Accidents	4,070	3,691	4,171	4,775	4,625	4,961	5,525	5,310	2,901	5,856
Total	10,215	9,600	10,752	11,645	11,364	12,232	13,165	12,468	7,088	14,939

Source : OSER

(5) Traffic Condition of Intersection

Intersection turning movement count survey was conducted at 12 locations in Abidjan. These intersections are major intersections with high traffic volume and recurring congestion.

The survey results indicate that traffic concentrates in many intersections operating at near or over capacity. Table 1.6 shows the number of intersections by traffic volume level (16-hour PCU). The non-signalized intersections are also heavily loaded with more than 150,000 PCU for 16 hours.

Table 1.6 Number of Intersections by Volume Level

16-hour PCU volume	Signalized Intersection	Non-signalized Intersection	Roundabout
> 150,000	1	2	1
150,000 - 100,000	3	0	0
100,000 - 50,000	1	0	2
< 50,000	0	0	2
Total	5	2	5

Source: JICA Study Team

The capacity analysis in the signal intersection was conducted like the above for peak hours of the day. In the signalized intersection, the saturation rate is basically obtained from the flow capacity per approach and the structure of the approaches. The flow capacity of an approach is calculated from the lane types and the composition of directional traffic volumes. The intersection saturation rate aggregates the green phase saturation rates which are obtained as the normalized traffic volumes. If the intersection saturation rate exceeds 1.0, any attempt to improve the signal system for the intersection fails to meet the traffic demand without creating long queues. The desirable intersection saturation rate is 0.9 or less.

Table 1.7 and Table 1.8 show intersection saturation rate of signalized and non-signalized intersections. Intersection saturation rate exceeds 0.9 at most intersections. The congested direction is found with the high normalized traffic volume, and therefore intersection saturation rate of the whole intersection becomes particularly higher.

Table 1.7 Intersection Saturation Rate of Signalized Intersection

Intersection No.	Direction	Observed Traffic Volume	Saturation Flow Rate	Normalized Traffic Volume	Possible Flow Capacity	Intersection Saturation Rate
1	V1	773	3,791	0.268	1,866	1.983
	V2	416	1,189	0.350	457	
	V3	4,659	3,549	1.313	1,747	
	V4	1,084	1,618	0.670	622	
6	V1	1,875	3,009	0.623	1,332	1.497
	V2	1,881	2,615	0.719	1,158	
	V3	1,685	2,532	0.666	1,121	
	V4	2,655	3,194	0.831	1,415	
7	V1	1,190	3,810	0.312	1,482	0.929
	V2	673	1,952	0.345	976	
	V3	765	3,327	0.230	1,294	
	V4	815	1,321	0.617	660	
8	V1	1,897	3,261	0.582	1,739	1.745
	V2	695	1,879	0.370	313	
	V3	1,524	1,919	0.794	256	
9	V1	1,945	5,159	0.377	2,751	0.732
	V2	236	1,646	0.144	274	
	V3	45	1,681	0.026	224	
	V4	2,078	5,347	0.389	2,852	
	V5	443	1,969	0.225	328	
	V6	164	1,776	0.092	237	
10	V1	4,088	5,079	0.805	2,370	1.435
	V1'	137	1,495	0.091	1,096	
	V2	2,483	3,942	0.630	1,927	
	V3	2,148	5,632	0.381	2,441	
	V4	732	3,806	0.192	634	

Source: JICA Study Team

Table 1.8 Intersection Saturation Rate of Non-Signalized Intersection

Intersection No.	Direction	Observed Traffic Volume	Saturation Flow Rate	Normalized Traffic Volume	Possible Flow Capacity	Intersection Saturation Rate
2	V1	621	715	0.868	358	1.786
	V2	1,018	1,303	0.781	652	
	V3	2,094	2,082	1.006	1,041	
	V4	558	940	0.593	470	
3	V1	1,672	3,968	0.481	1,984	1.019
	V2	907	1,229	0.441	205	
	V3	268	1,115	0.137	186	
	V4	1,979	3,883	0.367	1,941	
	V5	37	1,105	0.035	184	
4	V1	1,542	1,234	1.250	617	1.896
	V2	726	1,393	0.521	697	
	V3	33	1,087	0.030	543	
	V4	812	1,256	0.646	628	
	V5	259	1,273	0.203	636	
5	V1	1,454	983	1.479	492	1.837
	V2	467	1,306	0.358	653	
	V3	845	779	1.084	390	
11	V1	467	1,221	0.382	611	1.033
	V2	589	1,007	0.585	504	
	V3	436	1,156	0.377	578	
	V4	785	1,206	0.651	603	
12	V1	2,439	3,745	0.651	1,872	1.183
	V2	510	1,358	0.375	226	
	V3	1,511	2,390	0.632	398	
	V4	413	2,645	0.156	1,323	

Source: JICA Study Team

(6) Traffic Control Devices

1) Traffic Signals

Traffic signals are a basic tool for controlling vehicular and pedestrian movement at intersections. In the history of traffic signals, the Ivorian government considered the development of their road signals after their independence in 1960 and the first traffic signal was installed in Abidjan in 1963. Since then, 230 traffic signals have been installed. Most of the equipment or materials for the existing traffic signals have been supplied from Europe (France, Italy, etc.). Some equipment also came from China.

The maintenance and control of the traffic signals are done by AGEROUTE. Accordingly, no one other than AGEROUTE can adjust the signal timing of the traffic signals. Signal timing was prepared when these traffic signals were initially installed. Subsequently, signal timing is not adjusted except for when inadequate timing is found as a result of disparity of traffic condition among the approaches.

Therefore, the traffic volume, such as at peak hours, increases and cannot be controlled by the traffic signals. When there is a need, the police sometimes direct the traffic at peak hours with disregard to the traffic signals.

The government has a project to modernize the controlling of traffic signals at all intersections in the center of Abidjan district. In addition, they see the need to install another 30 to 40 signals in currently uncontrolled intersections. However, the government has no plans for intersection improvement, but rather intends to install traffic signals in most of the roundabouts, especially the one found in the airport area. They have created a budget estimate, but have not found the funds yet.

2) Overload Detection Devices

There is an overload detection device being built right outside of Abidjan along the route to Yamoussoukro that will detect overloaded vehicles. The government intends to build two of these systems in fixed locations and have 10 mobile units along the highway.

The construction of the Overload Detection Devices is part of the implementation of the Programme of Community action Infrastructure and Road Transport (PACITR) and the application of Regulation 14/2005/CM/UEMOA adopted by the Council Ministers of UEMOA, on the harmonization of standards and control procedures template, weight and axle load of heavy vehicles transporting goods. To do this, the UEMOA Commission has therefore decided to support States in building and equipping a weigh station on the Community network of each of its Member States. AGEROUTE is in charge of the implementation of the project.

3) Other Traffic Control Devices

Generally, arterial streets in Abidjan have pavement markings (lane lines, turn arrows, stop lines, pedestrian crossings, etc.). However, most of them are worn out and not functioning well.

There are no delineators and therefore road separation is accomplished with guardrails of the New Jersey type. This guardrail is a concrete type, and it is not easy to change traffic regulation. Moreover, safety is not ensured because they are hard structures made of concrete that cause great damage to the vehicles during accidents.

As for the pavement markings and traffic regulation signs built in Abidjan, a French standard (XP P98-501, XP P98-531) is the basis. Some traffic regulation signs still remain, but traffic regulatory signs in the Study area are still suffering from the effects of the civil wars and are currently not in acceptable condition.

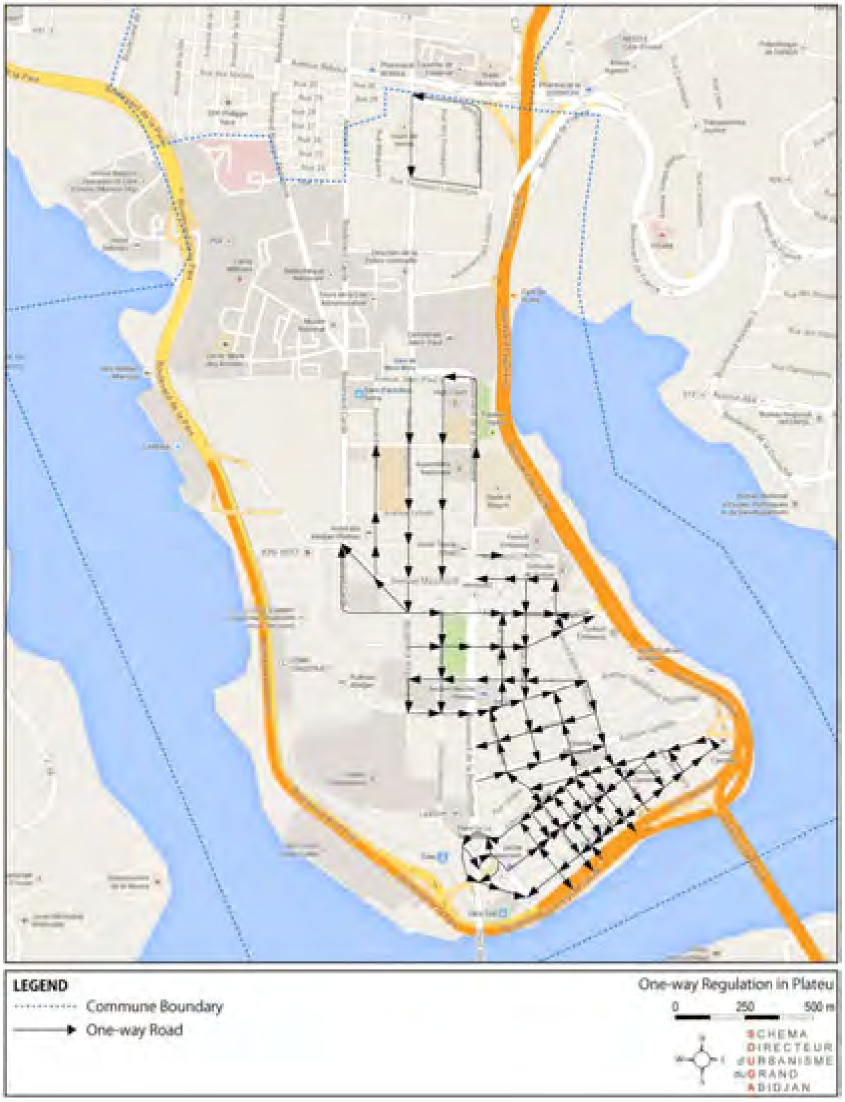
(7) Traffic Management Measures

1) Truck Regulation

Trucks are not allowed to pass though inside Plateau during the time period of 6:00 to 9:00 and 16:30 to 20:00 excluding highways surrounding Plateau. This regulation is applied for trucks of which weight is more than three tons with more than 15 wheels; however, delivery trucks are allowed to pass through inside Plateau anytime.

2) One-Way System

The one-way system is one of the measures to improve the traffic flow as it reduces the number of conflicts at intersections. On the other hand, trip length becomes longer due to the restriction on flow direction, and public transport users have to suffer inconvenience due to route diversion. Normally a one-way system is applied to two streets parallel to each other. The one-way system is applied only to several streets in the Plateau Commune of Abidjan as shown in Figure 1.9.



Source: JICA Study Team

Figure 1.9 One Way Regulation in Plateau

3) Parking Management

i) General

Some parking inside private building is managed by private sector and on-street public parking is managed by AAD. AAD dispatches enforcers to their parking to keep it organized by leading parking users to keep proper usage of the parking. On-street parking in front of private premises such as restaurant can be utilized legally if applicant pays tax to AAD and if parking vehicles do not disturb the through traffic.

However, the situation of increasing automobiles and continuing reliance on private vehicles in Abidjan, it is essential to increase the parking capacity in Abidjan, especially in Plateau. Problems of overflowing parking vehicles are observed everywhere in Plateau. On-street public parking spaces are determined by AAD, but parking is not efficiently managed. Illegal on-street parking overflowing the designated parking area is reducing the number of available driving lanes. This causes traffic disorder, consequently reducing the road capacity and increasing the travel time and eventually the traffic pollution.

ii) Parking lots

Some typical parking facilities consist of government office buildings, private office buildings and commercial buildings are surveyed. Time of operation and capacity of the facilities in the Parking Facility Survey are shown below.

Table 1.9 Parking Sites

Location	Facility	Name of Parking	Opening Hour	Total Floor Area of the Building (m2)	Parking Area (sqm)		Parking Capacity	
					Outside Building	Inside Building	Motor cycle	Passenger Car
1	Governmental Office Building	Cité Administrative TOUR C	24 hours	13,650	0	5,460	0	475
2		Immeuble POSTEL 2001	24 hours	13,769	640	3,700	0	322
3		Immeuble SCIAM	24 hours	18,060	240	10,290	0	260
4		Cité Administrative TOUR D	24 hours	17,380	0	5,690	0	495
5		Parking Hôtel de ville (district)	6:00 - 22:00	1,890	300	360	0	31
6	Private Office Building	Immeuble JECEDA	24 hours	13,910	0	2,320	0	172
7		Immeuble Pharmacie Long Champ	6:00 - 23:00	14,350	300	1,220	0	106
8		Immeuble HARMONIE	24 hours	10,165	0	2,060	0	179
9		Parking NOUR AL HAYAT	24 hours	4,750	0	860	0	75
10		Immeuble NABIL	24 hours	5,380	370	3,170	0	132
11	Commercial Building	Immeuble BICICI	7:30 - 20:00	5,880	0	680	0	50
12		Immeuble Hôtel IBIS	6:00 - 20:00	2,700	90	290	0	25
13		Parking Amenagé Super Trade Center	7:30 - 20:00	26,400	0	410	0	36
14		Immeuble les HEVEAS	6:00 - 22:00	7,350	0	1,890	0	140
15		Immeuble SGBCI	24 hours	8,550	550	690	7	60

Source: JICA Study Team

iii) Tariff

The tariff varies according to the location as shown in the table below. A parking tariff is set in some parking facilities, but most parking facilities can park free. A parking ticket and the parking tariff payment are not systematized and are done all with a manual.

Table 1.10 Parking Tariff

Location	Facility	Name of Parking	Parking Fee		Ticketing/ Payment
1	Governmental Office Building	Cité Administrative TOUR C	Free	No Parking Lots	N/A
2		Immeuble POSTEL 2001	Free	No Parking Lots	N/A
3		Immeuble SCIAM	Free	No Parking Lots	N/A
4		Cité Administrative TOUR D	Free	No Parking Lots	N/A
5		Parking Hôtel de ville (district)	Free	No Parking Lots	N/A
6	Private Office Building	Immeuble JECEDA	Not Free	3,000 FCFA for every Month	Manual
7		Immeuble Pharmacie Long Champ	Free	No Parking Lots	N/A
8		Immeuble HARMONIE	Free	No Parking Lots	N/A
9		Parking NOUR AL HAYAT	Not Free	1,000 FCFA for First one Hour 500 FCFA for Additional one Hour 69,000 FCFA for three Months	Manual
10		Immeuble NABIL	Free	No Parking Lots	N/A
11	Commercial Building	Immeuble BICICI	Free	No Parking Lots	N/A
12		Immeuble Hôtel IBIS	Free	No Parking Lots	N/A
13		Parking Amenagé Super Trade Center	Not Free	500 FCFA (Fixed price, free charge if expenditure is more than 5,000 FCFA)	Manual
14		Immeuble les HEVEAS	Free	No Parking Lots	N/A
15		Immeuble SGBCI	Free	No Parking Lots	N/A

Source: JICA Study Team

iv) Parking Demand

The present parking situation shows an overall saturation of available parking capacity. Table 1.11 summarizes the peak hour parking occupancy ratio of each parking. Parking volume exceeds the capacity in some parking, which can be roughly identified by parking occupancy ratio over 1.0. It ranges in a wide variety. Some parking shows low occupancy rate, which might happen due to the preference of the drivers who do not intend to use parking inside the building especially on the basement or who do not have permission for the usage of the parking where permission is required to enter the parking for the security reason.

Table 1.11 Parking Occupancy Ratio in Peak Hour

Location	Facility	Name of Parking	Parking Ratio
1	Governmental Office Building	Cité Administrative TOUR C	0.25
2		Immeuble POSTEL 2001	0.19
3		Immeuble SCIAM	0.49
4		Cité Administrative TOUR D	0.39
5		Parking Hôtel de ville (district)	1.04
6	Private Office Building	Immeuble JECEDA	0.04
7		Immeuble Pharmacie Long Champ	0.47
8		Immeuble HARMONIE	0.13
9		Parking NOUR AL HAYAT	1.12
10		Immeuble NABIL	0.36
11	Commercial Building	Immeuble BICICI	1.98
12		Immeuble Hôtel IBIS	0.76
13		Parking Amenagé Super Trade Center	0.99
14		Immeuble les HEVEAS	0.46
15		Immeuble SGBCI	0.80

Source: JICA Study Team

(8) Traffic Management on Highways

The government has highways which it wants to turn into expressways soon. One is the Abidjan – Yamoussoukro and another is the Abidjan-Bassam Highway that is currently under construction. These highways will have toll fees chargeable for drivers who will use the routes. The charges will be based on the distance covered by the vehicles. The toll fee payment will be done by several means.

The control and maintenance of the expressways will be done by private companies in the future, but for now, AGEROUTE does that.

1.2 Public Transport

1.2.1 Public Transport Today

(1) Conventional Bus

The public bus operated by SOTRA (Société des Transports Abidjanais) consists of a network (Figure 1.10) of 84 lines including 14 express routes in 2008 totaling nearly 1,200 km (one-way) operated by a total fleet of 819 vehicles, with a 73% fleet availability (about 600 vehicles). The cost of a SOTRA bus ticket is 200 FCFA for a normal bus and 500 FCFA for an express bus, which have been set by the government since 1994. A principal benefit of the express bus service is that a bus passenger should have a seat. SOTRA also operates a water bus service at a fare of 200 FCFA. The number of passengers on the water bus service is a fraction of that on the bus service. As depicted later in Figure 1.14, the bus attracts a public transport market share of around 11%.

Source: SOTRA

Figure 1.10 SOTRA Bus Network in Abidjan

SOTRA is subsidized for the low prices in the tariff. The government compensates 80% of the monthly cost for students to obtain a bus card (15,000 FCFA per month) and 50% for civil servants. However, those compensations from the government often do not come on time, causing a real financial problem for SOTRA.

SOTRA also operates a water bus service at a fare of 200 FCFA. The number of passengers on the water bus service is a fraction of that on the bus service. As depicted later in Figure 1.14, the bus including the water bus attracts a public transport market share of around 12%, which has dropped from 28% in 1998.

SOTRA has experienced a huge decrease in the quantity of their buses because of the failure to purchase new buses in the last 26 years. While they had 1,200 buses in 1987, they now have only half of the fleet available. This has caused a drop in their market share as described later. Their 600 buses allow them to carry only 650,000 persons out of total 13.6 million trips per day by the people in Abidjan[2]. If they had more buses, they could serve more trips.

However, they intend to have 1,000 buses from 2013 up to 2016 which could enable them to carry about 1.2 million passengers. They have a plan to purchase buses from a 15 billion FCFA loan that they obtained from an Egyptian bank (AFES-CI) and another 5 billion FCFA grant from the Ivorian government.

[2] Total trips excluding walk made in the District of Abidjan and Grand Bassam, estimated based on the Household Interview Survey 2013.

(2) Informal Sector

The Gbaka, which is essentially a minibus operating on a fixed route service with a capacity of between 14 and 32 seats, is shown in Figure 1.11. It is subject to transport authorization issued by AGETU (Agence des Transports Urbains) under the Ministry of Transport for a particular line of operation. Gbaka serve the entire city of Abidjan with the exception of the Plateau (Figure 1.12). However, as some Gbaka licenses are issued by the communes, the true number of Gbaka currently in operation is unknown. AGETU has estimated that, in 2009, there were around 5,600 Gbaka (about 3,200 of which are authorized) operational in any day (see Table 1.15). Gbaka are diesel vehicles which are 15 years old on average and are often not well maintained, causing a higher risk of accidents. Nevertheless, the Gbaka is attracting a larger public transport market share of around 33%.

Source: JICA Study Team

Figure 1.11 The Gbaka's in Abidjan

Source: Nicolas JOST et Pascal MICHON, Etude de la mobilité dans une métropole de l'ouest africain - Année 2008 - 2009

Figure 1.12 Agglomerated Network of Gbaka Operations in Abidjan

Meter taxis are painted in a red/orange color. Authorized meter taxis may belong to the formal sector; however, since some meter taxis are not authorized and some also join illegal Woro-Woro operation as described later, the situation is chaotic. AGETU has estimated in 2009 that the number of meter taxis was around 17,400 (about 8,800 of which are authorized) with around 80% operational at any one time (see Table 1.15). Meter taxis are 17 years old on average, and most of them are not well maintained.

In Abidjan, there is also a Woro-Woro or intra-communal taxi as seen in Figure 1.13. From the outside the only difference between that and the meter taxi is the color of the vehicle. The intra-communal taxis have a color that is unique to each commune. Licenses of intra-communal taxis are issued by communes. The total number of intra-communal taxis is estimated by AGETU at 5,800 vehicles in 2008 with an operational fleet of around 4,640 circulating vehicles on any particular day.

Source: JICA Study Team

Figure 1.13 An Example of a Woro-Woro in the Port Area

The problem of the Woro-Woro is that it often operates as a shared, fixed-route, inter-commune taxi as well[3]. Though it is illegal, even private vehicles and meter taxis often join this Woro-Woro service, which has a fixed tariff depending on the distance. Some drivers even have no driving license, impairing the traffic safety. Illegal Woro-Woro usually departs from an informally designated Woro-Woro station as soon as it is filled with four passengers; thus, the frequency depends on the demand of passengers.

Overall, the Woro-Woro, whether it may be legal or illegal, attracts the largest public transport market share of around 44%. It has been required to perform local services of proximity for several years. It has developed significantly in recent years due to some of its competitiveness compared to other modes, and secondly thanks to the shortage in supply of buses. As a result of the failure of the implementation of the earlier master plans, there has been an extensive growth in the informal sector as a product of its convenience to users and the readily available rolling stock that is the Gbaka and Woro-Woro.

The fares on Gbaka services will vary according to the time of day or the level of congestion. A Gbaka trip for example from Adjamé to Abobo could cost around 200 FCFA, which could be reduced down to 100 FCFA in off-peak hours, whilst a similar 15 km trip in a Woro-Woro would be around 300 FCFA with a meter taxi fare for a similar trip in the range of 1,500 FCFA. This informal sector consisting of

[3] If an intra-communal taxi operates as a shared, fixed-route taxi, the roof lamp must be taken off to operate as a private vehicle.

Gbaka and Woro-Woro attracts a significant market share of the public transport mode of 77% whereas the meter taxis account for only 9% as presented in Figure 1.14.

(3) Water-Based Transport

SOTRA also operates a water bus service at a fare of 200 FCFA. SOTRA operates four water bus routes namely, Treichville - Plateau, Treichville - Cocody, Treichville - Yopougon, and Plateau - Yopougon. The number of passengers on the water bus service is a fraction of that on the bus service.

Including the above, there are three types of lagoon transport in Abidjan:

- Modern transport, executed by SOTRA at a fare of 200 FCFA;
- Semi-modern transport, executed by private Marine System Company at a fare of 150 FCFA; and
- Traditional private transport, executed by artisans at a fare of 100 FCFA.

These types of lagoon transport run from the east to the west through three lagoon complexes that are Aby complex (covering 427 km^2), Ebrié complex (covering 506 km^2) and Grand-Lahou complex (covering 182 km^2). The total area of these complexes is nearly 1200km^2 stretching for about 300km. During 2009 to 2010 lagoon transport of Abidjan had 20 transport lines. Other lagoon transport lines exist between Abidjan and Grand-Lahou, Adiaké (Aby), and Ghana.

The semi-modern and the traditional lagoon transport have 20 lines of transport in Abidjan, represent a fleet of fifty boats with a capacity of 25 to 170 seats on average, according to the 2009-2010 statistics of DGAMP (Direction Générale des Affaires Maritimes et Portuaires). The semi-modern and traditional lagoon transport took 10 million passengers for the annual traffic, while the modern lagoon transport took about 13.3 million passengers per year[4]. There are about 31 water bus stations, but they are not well managed. Prices of the semi-modern and the traditional lagoon transport are determined and fixed by the lagoon transport union and the Ministry of Transport (or AGETU) does not have any power on the rate setting.

This lagoon transport provides a quick access to Plateau (i.e., the central business district) with a ticket price of 150 to 200 FCFA from Yopougon, Bingerville and Cocody in an estimated time of 10 to 25 minutes. Meanwhile, from those communes to Plateau takes around 45 minutes by bus with a cost of at least 200 FCFA. Furthermore, a travel to Ghana costs 18,000 FCFA by road while it costs 6,000 FCFA by lagoon. Thus, the development of lagoon transport presents many advantages.

(4) Others

There is also operational a limited national railway service but is only carrying a limited number of passengers on average nationally less than a 1,000 per day with a not dissimilar additional number of international passengers daily.

[4] Statistics from SOTRA

The largest city bus station in Abidjan is North (or Adjamé) Bus Station. This bus station to the north of the Plateau serves as a major interchange between bus, rail, Gbaka, and Woro-Woro. As the public transport is understood further, it is a certainty that this bus station, along with South Bus Station, plays an important and key role. On the other hand, Gbaka stations are separated from the bus stations and usually located on unpaved (poorly drained) land.

1.2.2 Public Transport Trends

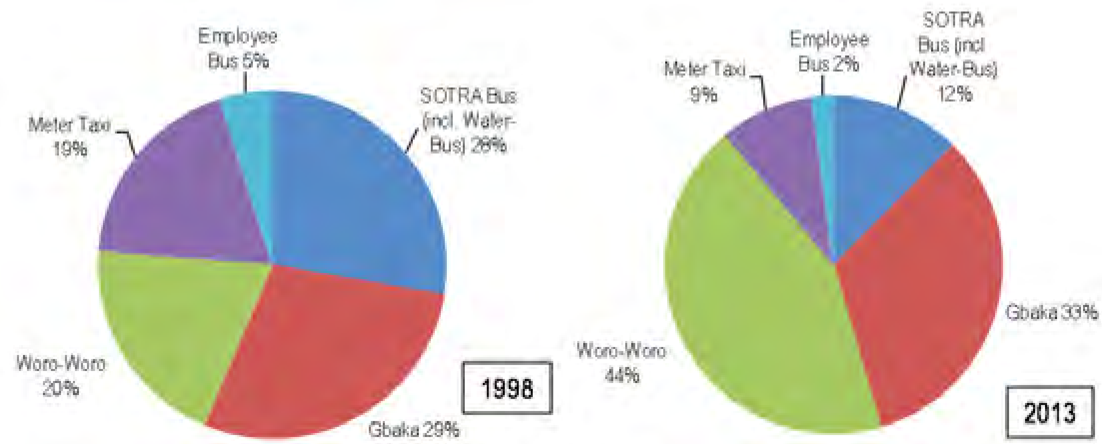
Between 1998 and 2013, the number of non-walk trips has increased from 3.2 million trips to 5.7 million trips or at a moderate growth rate of 4% per annum. However, within the same time frame there has been a significant change in the modal characteristics of a person trip as depicted in the adjacent table. In fact, in absolute terms the person trips by Woro-Woro have grown at a significant rate of a little excess of 7% per annum whilst the attractiveness of the passenger bus has declined at nearly 2% per annum.

As seen in Table 1.12 and Figure 1.14 when considering public transport alone, between 1998 and 2013, there is almost a direct shift in modal share between SOTRA bus and Woro-Woro with the later dominant by 2013.

Table 1.12 Percentage Modal Split

Mode	1998	2013
Car & MC	14.0	10.0
SOTRA (incl. Water Bus)	24.0	11.2
Gbaka	25.0	29.7
Woro-Woro	17.0	39.2
Meter Taxi	16.0	8.1
Employee Bus	4.0	1.9
Total	100.0	100.0

Source: The World Bank and JICA Study Team

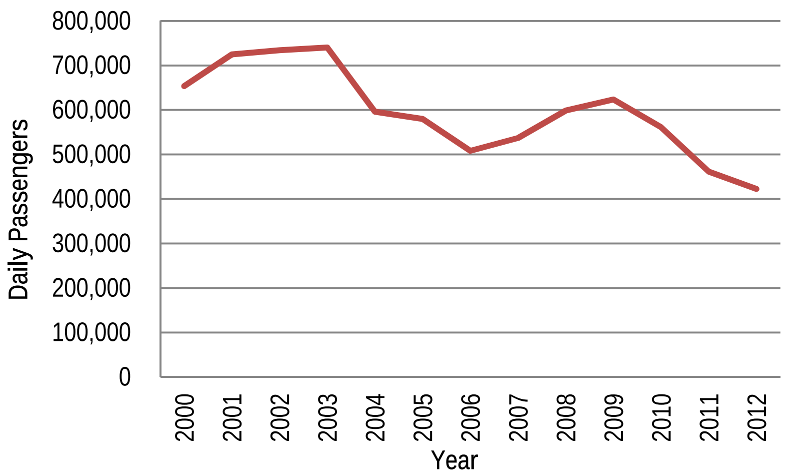


Source: The World Bank and JICA Study Team

Figure 1.14 Change in Public Transport Mode 1998 to 2013

The decline in the usage of SOTRA public transport service is shown in Figure 1.15 and Figure 1.16 respectively for bus and water bus. In the year 2002, SOTRA carried around 750,000 bus passengers daily. By 2012, this had decreased to around 400,000 passengers, a decline of some 47%. In the discussions with AGETU and SOTRA, four key reasons for this were identified namely:

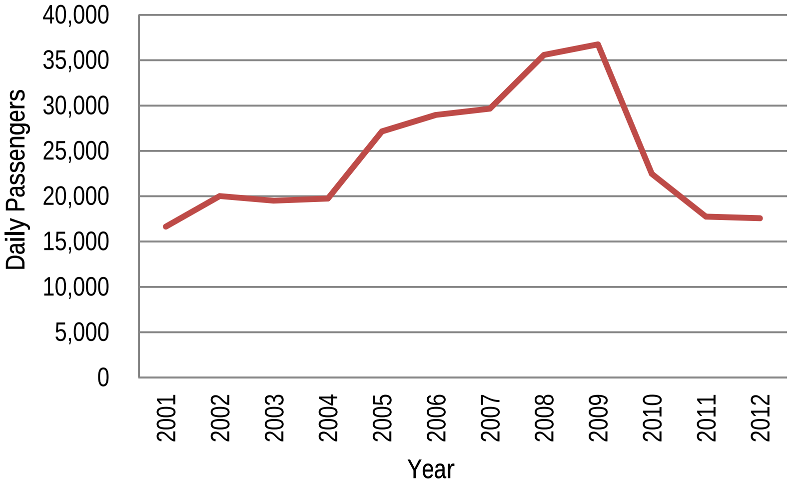
- Lack of proper infrastructure (i.e., bus exclusive lanes), which would keep the bus operation from traffic congestion;
- Decrease in size of the bus fleet, due in part to the above-mentioned financial problem, causing an overcrowding situation of the bus and impairing the quality of service such as frequency and coverage;
- Flexibility of the informal sector; and
- Increase in car ownership.



Source: SOTRA

Figure 1.15 Trends in Bus Passenger Ridership

There has also been a decrease in the number of SOTRA water bus passengers. Based on the above discussions, the main reason is related to the lack of the service coverage of the SOTRA bus. That is, there is no available access mode to the water bus stations because there is no coordination with the bus network. Thus, there has been a simultaneous decrease in the number of both bus and water bus passengers.



Source: SOTRA

Figure 1.16 Trends in Water Bus Passenger Ridership

1.2.3 Relevant Organizations

The Ministry of Transport is responsible for supervision of all urban transport. It is responsible for planning of not only urban public transport but also traffic control including vehicle registration and inspection, driving licenses, traffic safety, etc. Organization of the Ministry of Transport as of December 2013 is presented in Table 1.13.

Table 1.13 Organization of the Ministry of Transport

MINISTER'S SECRETARIAT OFFICE
- Chief Secretary - Deputy Secretary - Technical Advisor - Air - Technical Advisor - Land - Technical Adviser in charge of operating entities - Technical Advisor - Maritime - Private Secretariat - Mail Service
OPERATING SERVICES & DEPARTMENT
- Communications and Public Relations Service - Legal Affairs and Litigation Department - Information Technology, Archives and Documentation Department - Air Transport Department - Financial Affairs Department - Human Resources Department - Planning, Evaluation and Projects Department - Fluidity of Transport Monitoring Division - Automobile Self-Service Autonomous Division
GENERAL INSPECTORATE OF TRANSPORT
DIRECTORATE GENERALS
- Directorate General for Maritime Affairs and Port (DGAMP) - Directorate General of Land Transport and Traffic (DGTTC)
OPERATING ENTITIES
- National Civil Aviation Agency (ANAC) - Urban Transport Agency (AGETU) - Road Safety Office (DARE) - National Land Transport Company (SONATT) - Abidjan Transport Company (SOTRA) - Ivorian Cargo Transport Office (OIC) - SITARAIL - Ivorian Automobile Technical Control Company (SICTA) - Regional Academy of Science and Technology of the Sea (ARSTM) - Airport, Aeronautical and Meteorological Operation and Development Company (SODEXAM) - FHB International Airport of Abidjan (AERIA) - Autonomous Port of Abidjan (PAA) - Autonomous Port of San Pedro (PASP) - Aviation Security Agency (ASECNA)

Source: Ministry of Transport

(1) Former AGETU

Following the establishment of AGETU[5] in 2000, it assumed responsibility of urban transport. The board of directors at its creation included representatives of the Ministries of Transport, Interior, Economy and Finance, Abidjan and the communes and the local community. The main objective of AGETU was to help to ensure that all actions, measures and reforms of different modes or services of transport as well as the investments that are required were coordinated and harmonized to satisfy the travel needs of the population at a minimum price for users and at a minimum economic, social and environmental cost to the community. To this extent the main objectives were:

- Define the network of urban transport services and technical specifications of the operation of urban transport;
- Issuing authorizations for services of urban passenger transport (inscriptions, modifications and the register of approved carriers;
- Fare integration between operators;
- The development and the issuing of tender documents for the selection of public service providers in urban passenger transport (evaluation of the tenders, drafting of agreements and contract documents, procurement and monitoring of the implementation of the contracts);
- The design and programming of specific urban public transport infrastructure including bus lanes, bus stations, parking areas and taxi ranks;
- Coordination of parking and traffic;
- The establishment and management of statistical monitoring of urban transport; and
- Contribution to the measures to deal with air pollution caused by motorized transport.

The situation in terms of management was that AGETU was responsible for all public transport in Abidjan Autonomous District (AAD) as well as in the surrounding communes of Anyama, Bingerville, Grand Bassam, Dabou, Songon, and Jacqueville. However, AGETU had little control over the informal sector. Also, early in 2013 AAD[6] established the Abidjan Urban Planning Agency (AUPA). It was uncertain on the different responsibilities of the two organizations. There was a significant potential for overlap in their responsibilities. Regarding particularly regulatory authorities in urban transport, the issue was that important constraints such as those opposed to the rise of AGETU were not likely to reassure operators and users who expected much from this organization.

On August 6, 2014, AGETU was dissolved as well as SONATT, which was in charge of issuing vehicle registrations called gray cards, license plates, driving licenses, and nationwide transport licenses and managing the database. Roles of both AGETU and SONATT have been taken over by an Integrated Management Agency under the Ministry of Transport. For technical operation, a Columbian group, Quipux S.A., which specializes in the development of integrated transportation management systems, has got a public service concession of issuing driving licenses with IC chips, gray cards, license plates, etc. for six years.

[5] The description of AGETU is a summary in brief of a World Bank document, described by the reference http://www4.worldbank.org/afr/ssatp/Resources/Presentations/coodinationInstitutionnelle.pdf.
[6] AAD currently has an independent budget and the position of governor is a presidential appointment.

(2) DGAMP

DGAMP is under the Ministry of Transport (MOT) as the Autonomous Port of Abidjan (PAA). The commercial management of the Port is done by the PAA, while the security management including the sea is done by the DGAMP.

Although a law on maritime transport exists (decree 60-409MPT/TA of 03 October 68 bearing on regulating the navigation of the interior waterways), it is for safe order only and it is not for lagoon transport. For example, an urgent rescue system exists for sea but not for lagoon transport, because the lagoon transport boats have no radio communication system. Furthermore, there are no building standards for lagoon transport.

1.2.4 Operation Contract of Urban Public Networks

The network of urban public transport was first defined in the early years of the independence of Côte d'Ivoire and put into practice through an established contract with SOTRA created by a joint partnership between the State (holding 60% of the shares) and private partners. SOTRA is subject to the technical supervision of the Ministry of Transport and the financial supervision of the Ministry of Economy and Finance. A memorandum of association dated August 18, 1960 was granted to SOTRA for public mass transport bus service in the city of Abidjan. Following this agreement, several other agreements have been signed between the Ivoirian government and SOTRA. Some of these agreements are:

- The concession agreement n° 157/61 approved by the President of the Republic on June 6, 1961;
- The concession agreement from July 1, 1976 approved by the President of the Republic on October 12, 1976, which extended the concession to lagoon transport; and
- The concession agreement of October 1, 1983 approved by the President of the Republic on June 21, 1984.

In 1998, a framework study conducted in the Transport Sector Adjustment Credit Project (CI-PAST) of Cote d'Ivoire by the World Bank concluded that the urban transportation was insufficient to meet the growing demand of public transport in the city. To partly satisfy this high demand, the government decided to review the contract for urban public transport system in Abidjan. Following this review, two agreements have been signed by the Ivoirian government with SOTRA and another urban transport company named SOTU (Société des Transports Urbains) of which the main clauses are presented in Table 1.14. However, SOTU failed to operate the concession service due to the financial and technical difficulty, and SOTRA has "taken over" the service area of SOTU.

Table 1.14 Characteristics of Concession Agreement for Public Service

Legal Framework	Status of the Concession Company	Operation Area	Remarks
Concession agreement for a period of fifteen (15) years, signed on September 18, 1998 between the Government of Côte d'Ivoire and the company of urban transport (SOTU) for the operation of public transport services in the communes of Abobo and Yopougon. The agreement was approved by Decree n°98-631 on November 11 1998.	Public Limited Company with a book value of two (2) billion FCFA capitals, of which 10% share for the Ivoirian government, 75% private shares, 5% SOTRA shares and 5% shares for the District of Abidjan.	Limited to the communes listed below: - Abobo - Yopougon	Unfortunately, this agreement was not implemented precisely because of the failure of SOTU to mobilize the financial and technical resources needed for the operation of the concession service.
Concession agreement for a period of fifteen (15) years, signed November 11,	Mixed Economy Company (MEC) with a book value of	Limited to the communes listed below:	In addition to the perimeter attributed to SOTRA, the

1998, between the Ivoirian government and Abidjan Transport Company (SOTRA) for the operation of Abidjan Mass Transit service. The agreement was approved by Decree n° 99-189 on February 1999.	three (3) billion FCFA capital, of which the Ivoirian government holds 60.1% share, 39.8% shares belonging to IRIS BUS Group and 0.07% belonging to the District of Abidjan.	- Adjamé - Plateau - Cocody - Attecoubé - Treichville - Marcory - Koumassi - Port-Bouët	company services covers Abobo and Yopougon due to the inability of SOTU to service those areas. The contract with SOTRA was expired in 2013 and it should be renewed by the new regime of the government.

Source: Concession agreement between the State - SOTRA and SOTU, 1998

The regulator, which was formerly AGETU and is currently the Ministry of Transport, is responsible for regular monitoring of the implementation of the signed agreements through the following steps:

- The control of operation through field surveys to verify compliance to operating standards of the concession service as defined in their specifications in regard to the timing, the frequency of service, and the quality of service offered to the clients by the contractor;
- Analyzing results from the operation of contractor in order to make recommendations to the government for the adoption of measures aimed at improving the quality of service; and
- Supervising related perimeter in order to avoid the non-overlapping of perimeters attributed to other operators; exclusive market segment allotted to the contractor.

The regulator is paid a fixed concession fee at a rate of 0.2% of the turnover after tax, which is called duty concession fees.[7] The government's policy to develop lagoon transport was also manifested by granting concession of this transport mode to SOTRA.

The Ministry of Transport has opened entry to the market of lagoon transport services to private companies since early 2014. This liberalization of the lagoon transport market is expected to change the current situation of water bus services provided with a limited coverage by SOTRA as the sole formal operator and traditional boat services by informal operators. A Turkish company named Rainbow Line has been announced as the first private operator of lagoon transport services. Although they planned to start the operation with 45 vessels from April 2014, there are no lagoon transport services provided by this new private company yet as of September 2014.

1.2.5 Informal Service Operation

Until the dissolution of AGETU, the issuance of licenses since 2005 had allowed AGETU to have a fairly comprehensive database on the regular services from informal public transport. Apart from the legal tender, the market has however encountered a high number of illegal vehicles which are in complicity with the police that should be controlling the traffic rather than being involved in bribe operations with these illegal vehicles[8].

As of December 31, 2009, the number of vehicles recorded in the database of the management system of urban transport (SIGTU) of AGETU is presented in Table 1.15.

[7] Article 36 of the specifications of the State - SOTRA convention
[8] KONAN, Yao Godefroy (2011). *Evaluation de la régulation des transports urbains dans l'agglomération abidjanaise par l'AGETU*, Mémoire de DESS Régulation Economique et Gestion de Projets d'Infrastructures, Université de Cocody, Abidjan.

Table 1.15 Number of Vehicles by Type of Urban Transport Services Recorded in AGETU

	Minibus (Gbaka) with a 10-39 seating capacity	Vehicles with a large (40-70) seating capacity	Vehicles with a very large (over 70) seating capacity	Meter taxis with a 5-9 seating capacity
Number of owners	2,924	32	1	6,757
Number of recorded vehicles	5,584	83	2	17,355
Minimum number of vehicles per owner	1	1	2	1
Maximum number of vehicles per owner	37	45	2	169
Average number of vehicles per owner	2	3	2	3
Number of valid transport vehicles with authorization	3,171	39	1	8,806
Number of vehicles with authorization expired	2,413	44	1	8,549
Available number of seats	99,079	4,509	148	69,420

Source: Activity report of AGETU, as of December 31, 2009

The above table gives the following observations:

- Out of 17,355 licenses issued during the period 2005 to 2009 for meter taxis, only 8,806 vehicles are valid as of December 31, 2009; and
- Out of 5,584 approved licenses issued during the period of 2005 to 2009 for minibuses, only 3,171 vehicles are valid as of December 31, 2009.

Compared to 2005, there has also been an increase in the number of licenses issued for meter taxis from 7,882 to 8,806 with a growth of about 12%, for minibuses from 2,338 to 3,171 with a growth of about 36%. This reflects the effect of the efforts of the regulator urging transport operators to have formal licenses except for intra-communal taxis, where the situation is hindered by the institutional conflict with the communes about the PTU (urban transport scope) managed by AGETU.

1.3 Railway

1.3.1 Railway Sector in Cote d'Ivoire

The existing railway system provides inter-regional freight and passenger railway services, which connects between Cote d'Ivoire and Burkina Faso. Its route length is 1,155km from Abidjan of Cote d'Ivoire to Ouagadougou of Burkina Faso and it is a non-electrified railway system with single track in meter gauge.

Source: SIPF

Figure 1.17 Annual Total Railway Passengers by Station

In 1904, construction of the railway in Cote d'Ivoire was commenced in Abidjan as a section of RAN (Abidjan Niger Railway) and partial operation began in 1905. Since then its route was gradually extended i.e. to Dimbokro in 1910, to Bouake in 1912, to Niangoloko –Bobo Dioulasso (Burkina Faso) in 1934, and finally reached Ouagadougou, capital of Burkina Faso, in 1954. RAN was controlled under French governance until 1954 when it was placed under joint-management of Cote d'Ivoire and Burkina Faso. After the 1970s, RAN has experienced some financial issues due to overinvestment and reduction of passenger transport, and then both countries established their own national railway system because both Governments preferred individual railway operation within their respective territories. In Cote d'Ivoire, SICF (Societe Ivoirienne des Chemins de Fer) was responsible for operating the railway services. However, this system change downgraded railway operation and thus both Governments have to find a way to return to joint operation. As a result, the Cote d'Ivoire Government decided to take responsibility for railway assets management only and SICF has changed to the current organization, SIPF.

Through this railway system reform, it was decided to privatize railway operation and SITARAIL, of which 70% of the ownership is held by the private sector and the remaining 30% is owned by both Governments, was entrusted as railway operator by tendering in 1993 and it began railway operation from 1995 based on the concession agreement with both the Cote d'Ivoire and Burkina Faso Governments.

1.3.2 Railway Facilities

(1) Track Facilities

The railway lines consist of non-electrified single track with 1,000 mm gauge. The track is aged and deteriorated but is in relatively good maintenance condition. The railway tracks are generally flat with mild slopes and are in good alignment. The tracks are mostly laid on a low height embankment provided on the flatland, with some track laid on an embankment of 10 m or higher.

Table 1.16 Outline of Existing Railway Facilities

Items	Description
Route length	639 km
Number of tracks	single
Alignment standard	minimum curve radius: 120 m, maximum gradient: 25%, cant: 0
Track gauge	Metric spacing
Bridges	A total of 126 bridges to be built of which 30 are found in Abidjan (see attachment for detail)
Tunnels	0

Source: SIPF

(2) Safety Installations

The entire railway section of SITARAIL is without an interlocking system between traffic lights and turnouts. With no interlocking system between traffic lights and turnouts, the departure of trains is permitted by exchange of information between stationmasters in the blocked section.

Table 1.17 Outline of Signal and Communication Facilities

Items	Description
Signaling system category	Mechanic system
Communication system	Fiber optic base

Source: SIPF

(3) Stations

At present SITARAIL manages a total of 39 stations, of which 8 passenger stations and 10 freight stations are in the District of Abidjan.

Table 1.18 Outline of Existing Stations

Items	Description
Station (passenger)	Total number is 39 stations, with 8 found in the District of Abidjan: Treichville, Laguna station, Plateau Depot, Locodjro, Agban, Banco, Old Anyama and New Anyama
Station (freight)	Total number is 39 stations, with 10 found in the district of Abidjan: Vridi station, Port-Bouet Treichville, Laguna station, Plateau Depot, Locodjro, Agban, Banco, Old Anyama and New Anyama

Source: SIPF

(4) Rolling stock

Current railway fleet of SITARAIL consists of a total of 409 vehicles and 304 identified vehicles. Among them, there are nine locomotives, 16 passenger cars, and 355 freight cars.

Total	409
Number of identified Car	304

Locomotives (CC)	9
Tow Locomotive	6
Passenger cars	16
Service cars identified	4
Service cars not identified	5
Special supervising cars	4
Work train	8
Heavy tamping	2

Flatcars (PP) R	39
Flatcars (PL) R	48
Flatcars none identified	21
Boxcars (K3)	54
Boxcars (K4)	68
Boxcars without identification	54
Wagon (T3)	15
Wagon (T4)	10
Wagon non identified	7
Hopper Cars identified	14
Hopper Cars non identified	12
Flat lower cars	2
Tanks identified	5
Tanks non identified	6

Source: SIPF

Figure 1.18 Rolling Stock Composition in SITARAIL

(5) Workshop and Depot (Freight Terminal)

1) Workshop

The SITARAIL workshop is located in Plateau, and its aerial view is shown in the following pictures. Total area of the workshop facilities is around 9 ha. Workshop facilities consist of the following:

- Track maintenance equipment shed
- Car inspection shed
- Major inspection and repair shop for locomotives
- Wagon repair shop
- Parts stock warehouse for storing parts and procurement management

The principal mission of the workshop in Plateau is track maintenance and car maintenance. The number of staffs in the logistic division is 300. As for the railway depots of SITARAIL, there are four existing depots, and among them the biggest depot is in Treichville. Periodic Maintenance of locomotives is carried out according to the following inspection cycles:[9]

- Light maintenance: every 16,000 car kilometers
- Principal parts inspection/repair: every 96,000 to 112,000 car kilometers
- Overhaul / repair: every 500,000 – 1,200,000 of car kilometers

Average age of locomotives is 30 years. Current policy on locomotive maintenance is mostly based on parts change without renewal, and thus obsolete locomotives cannot be repaired but they are retired.

In the wagon repair shop, freight wagons and passenger coaches are repaired, and in addition wheel maintenance is carried out.

In the parts stock warehouse, around 5,000 kinds of spare parts are usually maintained for parts change needs.

Track maintenance equipment area & shed

Ballast tamping machine.

Light locomotive inspection zone

Inspection for engine and bogie truck at the alternate locomotive inspection zone

Inspection of electric generators

[9] In Japan, Light maintenance is carried out after 25,000 km, principal inspection is after 125,000km and whole overhaul/repair is after 500,000 km. Accordingly, it is noted that almost the same principle of maintenance cycles as Japan is applied in SITARAIL.

Maintenance and Repairing of diesel engines.

Wheel maintenance and repair shop.

Wheel wear measurement and inspection

Wheel treatment / adjustment equipment

Freight wagon repair shop

Passenger wagon repair shop

Warehouse of spare parts and inventory management section

Source: JICA Study Team

Figure 1.19 Photos of Workshop

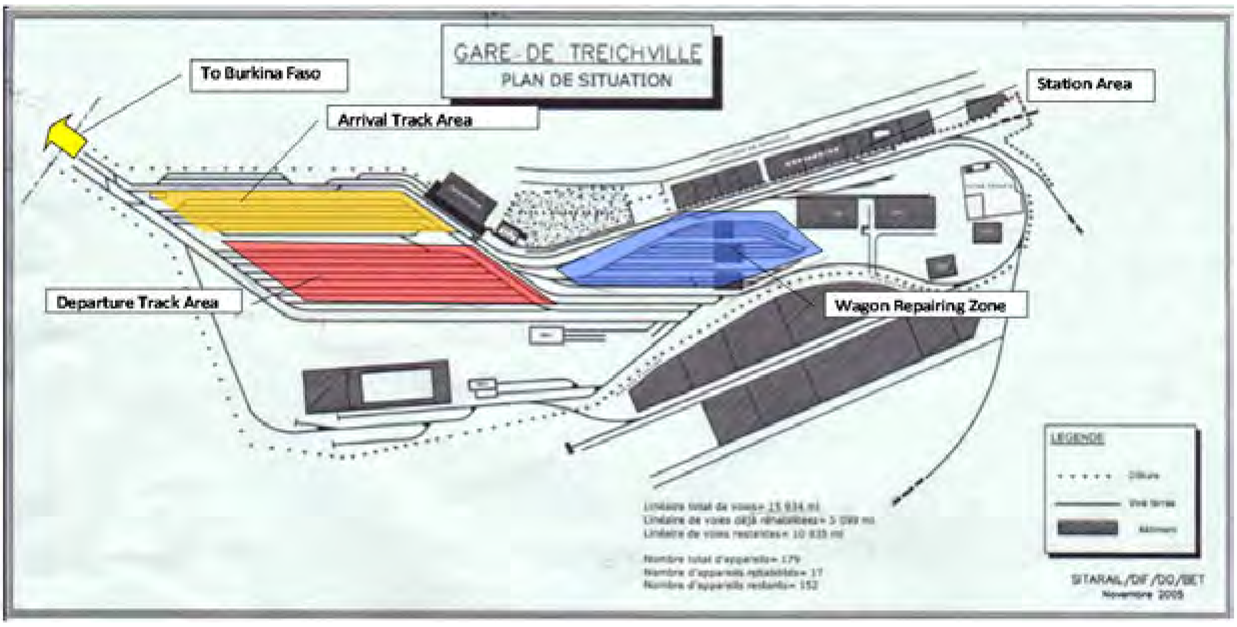
Source: Google Earth

Figure 1.20 Aerial View of SITARAIL Workshop in Plateau

2) Depot (Freight Terminal)

The hub function of freight transport is currently conducted in Treichville freight terminal, and its layout plan, being guessed not present one, is shown in Figure 1.21. Total area is around 30 ha. Total track length is 10.8 km and the number of turn-out switches is 152.

The station building is located on the north side of the freight yard area and passenger train service is also conducted. The main railway is located on the near side of the station and runs northward for Burkina Faso. Around three freight trains are dispatched each day. Each train carries 700 to 800 tons, and thus a total of 2,500 – 3,000 tons of cargo is transported each day. Man power for freight transport services is supported by 123 railway staffs who are working on a work-shift basis. Freight service facilities consist of an arrival trains siding with seven tracks, a departure train siding with nine tracks and a freight warehouse located on the south side of the yard area. According to the SITARAIL staff, loaded cars are measured in term of size and weighed on a special load inspection track. (Physical cargo size should be within 4.8 m of height and 3.6 m of width.)



Cargo weight and size inspection track

Manually operated Switching device

Inspection track after Ballast maintenance

Freight wagon car

Flat car for containers

Scene of cargo loading from truck

Source: SITARAIL

Figure 1.21 Layout Plan of Treichville Freight Station and Depot

1.3.3 Railway Operation

(1) Concession scheme

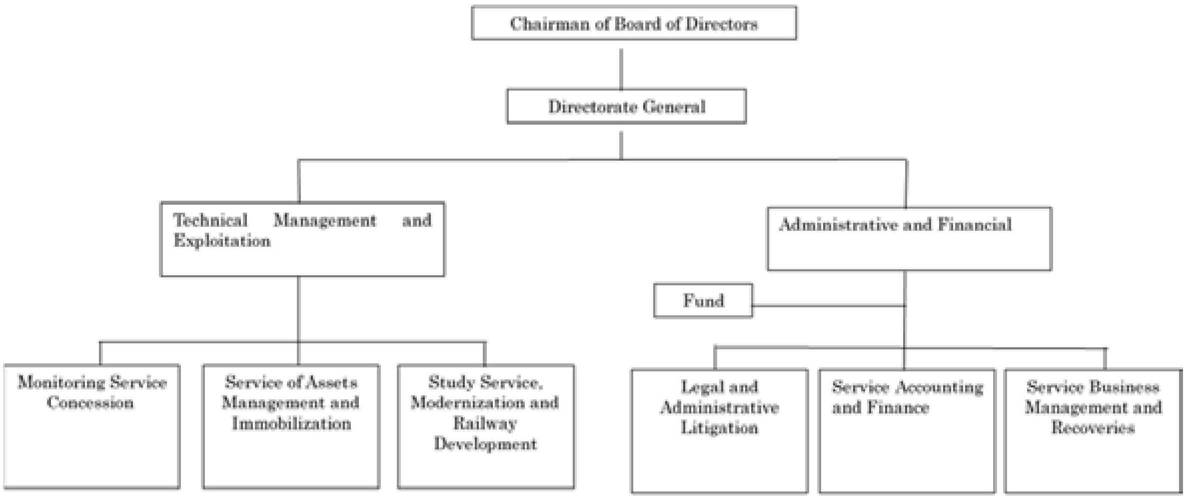
The railway concession scheme that was applied and has achieved good results in Latin America was applied in Côte d'Ivoire and Burkina Faso, as the first railway concession case in sub-Saharan Africa. The two states have jointly decided in December 1994 to offer the concession of the railway Abidjan-Ouagadougou to a private operator. The rail track belongs to both governments (Ivorian and Burkina Faso) as national property.

The concession contract between SITARAIL and the SIPF (Government Agency for rail management) was signed in December 1994. It was a contract for 15 years at first but then modified later for a longer period. The contract will expire in 2030. It was a rail management contract; meaning that SITARAIL is responsible for the rails and carrying out minor maintenance duties while major repairs and investments remain the sole responsibility of the government. Before being contracted to run the rails, the government owned all of the rail assets (tracks, locomotives) and these assets were made available to SITARAIL. Since then, SITARAIL has purchased two additional locomotives

According to the contract, SITARAIL should pay 6% of its annual income to SIPF: 3% exploitation fees and 3% part payment of the loan. There is also an extra payment of 829 million FCFA for the government assets (trains) being used by SITARAIL. This amount is put into a rail investment fund set up by the Ivorian and the Burkina Faso Governments. SITARAIL is subject to the tax law system common rules for private companies. However, for terms of petroleum products used in the locomotives, SITARAIL is exempt from the portion of the tax collected by the state in return for use of the road infrastructure.

(2) Railway Track Maintenance

In principle, railway track rehabilitation is the responsibility of SIPF and routine maintenance work is designated to SITARAIL according to the concession contract. SIPF is a State Corporation of which function is limited within railway asset management and monitoring of concession performance as shown below. However, it seems that there are controversial work items whether they are classified into rehabilitation category or ordinary maintenance category. Since this matter is concerned with each party's cost burden, both parties tend to have individual understanding on its scope demarcation.



Organization	A single general management, a single technical management, and single administrative and financial management branch
Railway staff	Total number of staff is 23
Function	Assets management department and the rail concession following up department
Budget for 2013:	1,453 billion francs CFA
Corporate status	A government own company with a capital of 3 billion francs CFA

Source: SITARAIL

Figure 1.22 Organization Structure of SIPF

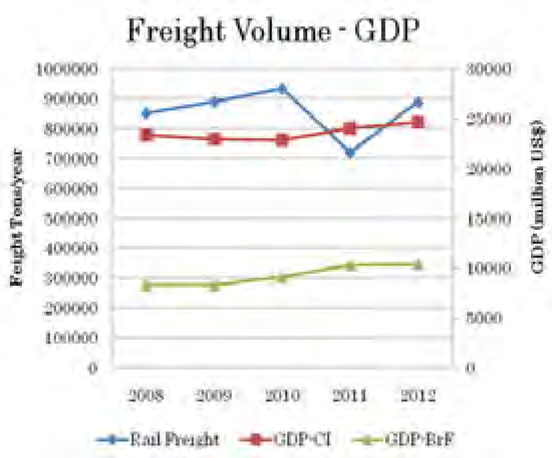
(3) Lacking Modern Railway Facilities, but Relatively High Business Discipline

The railway facilities of SITARAIL stay in a quite obsolete condition without facility investment for modernization. For example, there is no signaling and communication system necessary for rapid and frequent train operation. Furthermore, all of the turn-out facilities are operated manually, train operation safety is said to be scarcely maintained owing to lack of human capacity. In other words, this might be because of the low number of train operations and low transport volumes; however, it is necessary to upgrade railway facilities to the level that is technically required to maintain railway safety. Nevertheless, it seems that daily operation is carried out with good business norms and there is no misconduct so far.

(4) Transport Volumes

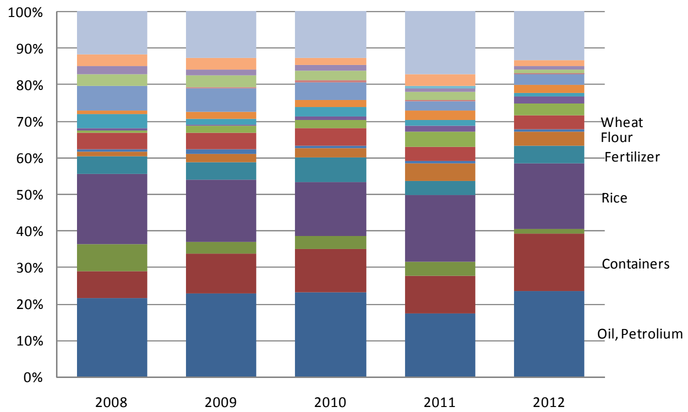
1) Cargo Transport

Before the railway concession by SITARAIL, railway freight volumes were around 250 thousand tons /year. The railway freight volumes transported by SITARAIL have shown a steady growth trend since 1995 and reached its highest volumes, one million tons, in 2001. However, this favorable situation was interrupted in 2002 due to the crisis in Cote d'Ivoire at that time. As a result, railway cargo volumes have dropped drastically to almost 200 thousand tons. During this turmoil period, SITARAIL suffered damage to its railway assets such as track and equipment. After 2004, railway cargo volumes recovered in a swift pace to around the 900 thousand tons of current volume. In Figure 1.23, GDP (Gross Domestic Product) of both countries is also displayed. GDP of Cote d'Ivoire seems to affect railway cargo volumes slightly with a one to two year time lag; however, no clear evidence is observed. Freight volumes by cargo type are shown in Figure 1.24. Primary goods types are oil and petroleum, then containers and rice follow, these three cargo items cover around 60% of total cargo volumes. These railway cargos include both domestic and international freight; however, most of them are considered to be international transit cargoes to neighboring land-locked countries, i.e. Burkina Faso and Mali, due to the locational advantage of Abidjan port in western Africa region.



Source: SITARAIL

Figure 1.23 Railway Freight Volume and GDP



Source: SITARAIL

Figure 1.24 Trend of Cargo Volume by Goods

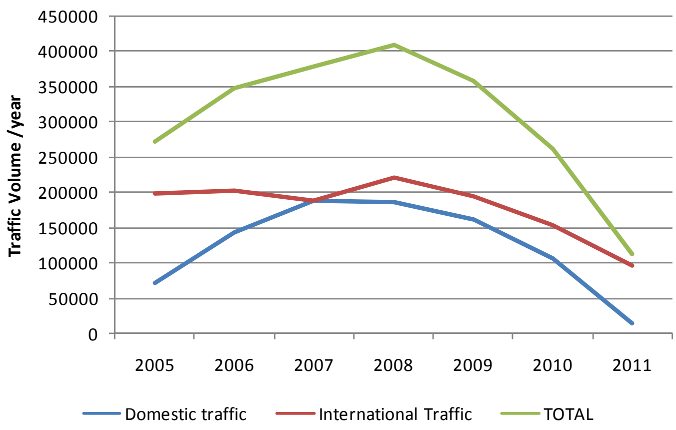
Table 1.19 Trend of Annual Freight Volume in SITARAIL

TONNAGE PRODUCED						
N°	DATA ELEMENTS	2008	2009	2010	2011	2012
1	***Hydro***	183,368	201,777	215,771	125,015	207983
2	***Containers***	63530	98741	110521	73,907	139524
3	***Cement***	61,480	27,963	33,718	26,710	11379
4	***Rice***	165,363	149,720	136,791	133,012	159552
5	***Fertilizer***	38,394	45,385	63,095	26,597	43487
6	***Flour***	11,119	19,372	22,728	34,302	33508
7	***Salt***	5,549	10,475	6,459	5,673	6161
8	***Wheat***	39,204	40,755	44,361	27,667	34627
9	***Vegetable oil***	6,559	15,777	22,750	30,343	28276
10	***Pasta***	4,757	4,129	9,804	12,106	17564
11	***iron; wires; coiled steel***	32,849	14,331	21,846	10,518	8182
12	***Sugar***	8,651	15,916	17,495	17,677	18133
13	***Cotton Bales***	56,568	58,575	47,420	19,816	28890
14	***Cotton Grains***	0	2,873	5,710	2,008	90
15	***Live animals***	26,854	28,297	21,881	16,244	8645
16	***Mango***	19,931	14,107	15,533	6,216	8133
17	***Sugar D***	0	0	0	5,867	0
18	***Vegetables***	25,783	27,777	17,661	22,534	13948
19	***Others (miscellaneous)***	101,223	114,452	120,719	124,442	120646
20	***TOTAL***	**851,182**	**890,420**	**934,265**	**720,653**	**888,728**

Source: SITARAIL

2) Passengers Transport

The trend of railway passenger volumes in SITARAIL is shown in Figure 1.25. Current passenger transport volume of SITARAIL is around 110 thousand in 2011, of which 90% is for international passengers. Until 2008 annual railway passenger volume was in a growing trend for both international and domestic transport; however, after it reached around 400 thousand passengers, it turned to follow a decrease trend, including international passengers. From this trend, passenger business of SITARAIL seems to be steadily shrinking, and is a negative factor in the decision as to whether to maintain passenger transport services although there is an agreement to provide passenger transport services between SITARAIL and the Government.



Source: SITARAIL

Figure 1.25 Trend of Passenger Transport

From the viewpoints of railway facilities standards such as station location and track equipment etc., the current level cannot satisfy the minimum requirements of passenger train operation such as track capacity and train control etc. Expansion of passenger railway services should be determined based on different contexts including development of a new urban train plan.

(5) Tariff

1) Freight Tariff

The freight tariff is stipulated to be independently and freely decided by SITARAIL. However, considering actual market competition from truck haulage, there are two kinds of tariff rates applicable, i.e. the official tariff and the commercial tariff, of which the price is varied, depending on negotiation with freight consigners. As a result, the commercial price is discounted around 20 to 30% below the official tariff rate.

As a situation to push container freight cost, there is cargo volume imbalance by direction. Regarding the imbalance between loaded wagons and empty wagons in freight route, about 70 to 80% of return wagons are assumed to be empty because reverse freight demand cannot fill vacant cargo space. To achieve effective container transport, it is important to increase return cargo demand by conducting a marketing campaign to end users.

Table 1.20 Tariff Table for Passenger Transport

Unit: FCFA

LOCALITE	TARIF		OBSERVATIONS
	1ère classe	2ème classe	
ABJ-OUAGA	35 000	25 000	
ABJ-BOBO	30 000	20 000	
ABJ-KOUDOUGOU	34 000	24 000	
ABJ-BANFORA	29 000	19 000	
ABJ-NIANGOLOKO	29 000	19 000	
ABJ-BKE	22 500	12 500	
ABJ-FERKE	25 000	15 000	

Source: SITARAIL

(6) Passenger Transport Fare

Railway fare between Abidjan and Burkina Faso is 35,000 FCFA for the first class and 25,000 FCFA for the second class. However, passenger railway services are now outsourced to a third party operator, a Burkina Faso company. Current tariff table for passenger transport services is shown in Table 1.20. Passenger train service consists of first class and second class, of which the difference is 10,000 FCFA.

1) Traffic Accidents

Needless to say, first and essential issues of railway transport are to ensure traffic safety, which is related to traffic other than railway. According to the statistics of SITARAIL, the number of railway accidents, including minor incidents, is gradually increasing. Of course, serious accidents like head on collision have not taken place recently. However, in 1994 a fatal railway accident took place when both a freight train and passenger train had a head on collision. By accident type, derailment occurs around 40 times per a year, and personal injury accidents also take place around 40 times per year. The cause of the accidents is considered to derive from various factors such as track machines. As an accident factor, crossings are manually controlled in the city while simple sign boards regulate other crossings in the countryside. A derailment took place in 2010. The cause of the accidents is mostly due to excessive speed of the train, and the number of passengers is decreasing. Monthly accident ratio of R/C accidents is two accidents per month.

Table 1.21 Trend of Railway Accidents in SITARAIL

ACCIDENTS INCIDENTS DISRUPTION OF OPERATIONS					
N°	INCIDENT TYPE	2009	2010	2011	2012
1	***DERAILEMENT***	21	40	40	47
2	***TRACK INCIDENT***	75	230	193	358
3	***WAGON INCIDENTS***	70	169	133	254
4	***LOCOMOTIVE INCIDENTS***	24	83	88	116
5	***SWITCH ENGINE INCIDENTS***	9	20	19	64
6	***COLLISION***	0	0	0	0
7	***ACCIDENTS INVOLVING PERSONS***	26	78	44	38
8	***ATTACKS***	29	64	28	20
9	***OTHERS (MISCELLANEOUS)***	38	137	80	89
	TOTAL	**292**	**821**	**625**	**986**

Source: SITARAIL

1.3.4 Position of the District of Abidjan in View of the International Freight Corridor

(1) Competitive Freight Corridors across the West African Region

The current freight railway system operated by SITARAIL constitutes an inter-regional freight corridor between Abidjan port and Ouagadougou (Burkina Faso). This freight flow operates for maritime transit between inland countries and coastal countries, and represents important trade flow in the West African region. Its future prospect depends on the growth trend of international transit flow and regional competition in freight corridor development.

As countries surrounding Cote d'Ivoire, the following inland countries would be beneficiaries of international transit routes from Abidjan.

Table 1.22 Railway connection with Cote d'Ivoire

Country	Capital	Railway connection with Cote d'Ivoire
Burkina Faso	Ouagadougou	Existing (Abidjan-Ouagadougou)
Mali	Bamako	Not existing but has road connection
Niger	Niamey	Not existing

Source: JICA Study Team

On the contrary, the following coastal countries become competitors to Cote d'Ivoire through the alternative ports with their connected freight corridors.

Table 1.23 Competitors to Cote d'Ivoire

Country	Port competing with Abidjan
Ghana	Takoradi, Tema
Togo	Lome
Benin	Cotonou

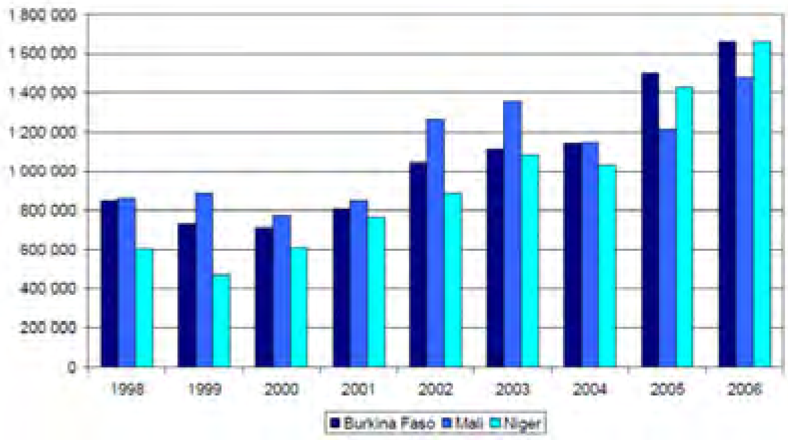
Source: JICA Study Team

Source: West Africa and Morocco route maps

Figure 1.26 Geological Location Map of West African Countries

(2) Transit from/to Inland Countries and Main Gateway Port

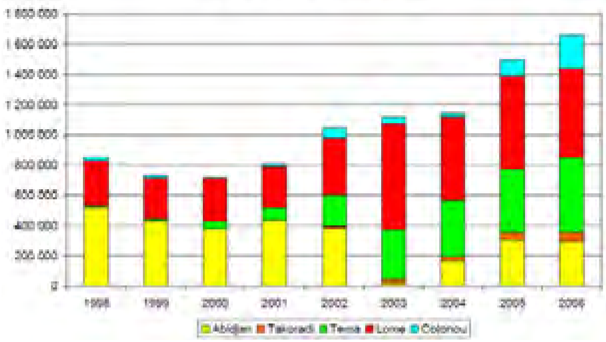
Overall maritime transit to/from the three landlocked countries mentioned above shows a continuous growth trend in the long term as illustrated in Figure 1.27. It is recognized that international transit from coastal countries to landlocked countries has been in a stable growth trend although there was a small decline once.

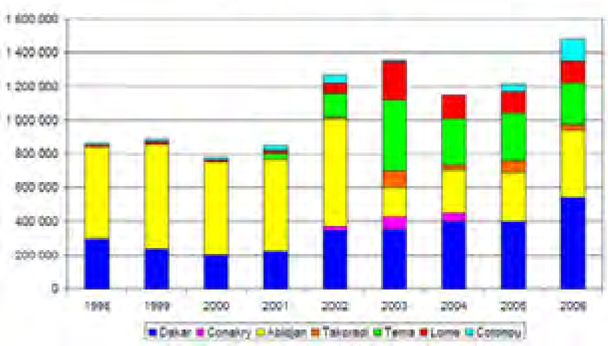


Source: ECOWAS's Infrastructure: A Regional Perspective, The World Bank Africa Region Sustainable Development Unit, December 2011

Figure 1.27 Maritime Transit for Burkina Faso, Mali and Niger

Looking at the transit by country, several countries choose Abidjan as their gateway port. However, the Cote d'Ivoire's political crisis in 2002 left a significant impact on its situation. As shown in Figure 1.28, both Burkina Faso and Mali kept Abidjan as their main gateway port until 2002; however, there is significant change and they have dispersed their gateway to several ports including Abidjan port after year 2003.

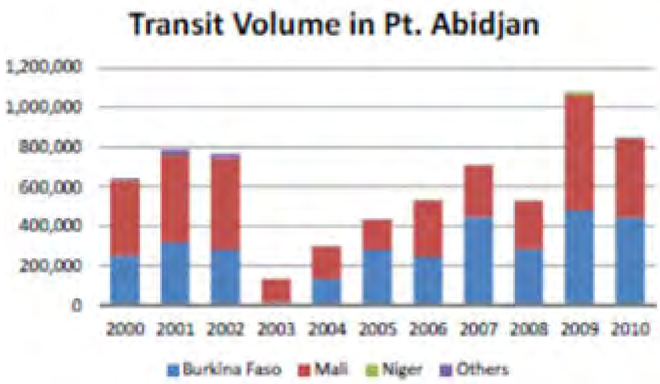




Burkina Faso Mali

Source: ECOWAS, UEMOA report

Figure 1.28 Maritime Transit by Shipping Port



Source : Data Collection Survey on Traffic for International Port and International Corridor in Western Africa (JICA)

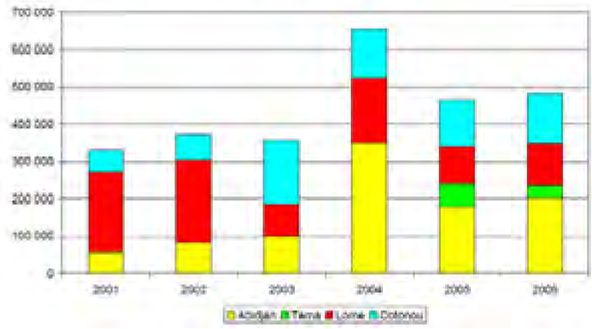
Figure 1.29 Maritime Transit by Shipping Port

As shown in Figure 1.28, it is recognized that neighboring inland countries tend to have changed their gateway port from depending on a specific port to diversifying to several ports since 2003, after the crisis of Cote d'Ivoire. No definite reasons are given; however, it seems that these inland countries intend to avoid allowing their transit routes to be vulnerable to the political risk of transit route countries and disperse their freight channels to multi directions for their security reasons. In addition to that, there is a long term trend on logistic systems that since freight commodity type becomes more diverse, freight customers request many options for their logistic channels, depending on their freight needs, and thus inland countries incline to secure as many transit routes as possible. This macro trend could cause Abidjan port to lose its dominant position in the transit routes to inland countries through tough competition by truck transport.

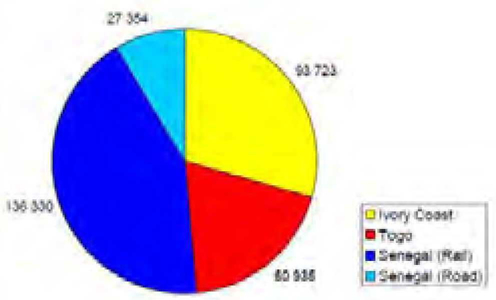
However, focusing on specific cargo, Abidjan port seems to keep its dominant position in the freight transport market.

Figure 1.30 shows the transit of petroleum products exported to Burkina Faso and Mali by freight corridors. In this figure, it is pointed out that Abidjan port seems to increase its share gradually year by year as long as observing the data for 2004-2006. This implies that surrounding landlocked countries are likely to intensify dependence on Abidjan port year by year. As the reason why Abidjan is chosen for shipping port of petroleum product, the following advantages are pointed out:

- There is an oil refinery facility in the vicinity of Abidjan port
- An oil storage facility is in Bobo-Dioulasso (Burkina Faso)
- A freight terminal located at Farkessedougou (Cote d'Ivoire) facilitates cargo transfer for Mali



Burkina Faso



Mali (2006)

Source: ECOWAS, UEMOA report

Figure 1.30 Transit of Petroleum Products by Freight Corridor

(3) Advantage of Abidjan-Ouagadougou Freight Corridor

1) Advantage as a Port with Railway Access

Currently there are few railway lines that provide access routes to sea ports from inland countries in the West African region. Cote d'Ivoire is an exception and Abidjan is a specific port with freight railway access, in this regard it has a comparative advantage in handling the long distance bulk cargo transport.

Source: African Infrastructure Country Diagnostic

Figure 1.31 Railway Access Condition to Ports in West Africa

2) Advantage in Efficient Port Operation

As shown in Table 1.24, Abidjan port demonstrates its high performance and has a significant edge on efficient port operation over other ports in the West African region. In particular, its comparative advantage resulted from container cargo handling capacity which features a container terminal with an area of 27 ha, 8 RTG (Rubber Tired Gantry Crane), and it achieves almost the same loading/unloading capability as major ports in Europe. In addition, since 2008 Abidjan port authority is considering the construction of a new port to accommodate large sized container cargo vessels in Il Boulay area. In the future, Abidjan port aims to be a main hub port in West Africa, which connects ocean container transport with the transit transport toward neighboring inland countries.

Table 1.24 Comparative Performance across West African Ports

Port	Container Dwell Tim(day)	Container vessel stay(hours)	Container freight vessel stay(hours)	General freight vessel stay(hours)	General freight vessel pre-berth waiting time(day)	Truck processing time for receipt and delivery of freight(hours)
Dakar	7	24	18	60	24	5.0
Abidjan	12	1	1	2.2	2.9	2.5
Tokorad	25	32	12.4	48	9.6	8.0
Tema	13	1	1	N/A	N/A	4.0
Lome	12	3618	24	48	48	6.0

Source: Data Collection Survey on Traffic for International Port and International Corridor in Western Africa (JICA)

(4) Future Prospects of Abidjan-Ouagadougou Freight Railway Corridor

1) Supply side

In view of the supply side factor, Abidjan-Ouagadougou freight corridor has the following comparative advantages:

- As a whole, Abidjan has a topographical advantage because it is located at the center of the West African region, and also close connection with inland countries is established through a land transport network developed between them. Thus, Abidjan can act as a main hub of the transit transport channel toward West and Central Africa.
- It is one of the freight corridors accepting railway transport which is suitable for bulk cargo transport over a long distance.
- Along the corridor, there are several logistic nodes, i.e. freight terminals for mode interchange, container storage depot, which contributes to seamless / convenient containers transport.
- Abidjan port accommodates efficient cargo services, especially in container cargo handling by providing loading/unloading facilities.

On the other hand, there are some issues in freight railway facilities:

- Since the existing railway line is non-electrified single track line, there is a limitation on expanding freight transport capacity.
- Railway infrastructures are too aged to provide efficient train operation and a part of the railway line requires complete track rehabilitation.
- Since train operation is done on a manual operation basis, there are issues concerning safe and efficient train operation.

2) Demand side

In view of the demand side factor, Abidjan-Ouagadougou freight corridor has the following comparative advantages:

- Transit demand from/to specific inland countries (Burkina Faso, Mali and Niger) will grow steadily in the future as long as regional stability is maintained in the whole of West Africa. This freight market growth makes Abidjan freight corridor a more significant one.
- In terms of container cargo handling, Abidjan port maintains a predominant position compared to other ports in West Africa. Viewing the general trend of future container cargo growth, close linkage of the freight corridor to Abidjan port will reinforce its ability to lead in transit transport.

3) Conclusion

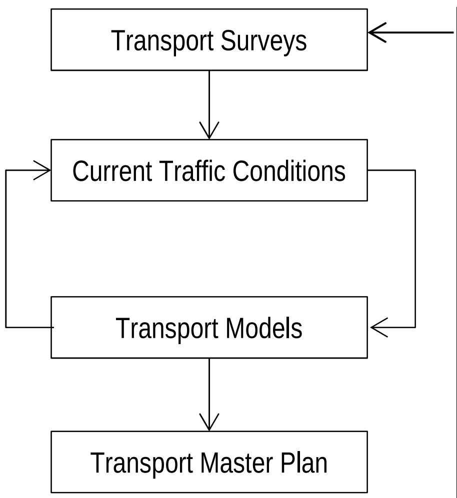
- Abidjan-Ouagadougou freight railway corridor does not only play a role as a local transit route for Burkina Faso but has a potential that strengthens close connection with surrounding inland countries by improving existing land transport infrastructure, vitalizing its topographical location to surrounding countries.
- Comparing to other freight corridors, this corridor already has essential factors to lead freight transport services, i.e. necessary port function, railway network and necessary freight terminal facilities etc. Taking these circumstances into account, it is thought that an Abidjan-Ouagadougou freight corridor has the necessary resources to promote freight corridor development and it can attain an advantageous position in the market competition in the future.

2.0 Transport-Related Surveys

2.1 General

There are eleven transport-related surveys are carried out to capture current transport condition and to build transport database as a basis of transport modeling (see Figure 2.1). General procedure of transport planning starting from conducting transport survey to establishing transport master plan is also shown in the figure. Transport survey results are essential for capturing current traffic conditions and major issues as well as for building transport models; those two items are mutually-connected to complement each other. Transport models are utilized for predicting future transport demand in the study area to build transport master plan.

Major findings and current traffic conditions result from each transport survey are shown in this chapter.



Transport Survey	Type of Survey
1) Household Interview Survey	- Interview
2) Activity Diary Survey	- Interview
3) Cordon Line Survey	- Interview - Count
4) Screen Line Survey	- Interview at some limited locations - Count
5) Intersection Traffic Volume Survey (ITVS)	- Count
6) Public Transport OD Interview Survey	- Interview - Count
7) Parking Facility Survey	- Interview - Count
8) Transportation Opinion Survey	- Interview
9) Travel Speed Survey	- Record
10) Cargo Transport Survey	- Interview - Count
11) Road Inventory Survey	- Measure

Source: JICA Study Team

Figure 2.1 Transport-Related Surveys and Procedure for Establishing Master Plan

2.2 Household Interview Survey

2.2.1 Introduction

(1) Background and Objectives

With a large population of Greater Abidjan containing 19 communes, namely, Abobo, Adjame, Anyama, Attecoube, Bingerville, Cocody, Grand-Bassam, Koumassi, Marcory, Plateau, Port-Bouet, Songon, Treichville and Yopougon, estimated at 5,054,000 inhabitants in 2014. Abidjan is characterized by an imbalance between high demand for transport and inconsistent supply. To adapt the transport supply to demand and to ensure individual freedom of choice of transport mode, transport master plan in Greater Abidjan is required to compensate for the lack of reliable and timely statistics on transport demand.

Within the above context, Household Interview Survey (hereinafter called HIS) was conducted under the following objectives:

- To collect current travel information of the residents in the survey area; and,
- To collect necessary data to build a transport demand forecast model.

(2) Outline of Household Interview Survey

1) Survey Coverage and Sample Size

The HIS covers 14 communes composed of 13 communes in the AAD (Abidjan Autonomous District) and Grand-Bassam to obtain the major movement of person trips within the survey area as shown in Table 2.1 and Figure 2.2 (hereinafter called as “the survey area”), whereas traffic flow between AAD and surrounding communes (including traffics to/from outside Greater Abidjan) were captured by other supplementary transport surveys, especially by Cordon Line Survey. The sampling rate was targeted as 2% of the population in the survey area, where the sample size was estimated at 20,000 households as shown in Table 2.2 .

Table 2.1 Communes in the Survey Area

No.	Name of Commune	No.	Name of Commune
1	Abobo	8	Marcory
2	Attecoube	9	Treichville
3	Yopougon	10	Port-Bouet
4	Adjame	11	Bingerville
5	Plateau	12	Anyama
6	Cocody	13	Songon
7	Koumassi	14	Grand-Bassam

Source: JICA Study Team

Source: JICA Study Team

Figure 2.2 Survey Area (HIS)

Table 2.2 Sample Size

Items	Total
Number of HIS Zones inside the Survey Area	391
Number of Households Sampled	20,000
Number of Household Members Sampled	74,309

Note: Number of sampled households was calculated at a sampling rate of 2%

Source: JICA Study Team

2) Setting of Sampling Rate and the number of samples

The relationship of the sampling rate with the target population and number of zones under the survey is given by the following equation:

$$\text{Target Effective Sample Rate: } r = \frac{1}{((RSD\ (A)^2 \times N)/\ (K^2 \times (ZK - 1)) +}$$

Wherein,
RSD(A): Relative Error
N: Size of mother group,
K: Reliability coefficient, and
ZK: Number of categories

3) Survey Method

Household registration data was not available since the latest census conducted in 1998 does not contain a list of individual households. Instead, primary sampling units (PSU), which is prepared for the 2014 census, were applied for the basis of the field survey. PSU, which is grouped by about 200 to 250 households each, are the smallest geographic units of which location is available in the map. In the first step, 20 households in each PSU were selected randomly to meet the number of sample households of each commune. After this, the surveyor counted the actual households and made a household list of the PSU.

The HIS was conducted through visiting every selected household by the surveyors. The data of the HIS was obtained through direct interviews. During the survey, surveyors visited homes and interviewed persons to be surveyed and contact by phone to hold subsequent meetings in case of absence. All the residents excluding those who are under six years old were interviewed in each household.

4) Survey Form Design

Survey forms were designed including following items described in Table 2.3.

Table 2.3 Items Collected in HIS

Form 1: Household Information	Form 2: Household Member Information	Form 3 : Trip Information
· Address · Household ownership · Housing type · Number of vehicles · Electricity Consumption	· Gender · Age · Relationship · Occupation · Income · Location of workplace/school · Social status · Day off (Non-workday) · Driving license · Vehicle availability · Transport fare · Season Ticket	· Origin and destination · Start and end time · Trip purpose · Trip Mode · Parking fare · Transport fare · Access, waiting and egress time for public transport users

Source: JICA Study Team

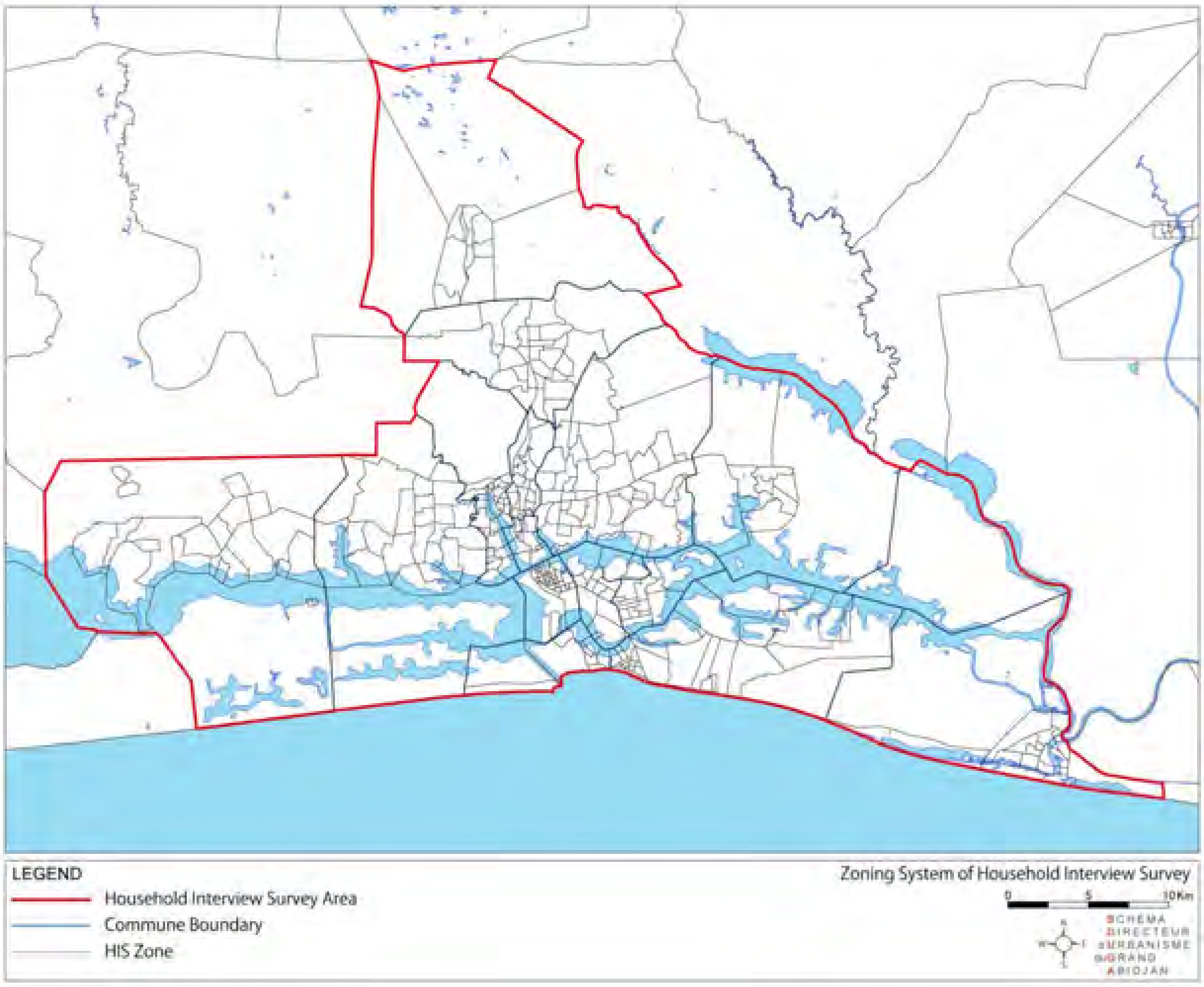
5) HIS Zoning System

HIS zones were set based on quartier, which is the smallest administrative district, as a basis of zoning system taking into account zones not belong to quartier, which is resulted in Table 2.4. 334 zones out of 392 zones are included inside the survey area.

Table 2.4 HIS Zoning System

Commune	Quartier Based Zones	Non-Quartier Zones
Abobo	28	0
Adjame	19	0
Attecoube	28	0
Cocody	45	0
Koumassi	14	0
Marcory	15	0
Plateau	14	0
Port-Bouet	45	0
Treichville	38	0
Yopougon	25	0
Anyama	10	5
Bingerville	7	4
Songon	22	2
Grand-Bassam	13	3
Alepe	7	5
Azaguie	9	2
Bonoua	5	3
Dabou	10	4
Jacqueville	8	2
Total	392	

Source: JICA Study Team



Source: JICA Study Team

Figure 2.3 HIS Zoning System

6) Samples Collected

HIS was conducted for about three months from the end of April to the end of July 2013, composed of survey preparation (training, sampling, permission, etc.), field survey, data processing and error checking. As a result, as many as 20,000 household samples including 74,309 household member samples were collected (Table 2.5) accounting for 86.6% of total target household members which was caused by two major factors:

- The difference between the assumed household sizes applied for sampling process and actual number. The number set in the sampling process was 5.8 obtained from 1998 census as the average household sizes in Greater Abidjan; meanwhile the number from the survey result was calculated as 4.2.

- Population in the non-quartier zones was not available in 1998 census. The population could not be estimated in the time restriction to implement field survey before extended vacation in the survey area.

Table 2.5 Number of Samples in Each Commune

Communes	Households	Respondents
Abobo	4,260	16,673
Adjame	1,400	5,354
Attecoube	1,320	4,695
Cocody	1,780	6,349
Koumassi	1,920	6,676
Marcory	1,080	3,744
Plateau	60	247
Port-Bouet	1,380	4,907
Treichville	580	2,109
Yopougon	4,840	18,464
Anyama	500	1,932
Bingerville	220	809
Songon	320	1,085
Grand-Bassam	340	1,265
Total	20,000	74,309

Source: JICA Study Team

2.2.2 Survey Results

(1) Summary of household base results

Average household size is 4.27 persons in the survey area. Average household size of Plateau is 4.73 persons, which is the highest in the survey area. Songon has the lowest household size, that is, 3.90.

Average household income is 185,000 FCFA/month in the survey area. Average household income of Cocody is 343,000 FCFA/month, which is the highest in the survey area. The lowest household income is shown in Songon as 109,000 FCFA/month.

Percentage of car owning households is 8.9% in the survey area. Percentage of car owing households of Cocody is 32.4%, which is the highest in the survey area. In Songon, the lowest percentage is shown as 2.8%.

Average daily trip rate per household is 5.90 trips in the survey area. The trip rate per household of Grand-Bassam is 6.92 trips, which is the highest in the survey area. The lowest trip rate is shown in Treichville as 5.00 tips.

Average trip rate per person is 1.60 trips in the survey area. The trip rate per household of Grand-Bassam is 1.71 trips, which is the highest in the survey area. The lowest trip rate is shown in Anyama as 6.63 trips.

Average daily trip rate per person is 1.62 trips in the survey area. The trip rate per person of Adjame is 1.77 trips, which are the highest in the survey area. The lowest trip rate is shown in Port-Bouet and Treichville as 1.49 trips.

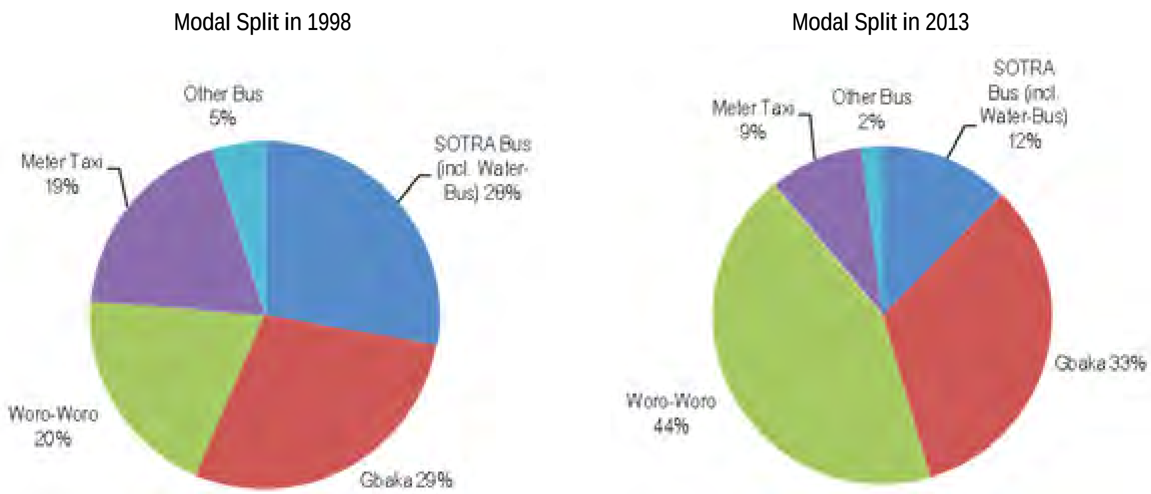
Table 2.6 Results of HIS

No.	Commune	Average Household (HH) Size	Average HH Income (1,000 FCFA)	Car Owing Households (%)	Trips/HH	Trips/HH (Excl. Walk)	Trips/ Person	Trips/ Person (Excl. Walk)
1	Abobo	4.50	161.2	4.9	6.37	2.60	1.63	0.67
2	Adjame	4.40	169.3	5.3	6.67	2.47	1.77	0.66
3	Anyama	4.44	126.5	4.6	6.36	1.41	1.46	0.33
4	Attecoube	4.09	141.7	3.6	5.72	2.53	1.58	0.71
5	Bingerville	4.23	161.3	6.0	5.94	2.52	1.70	0.72
6	Cocody	4.10	343.1	32.4	5.54	3.71	1.53	1.03
7	Grand-Bassam	4.28	172.5	6.3	6.92	2.44	1.71	0.60
8	Koumassi	4.00	156.0	6.9	5.58	2.63	1.69	0.80
9	Marcory	3.99	243.7	18.7	5.53	2.70	1.63	0.80
10	Plateau	4.73	294.6	19.4	6.66	4.09	1.67	1.03
11	Port-Bouet	4.09	169.8	4.6	5.10	2.61	1.49	0.77
12	Songon	3.90	108.9	2.8	5.70	1.54	1.70	0.48
13	Treichville	4.18	157.9	6.9	5.00	2.33	1.49	0.70
14	Yopougon	4.39	187.8	7.7	5.90	3.16	1.57	0.85
Total or Average		4.27	184.9	8.9	5.90	2.74	1.60	0.75

Note: Household members of age 6 or older (only average household size includes members of age 5 or younger)
Source: JICA Study Team

(2) Modal split

SOTRA Bus including water bus percentage of all trips in 2013 decreased 16% from 1998. On the other hand, Woro-Woro and Meter Taxi percentage increased. Especially, Woro-Woro percentage increased 28% from 20% to 48%.



Source: World Bank and JICA Study Team

Figure 2.4 Modal Split in 1998 and 2013

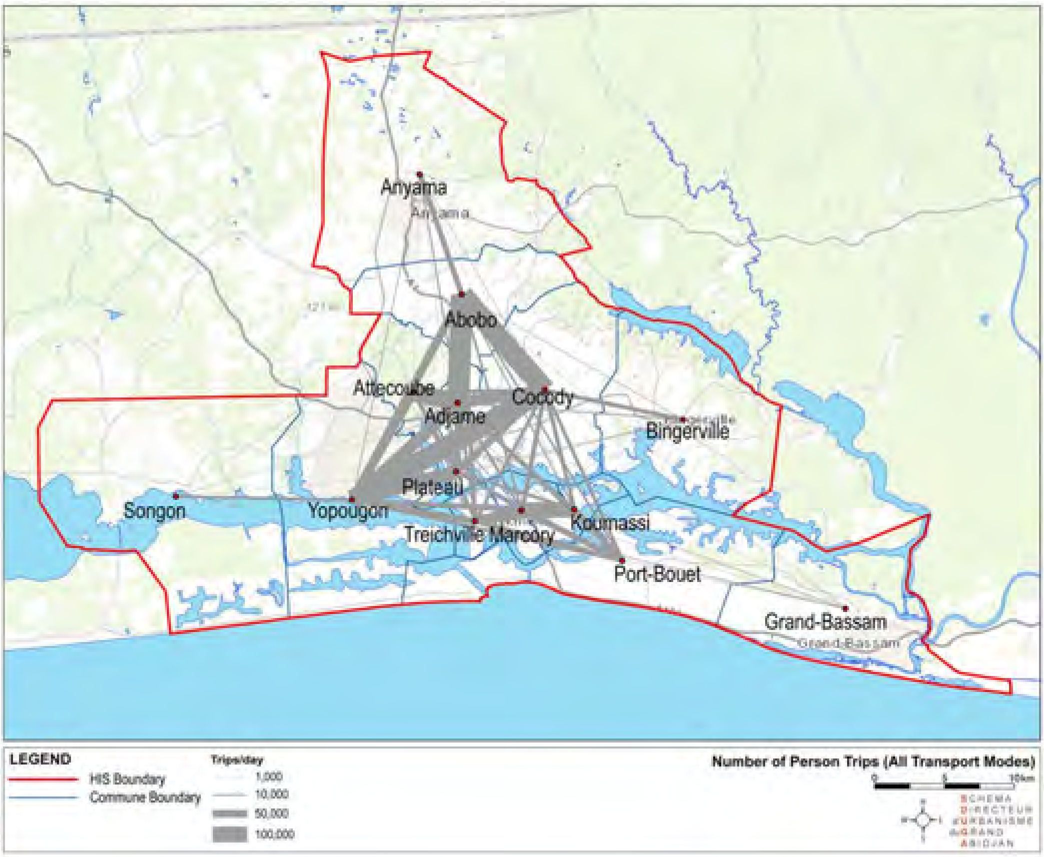
(3) Trips between Communes

1) All mode trips

Five most intensively patronized all mode trips are listed below.

- Between Abobo and Adjame
- Between Abobo and Cocody
- Between Cocody and Yopougon
- Between Adjame and Attecoube
- Between Koumassi and Marcory

Large portion of traffic is generated in Adjame, Abobo, Cocody, Yopougon, Attecoube and Marcory, which constitutes basic transport needs in Abidjan.



Source: JICA Study Team

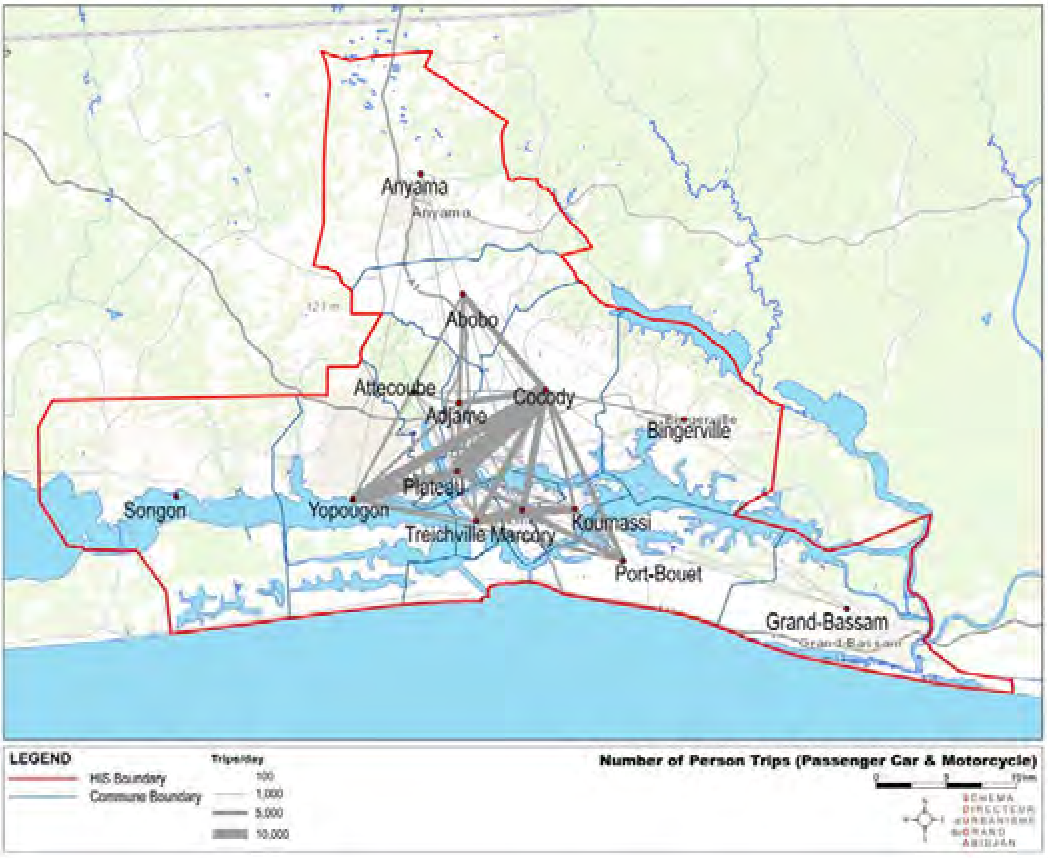
Figure 2.5 Daily All Mode Trips Excluding Walking and Bicycling

2) Passenger car

Five most intensively patronized car user trips are listed below.

- Between Cocody and Plateau
- Between Plateau and Yopougon
- Between Cocody and Yopougon
- Between Marcory and Treichville
- Between Cocody and Treichville

Comparing all mode trips excluding walking and bicycling, trips between Abobo and Adjame, which is mainly served by informal public transport mean, Gbaka and Woro-Woro, shows remarkable decrease. On the contrary, strong tie between Cocody and Plateau is indicated, which are known as a typical high status residential area a central business district in Abidjan.



Source: JICA Study Team

Figure 2.6 Daily Passenger Car Trips

3) SOTRA bus

Five most intensively patronized SOTRA user trips are listed below.

- Between Plateau and Yopougon
- Between Cocody and Yopougon
- Between Abobo and Cocody
- Between Abobo and Plateau
- Between Attecoube and Plateau

SOTRA bus provides basic transport needs connecting east-west and north-south corridors in Abidjan, which is shown as strong ties between Yopougon and Plateau, Cocody and Yopougon, Abobo and Cocody. Compared with the previous figure, it is obvious that transport demand between Cocody and Plateau is served by car, not by SOTRA bus.

Source: JICA Study Team

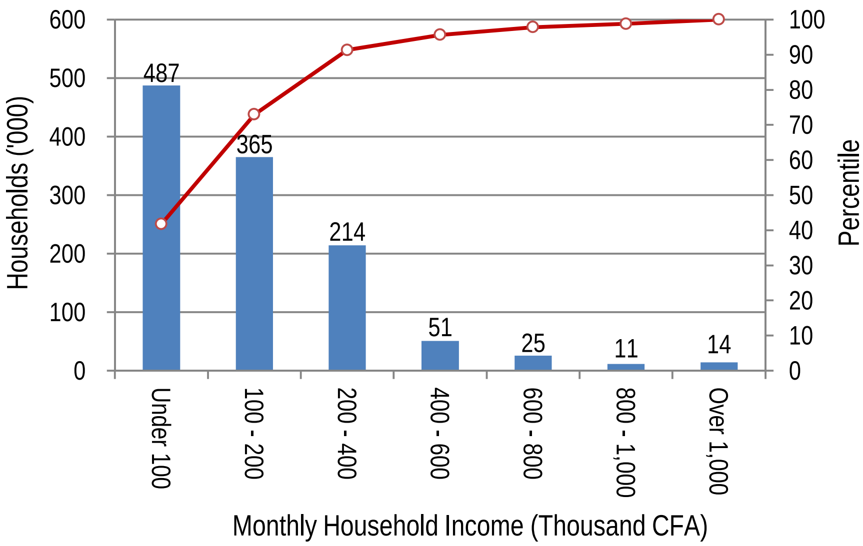
Figure 2.7 Daily SOTRA User Trips (SOTRA Bus and Water Bus)

(4) Household income distribution

As shown in Table 2.7 and Figure 2.8, the highest portion of household is observed whose income is under one hundred thousand FCFA per month in average, accounting for about 42%. The number of households decreases in proportion to their household income. More than 90% of households live with less than four hundred thousand FCFA per month.

Table 2.7 Monthly Household Income

Monthly Household Income ('000 FCFA)	Households ('000)	Percentage (%)
Under 100	487.3	41.7
100 - 200	365.0	31.3
200 - 400	214.0	18.3
400 - 600	50.8	4.3
600 - 800	25.4	2.2
800 - 1,000	11.4	1.0
Over 1,000	14.1	1.2
Total	1,167.8	100.0

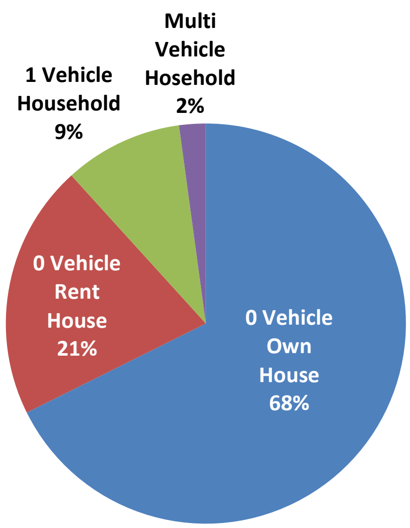


Source: JICA Study Team

Figure 2.8 Monthly Household Income

(5) Vehicle and residence ownership

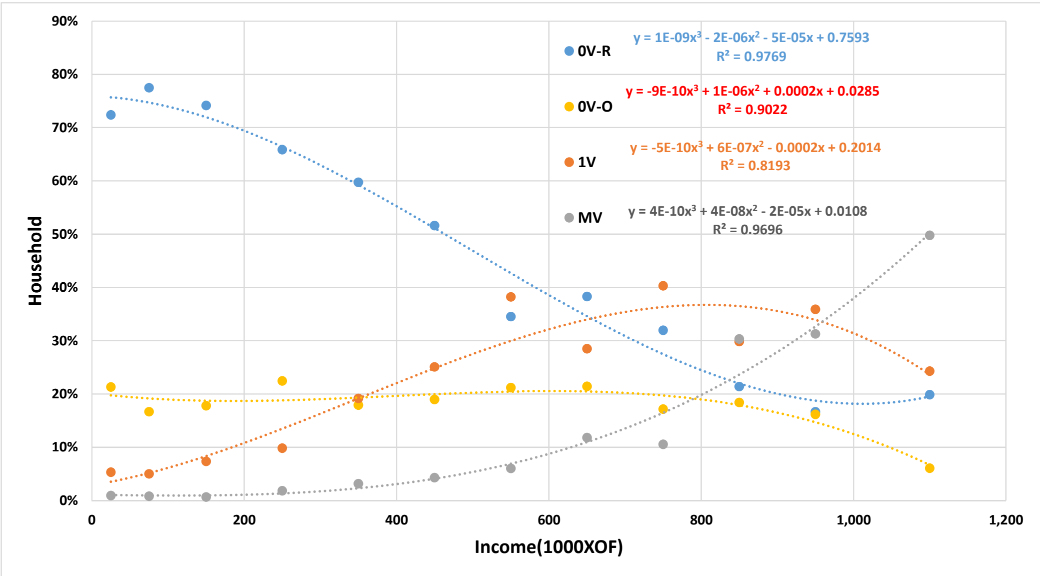
The composition of households by vehicle and residence ownership is shown in Figure 2.9, where household type is defined as four major household types, that is, those with 0 vehicle renting the living place (0V-R), those with 0 vehicle owning the living place (0V-O), those with 1 vehicle (1V) and those with multiple vehicles (MV). Households with 0 vehicle renting the living place (0V-R) are the most major type of households in the survey area, taking 68% of all households. Households with 0 vehicle owning the living place (0V-O) come next taking 21%, followed by those with 1 vehicle (1V) and those with multiple vehicles (MV) taking 9 % and 2%, respectively.



Source: JICA Study Team

Figure 2.9 Household Distribution by Ownership of Vehicle and Residence

Compositions of households by the above-mentioned vehicle and residence ownership in the range of income are illustrated in Figure 2.10. The ratio of households owning vehicles grows as the income goes up. While the percentage of vehicle-owning households is 11.81% on average in the survey area, it exceeds half when the income reaches 800,000 FCFA per month.

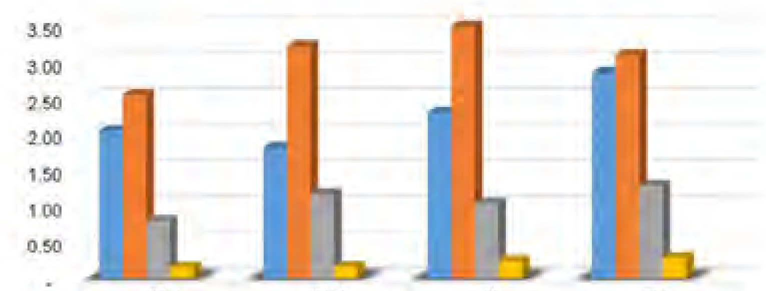


Source: JICA Study Team

Figure 2.10 Household Distribution by Ownership of Vehicle and Residence

(6) Daily Trip Rates

Characteristics of daily trip rates are analyzed by household type and trip purpose as shown in Figure 2.11. Average daily trip rate per household is 5.90 in the survey area. In general, households with vehicles (1V and MV) tend to have larger trip rates compared to households without vehicles. However, Home-Based Other (HBO) and Non-Home-Based (NHB) trip rates seem to be quite low; especially, NHB trip rates ranges from 0.15 to 0.28 in all household types. It is often the case if respondents omit to record these kinds of trips in the survey form.

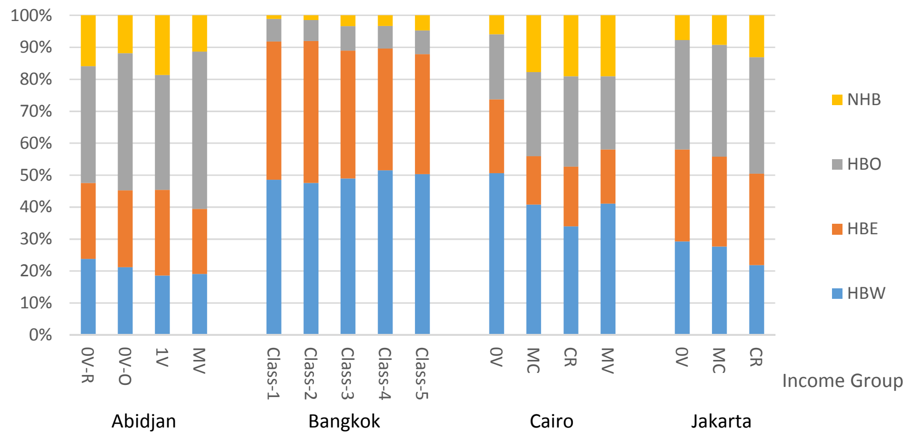


	0V-R	0V-O	1V	MV
HBW	2.04	1.81	2.31	2.86
HBE	2.55	3.23	3.51	3.10
HBO	0.79	1.16	1.04	1.29
NHB	0.15	0.16	0.24	0.28
Total	5.53	6.36	7.09	7.53
HHSize	3.90	4.94	4.78	5.32

Source: JICA Study Team

Figure 2.11 Daily Trip Rates per Household by Types of Ownership of Vehicle and Residence

Figure 2.12 shows comparison of compositions of trip purposes by household type in Abidjan, Cairo (Egypt), Bangkok (Thailand) and Jakarta (Indonesia). All the HIS results show that home-based trip purposes are dominant in each city, taking approximately 90% of total trips. Generally, Non-Home-Based (NHB) trips seem to have been underreported.



Source: JICA Study Team

Figure 2.12 Composition of Trips by Purpose in Major Cities

2.3 Activity Diary Survey

2.3.1 Introduction

(1) Objective

The Activity Diary Survey (ADS) was conducted to capture all activities and trips on two consecutive weekdays including trips which are too short for respondents to remember and to understand daily activities more precisely through the continuous recording method.

(2) Survey Location

The ADS covers 14 communes composed of 13 communes in the AAD (Abidjan Autonomous District) and Grand-Bassam, the same as that of HIS (hereinafter called as "the survey area"). The households were selected from those who were once surveyed in the Household Interview Survey (HIS), accounting for about 1,000 households.

(3) Methodology

1) General

To obtain accurate trip information in an entire day, "visiting homes, leaving survey forms, and collecting the survey forms by a re-visit method" was applied in the ADS. Respondents of the survey were basically all the members of the household aged five years or more. Surveyors visited households selected as samples, confirmed if there are any changes in the household and its member information since the last visit for HIS during the first interview session with the respondents. Particularly, cooperation of the respondents was necessary to write down times, activities, places, transport means and related information of all trips made in an entire day in 15 minutes intervals. The surveyor could then pick up the recorded information at the second visit. Thus, in the survey, a household had to be visited at least twice.

2) Survey Day and Duration

Activity Diary Survey focused on two consecutive weekdays.

3) Survey Items

The items obtained during the survey are listed below;

- Household and household member information e.g. sex, age, vehicle ownership,
- In-home activities e.g. sleeping, preparation, eating/drinking, watching TV/listening to radio, home activity, etc.
- Trip information composed of mode and duration (all trips of more than five minutes travel time)
- Out-of-home activities e.g. working, school, shopping, going to hospital, visiting friends/family, sport/pleasure, going to restaurant, holiday, other private activity, etc.

Each activity was observed with the basis of 15 minutes time-period.

4) Samples

Activity Diary Survey focused on 1,010 households selected from 20,000 households which were interviewed during the Household Interview Survey through a two-stage-sampling process:

- In the first stage, 101 primary sampling units (PSUs) were selected randomly, and
- In the second stage, 10 of 20 households were also drawn by simple random sampling for each PSU.

In total, 1,010 households were surveyed as shown in Table 2.8.

Table 2.8 Sample Households by Commune

Commune	Sample	Percentage (%)
Abobo	200	19.8
Adjame	80	7.9
Attecoube	60	5.9
Cocody	100	9.9
Koumassi	100	9.9
Marcory	50	5.0
Plateau	10	1.0
Port-Bouet	80	7.9
Treichville	30	3.0
Yopougon	230	22.8
Anyama	30	3.0
Bingerville	10	1.0
Songon	10	1.0
Grand-Bassam	20	2.0
Total	1,010	100.0

Source: JICA Study Team

(4) Survey Forms

The survey forms for ADS covers the characteristics of all activities made by the respondents on two consecutive weekdays which include time, place, means of transport (in the case of out-of-home activities), and so on.

2.3.2 Survey Results

Trips and activities were analyzed to understand those characteristics. Activities were divided into two main terms, in- home and out-of-home activity. Distribution of these activities were illustrated to depict activity pattern by household type which is defined in HIS; non-vehicle owning household renting their house (0V-R), non-vehicle owning household owning their house (0V-O), households owning 1 vehicle (1V) and households owning multiple vehicles (MV).

A trip is defined as a trip between in-home activity and out-of-home activity. Trip rates were obtained throughout the data. Other characteristics of trips, such as purpose of the trip, travel distance, etc., were also analyzed.

(1) Activity Distribution

Distribution of in-home activity, out-of-home activity and trips are summarized in Table 2.9 and Table 2.10 by household type, which is represented by frequency of each activity by time over the two day period. The major findings are shown below:

- Basic pattern of their activity shows similar pattern among each household type. Typical patterns of in-home activity are; more than 90% of people get up by 7:30 (9.8% of all activities are sleeping), peak hour of breakfast at home at 7:00 (only 4.9% of all activities), peak hour of lunch at home at 12:15 (17.1% of all activities) and peak hour of dinner at home at 20:00 (23% of all activities), those characteristics are commonly observed among all household types,
- Portion of work-related out-of-home activity by MV is lower than those of other household types as shown in Table 2.9,
- Peak of out-of-home activity appears twice a day, at 9:00 and 15:00, where about 30% are work-related activities and about 20% are school-related trips among all activities which are dominant,
- Portion of personal business by MV is higher than those of other household types,
- Larger numbers of travel appeared three times a day at 7:00, 12:00 and 17:00, accounting for about 20%, 20% and 19% share among all activities in the period,
- Percentage of walking trips decreased in 1V and MV whereas a large portion of car & motorcycle use is observed, and

Walking trips among all activities are dominant, followed by Woro-Woro, Gbaka and car, accounting for about 64%, 13%, 9% and 6% as shown in Table 2.10.

Table 2.9 Work-Related and School-Related Out-of-Home Activities by Household Type

Number of Out-of-Home Activities in Two Designated Survey Days	All Type	0V-R	0V-O	1V	MV
Work-Related Activity	89,726	59,793	20,647	8,353	932
School-Related Activity	46,406	26,512	13,306	5,414	1,173
Other Activities	1,307,709	772,698	372,431	132,268	30,312
Total	1,443,840	859,003	406,385	146,035	32,417

Percentage (%)	All Type	0V-R	0V-O	1V	MV
Work-Related Activity	6.2%	7.0%	5.1%	5.7%	2.9%
School-Related Activity	3.2%	3.1%	3.3%	3.7%	3.6%
Other Activities	90.6%	90.0%	91.6%	90.6%	93.5%
Total	100%	100%	100%	100%	100%

Source: JICA Study Team

Table 2.10 Trips by Household Type

Number of Trips	All Type	0V-R	0V-O	1V	MV
Walk	28,291	17,460	8,161	2,270	399
Car & MC	2,516	792	315	1,107	303
Meter Taxi	1,048	711	160	135	42
Woro-Woro	5,655	3,478	1,387	636	154
Gbaka	3,776	2,444	796	479	57
SOTRA Bus	2,188	1,288	668	205	25
Other Bus	388	263	34	90	1
Water Bus	65	47	18	0	0
Others	404	371	20	13	0
Total	43,927	26,483	11,540	4,923	981

Percentage (%)	All Type	0V-R	0V-O	1V	MV
Walk	64%	66%	71%	46%	41%
Car & MC	6%	3%	3%	22%	31%
Meter Taxi	2%	3%	1%	3%	4%
Woro-Woro	13%	13%	12%	13%	16%
Gbaka	9%	9%	7%	10%	6%
SOTRA Bus	5%	5%	6%	4%	3%
Other Bus	1%	1%	0%	2%	0%
Water Bus	0%	0%	0%	0%	0%
Others	1%	1%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Source: JICA Study Team

(2) Trip Rates

Trip rates per person and per household are shown in Table 2.11. Regarding households with no vehicles, while there is no major difference in trip rates per person between those renting the living place and those owning the living place, there is a significant difference in trip rates per household because the survey result has shown that the households owning the living place generally have more household members than those renting the living place. Similarly, households with multiple vehicles tend to have more trip rates particularly for other (home-based) purpose.

Purpose compositions of the trips and the daily trip rates by trip purpose are also presented in Figure 2.13 and Figure 2.14. Larger composition of trips of the home-based other purpose in the ADS implies that it has captured more trips of this purpose which tend to be overlooked in the HIS. It can be concluded that the ADS data are more reliable for trip generation modeling in the Greater Abidjan, though information obtained from the HIS is still valuable in terms of its large sample size and abundant data source.

Table 2.11 Daily Trip Rates per Household based on ADS

Trip Purpose	0V-R	0V-O	1V	MV	Total
HBW	2.56	2.86	2.43	1.70	2.60
HBE	2.25	3.26	2.46	2.26	2.50
HBO	3.93	5.79	4.70	7.47	4.50
NHB	1.71	1.59	2.44	1.72	1.76
Total	10.45	13.51	12.02	13.15	11.36
Household Size	3.40	4.58	3.61	4.89	3.72

Note: 0V-R: households with 0 vehicle renting the living place, 0V-O: households with 0 vehicle owing the living place, 1V: households with 1 vehicle, MV: households with multiple vehicle
HBW: home-based work, HBE: home-based education, HBO: home-based other, NHB: non-home-based
Source: JICA Study Team

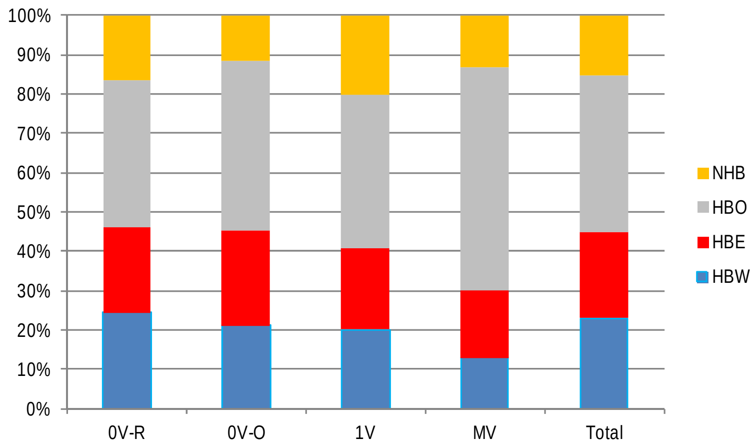
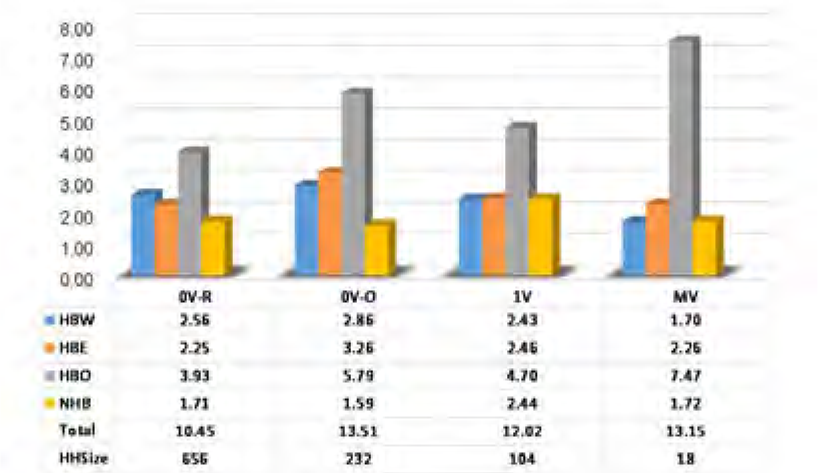


Figure 2.13 Purpose Composition of Trips by Household Type



Note: 0V-R: households with 0 vehicle renting the living place, 0V-O: households with 0 vehicle owing the living place, 1V: households with 1 vehicle, MV: households with multiple vehicle
HBW: home-based work, HBE: home-based education, HBO: home-based other, NHB: non-home-based
Source: JICA Study Team

Figure 2.14 Daily Trip Rates per Household by Purpose and Household Type

2.4 Cordon Line Survey

2.4.1 Introduction

(1) Objective

The main objective of the survey is to acquire trip information of passengers in private vehicles as well as buses on the major roads together with rail and air passengers crossing the boundary of the Survey Area. The trip data is utilized to estimate the present passenger travel demand in the form of Origin-Destination matrices.

(2) Survey Location

Survey locations are shown below.

Source: JICA Study Team

Figure 2.15 Cordon Line Survey Location

1) Survey Component

The Cordon Line survey consists of the following three kinds of OD and traffic count surveys:

- Road (Roadside OD interview survey/Traffic count survey),
- Railway (Railway passenger OD interview survey/Passenger count survey), and

- Airport (Air passenger OD interview survey/Passenger volume data collection and Traffic count survey).

2) Survey Type and Period by Survey Location for Interview Surveys

The surveys were conducted on one weekday (Tuesday, Wednesday or Thursday). The public holidays and the holidays of schools and universities and the periods of large events were avoided.

Table 2.12 Survey Period by Survey Location

No.	Road	Survey Type	OD Survey Period	Traffic Count Period	Cordon Station
1	Jacqueville – Yopougon	Roadside OD Interview (No.2: Implemented at the Ferry Port during its operation)	16 hours	24hours	Southwest
2	Jacqueville – Songon		16 hours	6:00 – 23:00	Southwest
3	A3 (Dabou – Songon)		16 hours	24hours	West-Inner
4	Autoroute du Nord (Attinguie – Plateau)		16 hours	24hours	Northwest-Inner
5	B107 (Azaguie – Anyama)		16 hours	24hours	North-Inner
6	Autoroute d'Abobo (Azaguie – Anyama)		16 hours	24hours	North-Inner
7	Brofodoume – Abobo		16 hours	24hours	Northeast-Inner
8	Palmeraie – Bingerville		16 hours	24hours	East-Inner
9	Bonoua – Grand Bassam		16 hours	24hours	East-Inner
10	Dabou – Bouboury		16 hours	24hours	West-Outer
11	Dabou – Lopou		16 hours	24hours	West-Outer
12	Autoroute du Nord (Attinguie – Sahuye)		16 hours	24hours	Northwest-Outer
13	B107 (Azaguie – Agboville)		16 hours	24hours	North-Outer
14	Autoroute d'Abobo (Azaguie – Yacasse)		16 hours	24hours	North-Outer
15	Alepe – Aboisso		16 hours	24hours	Northeast-Outer
16	Bonoua – Aboisso		16 hours	24hours	East-Outer
17	Felix Houphouet Boigny Airport (Boulevard de l'Aeroport)	Air Passenger OD Interview	All flights on survey date	24hours	Airport
18	Azaguie – Anyama (Railway)	Railway Passenger OD Interview	All trains on survey date	None	Railway

Source: JICA Study Team

3) Roadside OD Interview/ Traffic Count Survey

v) Vehicle Type

Vehicle types for the Roadside OD Interview/ Traffic Count Survey are classified into the following 12 categories:

Table 2.13 Vehicle Type

Type	Vehicle Type	Remark
1	Motorcycle and tricycle	2 or 3 wheel motorized vehicle
2	Private car (sedan)	For private use (sedan, SUV, etc.)
3	Private car (van)	For private use
4	Taxi	Meter taxi
5	Woro-Woro	Intra-communal shared taxi (5 seats or 8 seats)
6	Gbaka/ Small Bus	Intra/ inter-communal mini-bus (approx. 12 – 18 seats)
7	Bus	SOTRA/ Private bus
8	Coupled-bus	Coupled SOTRA bus
9	Small Truck	Lightweight truck, pick-up truck
10	Medium Truck	2 axles
11	Large Truck	More than 2 axles
12	Trailer	Semi-trailer with a tractor unit

Source: JICA Study Team

vi) Survey Methodology

a) Vehicle Count (Traffic Count Survey)

All passing vehicles of all vehicle types were counted. Surveyors continuously counted the number of vehicles by 15 minute intervals by vehicle type and by direction.

b) Occupancy

Occupants of passing vehicles were also counted at the survey station by 15 minute intervals by vehicle type and by direction excluding trucks (vehicle types 9 – 12).

c) Survey Items of Roadside OD Interview

Survey Items of Roadside OD Interview are shown below. All types of vehicles were interviewed. The survey items include the following items;

- Vehicle Type
- Number of Passengers including driver
- Address of Origin/ Destination
- Trip Purpose
- Location of Residence
- Type of Commodity (only for Trucks)
- Loading Ratio (only for Trucks)
- Bus Station (on station/ off station only for Buses)

- Number of Accompanying Persons in the same group to the same destination and purpose (only for Buses)

d) Bus Passenger Count

Surveyors also counted the number of passengers on buses which are stopped for interview. Surveyors got on the stopped buses and quickly counted the number of passengers. After counting, the surveyors got off the bus and filled in the survey sheet.

e) OD Interview Survey at Ferry Port

The survey was expected to be implemented at a Ferry Port in Songon. Some additional conditions were considered compared with other survey locations:

- OD Interview for bus driver was implemented at cross-strait ports.
- The number of buses (vehicle types 5 – 8) were counted at cross-strait ports.
- Interviews were implemented for passengers waiting for the ferry at the ferry port or on-board passengers.

vii) Railway Passenger OD Interview /Passenger Count Survey

a) Survey Location

Railway passenger OD interview survey was conducted on board the trains crossing the boundary of the Autonomous District of Abidjan to obtain trip information regarding on board passengers boarding/ alighting at four railway stations, namely, Banco (Abobo) Station, Adjame Station, Plateau Station and Treichville Station.

b) Survey Period

The survey period of the Railway Passenger OD Interview Survey was set on one weekday (Tuesday, Wednesday or Thursday) based on the train operation. The survey started from the beginning of train operation and ran until the end of train operation each day to catch all operating trains.

c) Sampling

The number of all boarding passengers was counted and at least 20% of boarding passengers were interviewed.

viii) Methodology

The Railway Passenger OD Interview Survey covered railway passengers from 6 years old and above. Surveyors got on the train and interviewed passengers to obtain trip information.

The survey items included the following information:

- Address of Origin/Destination
- Origin Type (Home, Work Place, School, Other)
- Trip Purpose (to home, to work place, to school, business (government), business (private sector), private matters, tourism, etc.)
- Railway Station (on/off station, access/egress mode)

- Train information (train number, seat class)

4) Air passenger OD interview survey/Passenger volume data collection and Traffic count survey

i) Survey Locations

The survey location was the departure waiting room or check-in counter for departing air passengers at the Felix Houphouet Boigny International Airport (FHBIA).

ix) Survey Day and Survey Period

The Air Passenger OD Interview Survey was conducted on one weekday (Tuesday, Wednesday or Thursday) based on the flight operation. The survey started from the beginning of flight operation and ran until the end of flight operation each day to catch all operating flights.

x) Sampling

The number of all boarding passengers was counted and at least 20% of all the international departing air passengers were interviewed.

- Sampling rate of flights surveyed: 100 % of flights
- Sampling rate for air passengers: at least 20 % of air passengers on the sampled flights

xi) Methodology

a) Vehicle Count

All passing vehicles of all vehicle types were counted at the gates of the airport. Surveyors continuously counted the number of vehicles by 15 minute intervals by vehicle type and direction.

b) Occupancy

Occupants of passing vehicles was also counted at the survey station by 15 minute intervals by vehicle type and direction,

c) OD Interview for Air Passengers

The Air Passenger OD Interview Survey covered all the departing air passengers. Surveyors interviewed air passengers in the waiting room or check-in counter for the departing passengers.

The Air Passenger OD Interview Survey included the following items;

- Nationality
- Address of Origin and/or land mark to specify the location at quartier level
- Origin Type (home, hotel, work place, school, other ( ))
- Trip Purpose
- Access Mode of transport
- Cost to come to the airport in case of public transport
- Travel time to the airport ( ) hours ( ) minutes
- Accompanying passengers
- Family/relatives/friend for Seeing-off

- How many family members, relatives, friends have come to the international airport for seeing off
- Flight information (flight number, destination of flight, name of airline, class)
- Stated Preference on train (possibility of using railway connecting Plateau, willingness to pay based on travel time)

  Stated Preference Survey included the following survey items;
- Modal choice and willingness-to-pay for an improved railway system which connects the airport and the plateau
- Assuming railway coach is comfortable and the operation is punctual
  - If travel time was reduced to one hour, which mode of transport would you select from your origin? If you select the railway, how much are you willing to pay for the service?
  - If travel time was reduced to 45 minutes, which mode of transport would you select from your origin? If you select the railway, how much are you willing to pay for the service?
  - If travel time was reduced to 30 minutes, which mode of transport would you select from your origin? If you select the railway, how much are you willing to pay for the service?

2.4.2 Survey Results

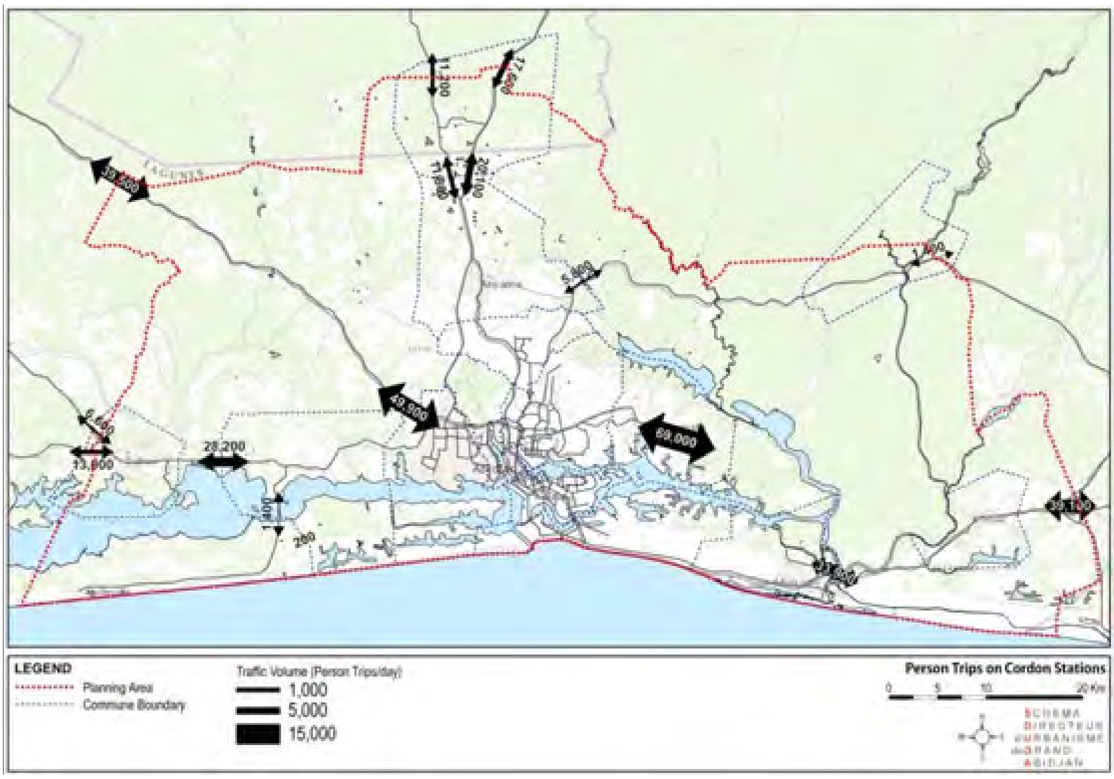
(1) Trips crossing cordon lines

Vehicle trips counted at cordon stations located at inner and outer cordon lines are shown in Figure 2.16. Movements between eastern and western side of Abidjan are stronger than that of northern side.

Source: JICA Study Team

Figure 2.16 Vehicle Trip Crossing Inner and Outer Cordon Line

Person trips counted at cordon stations are illustrated in Figure 2.17. As is the same with vehicle trip, movements between eastern and western side of Abidjan are stronger than that of northern side.

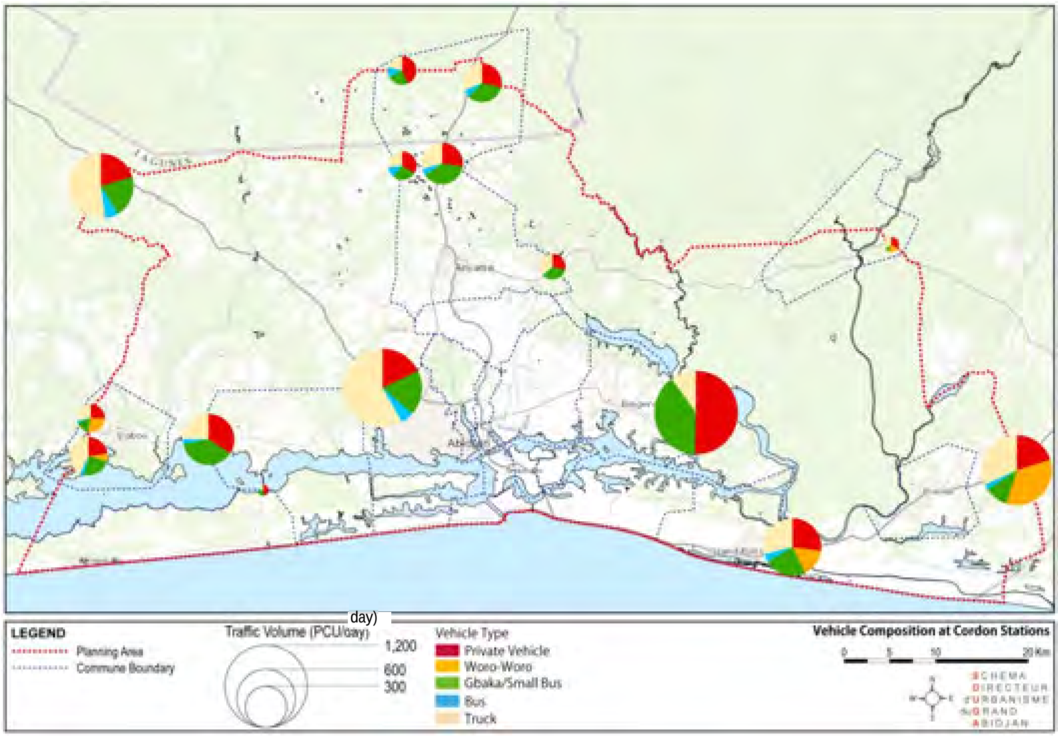


Source: JICA Study Team

Figure 2.17 Person Trips Crossing Inner and Outer Cordon Lines

(2) Vehicle Composition

Vehicle composition observed at western side of Abidjan and around Abidjan port mostly consists of trucks, which indicates importance of cargo traffic especially going through Autoroute du Nord connecting Abidjan and Yamoussoukro as shown in Figure 2.18. In contrast, trips at east side of Abidjan are mainly delivered by passenger cars, Gbaka/small bus or Woro-Woro. However, traffic volume at inner and outer cordon stations is quite smaller than that of in the center of Abidjan as described in Section 2.5 (Screen Line Survey).



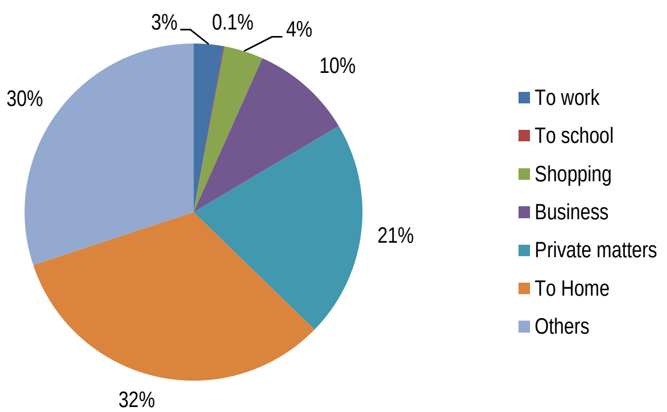
Source: JICA Study Team

Figure 2.18 Vehicle Composition at Cordon Stations

(3) Railway passenger interview survey

1) Trip Purpose

As shown in Figure 2.19, trip purpose of railway passengers mainly consists of three purposes, that is, "To Home" at 32%, "Others" at 30% and "Private Matters" at 21%. Share of business-related purposes is relatively low.

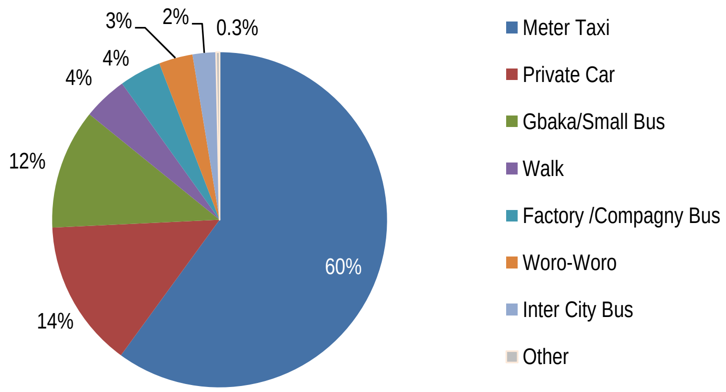


Source: JICA Study Team

Figure 2.19 Trip Purpose of Railway Passengers

2) Access and Egress

More than half of passengers take a meter taxi for their access or egress, followed by private car and Gbaka accounting for 14.1% and 11.5% respectively (see Figure 2.20)

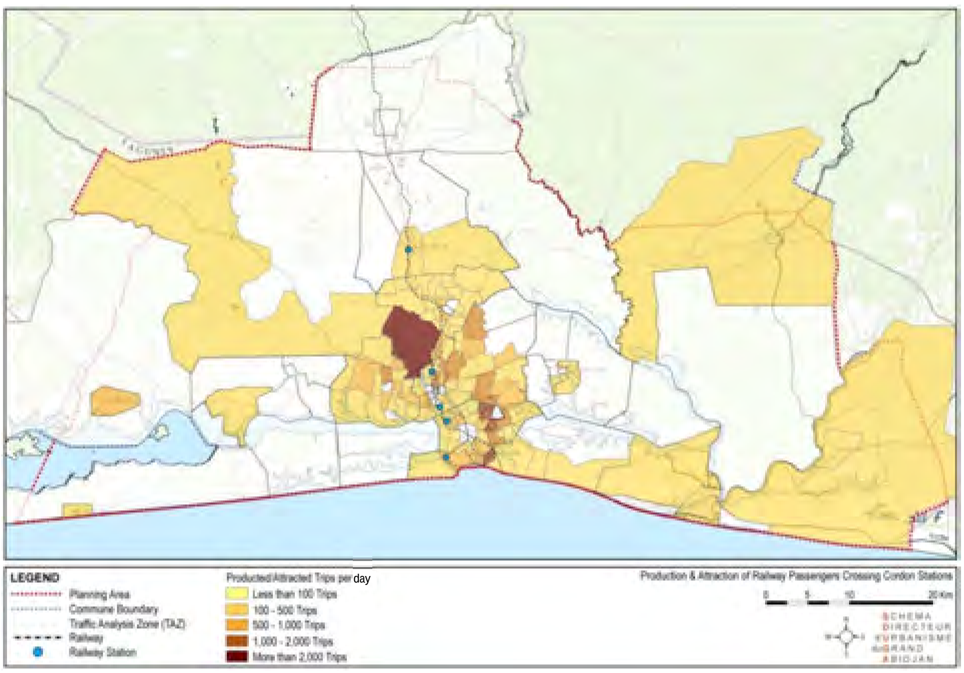


Source: JICA Study Team

Figure 2.20 Access/Egress of Railway Passengers

3) Trip production and attraction of railway passenger

The largest trip production and attraction is observed in Cocody though its number is less than 170 trips/day, followed by Adjame, Koumassi and Yopougon, each accounting for about 140 trips/day, (see Figure 2.21). The number of railway passengers is quite small compared to other transport modes.



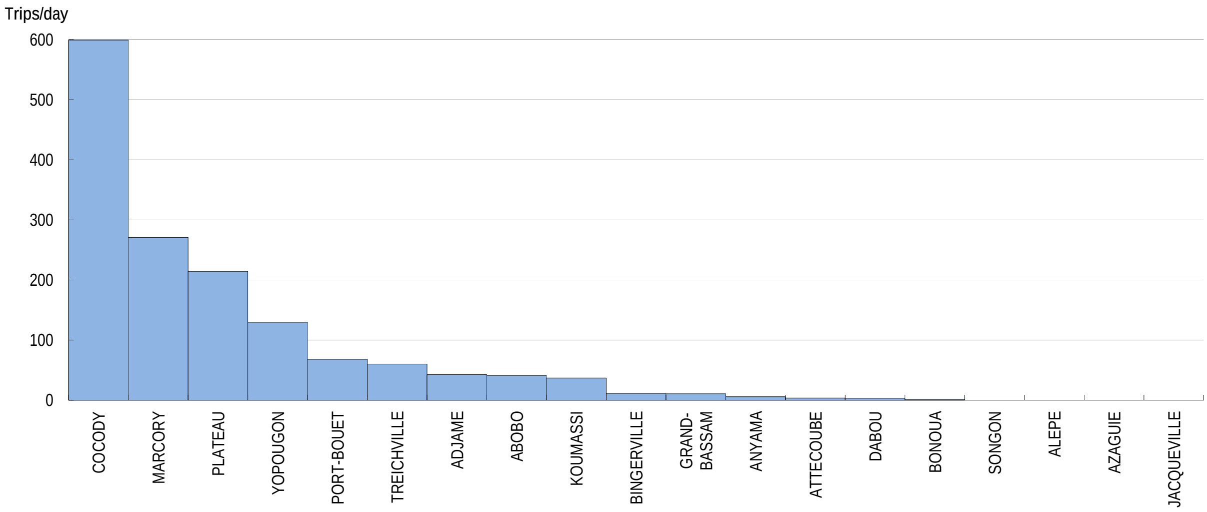
Source: JICA Study Team

Figure 2.21 Trip Production and Attraction of Railway Passengers

(4) Airport passenger interview survey

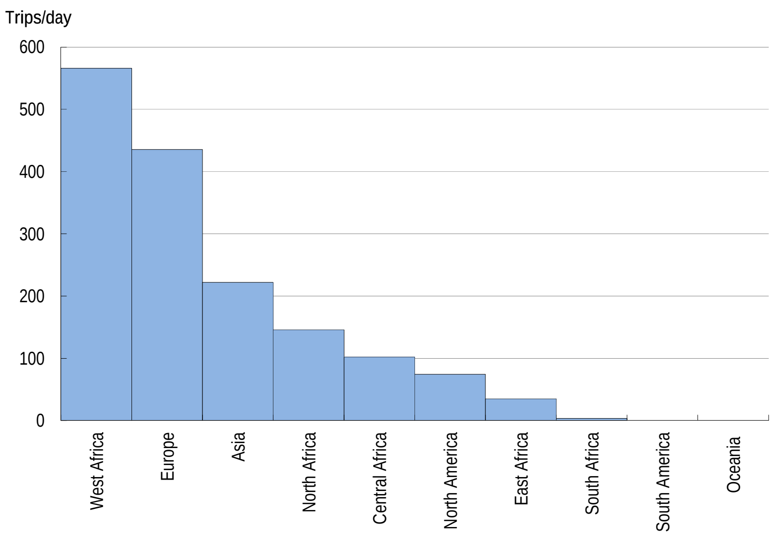
1) Trip production and attraction of airport passenger

The largest number of trip productions are observed in Cocody at about 40%, followed by Marcory, Plateau and Yopougon, accounting for about 18%, 14% and 9% respectively (see Figure 2.22). The most popular destination region is West Africa accounting for about 36%, followed by Europe at about 27% and Asia at about 14% (see Figure 2.23).



Source: JICA Study Team

Figure 2.22 Trip Production of Air Passengers (Greater Abidjan)

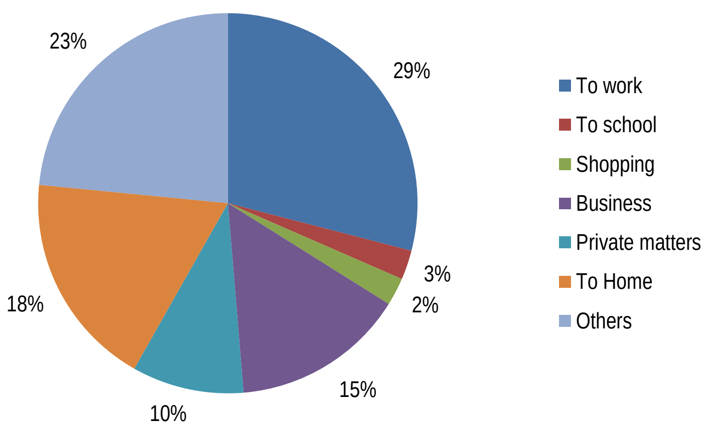


Source: JICA Study Team

Figure 2.23 Trip Attraction of Air Passengers (Foreign Countries)

2) Trip Purpose

Trip purpose of the air passengers is shown in Figure 2.24, indicating that the dominant trip purpose is "To Work", followed by "Other", "To Home" and "Business", accounting for about 29%, 23%, 18% and 15% respectively.

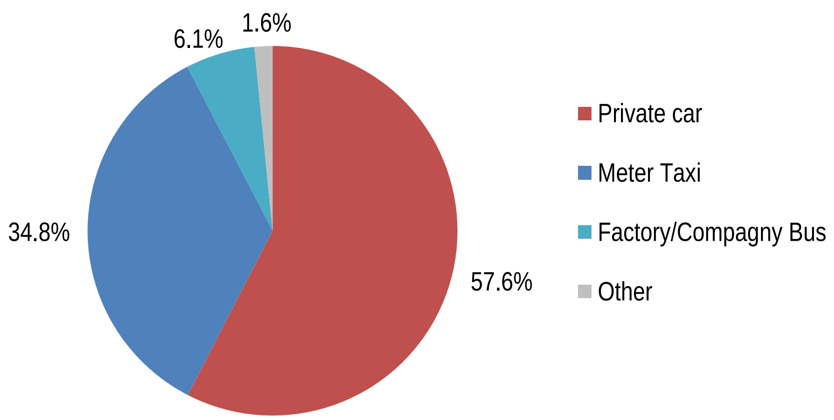


Source: JICA Study Team

Figure 2.24 Trip Purpose of Air Passengers

3) Access and Egress

As shown in Figure 2.25, private car dominates more than half of the trips, followed by meter taxi at 34.8% and Factory/Company Bus at 6.1%. Share of public transport is quite low at present.



Source: JICA Study Team

Figure 2.25 Access Mode of Air Passengers

2.5 Screen Line Survey

2.5.1 Introduction

(1) Objectives

The main objective of the survey is to verify the present OD matrices which are estimated based on the results of the Home Interview Survey. Also, by observing the traffic volume, the traffic conditions at the survey points can be understood such as hourly fluctuations.

(2) Survey Day and Duration

The Screen Line Surveys at each location were conducted on one weekday (Tuesday, Wednesday or Thursday) either for 16 hours (6:00 AM to 10:00 PM) or for 24 hours at the designated survey stations which were set up on major roads where they crossed the north-south screen line (the railway) and the east-west screen line (the expressway).

(3) Survey Location

Screen survey locations, duration and definition of direction are shown in Table 2.14, Table 2.15 and Figure 2.26. The north-south screen line was set on the existing railway and those of east-west are set on the expressway on the east side of Abidjan, a geographical boundary in the west and the bridges in the south.

Table 2.14 Survey Locations and Durations of Screen Line Surveys

No.	Screen Line	Duration	No.	Screen Line	Duration
1	North-South 1	24 Hours	13	East-West 1	24 Hours
2	North-South 1	16 Hours	14	East-West 1	16 Hours
3	North-South 1	16 Hours	15	East-West 2	16 Hours
4	North-South 1	16 Hours	16	East-West 2	24 Hours
5	North-South 1	16 Hours	17	East-West 2	16 Hours
6	North-South 2	24 Hours	18	East-West 2	16 Hours
7	North-South 2	16 Hours	19	East-West 2	24 Hours
8	North-South 2	16 Hours	20	East-West 2	16 Hours
9	North-South 2	16 Hours	21	East-West 2	16 Hours
10	North-South 2	16 Hours	22	East-West 3	16 Hours
11	North-South 2	16 Hours	23	East-West 3	24 Hours
12	East-West 1	16 Hours	24	East-West 3	16 Hours
			25	East-West 3	16 Hours

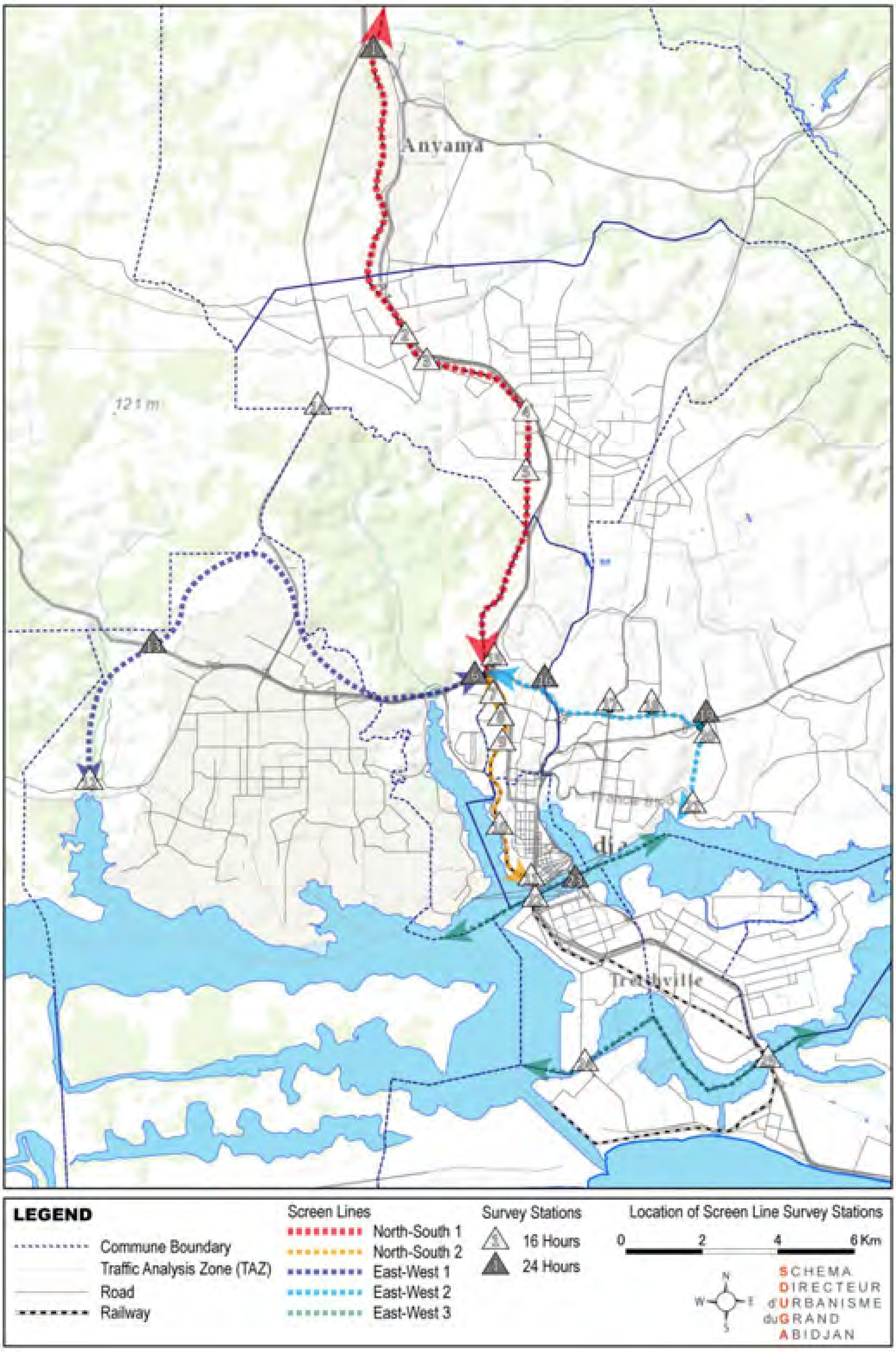
Source: JICA Study Team

Table 2.15 Survey Locations and Directions of Screen Line Surveys

Location	Section	Direction		
1	Anyama - Agboville	1	North to South	Inbound
		2	South to North	Outbound
2	Ndotre - Agripac	1	West to East	Inbound
		2	East to West	Outbound
3	Gare International Abobo - Anokoi Koute	1	South to North	Inbound
		2	North to South	Outbound
4	Derreire Rail - Rond Point Gendarimerie	1	South to North	Inbound
		2	North to South	Outbound
5	Epp Bad - Anador Banco	1	West to East	Inbound
		2	East to West	Outbound
6	Yopougon - Adjame	1	West to East	Inbound
		2	East to West	Outbound
7	Pharmacie Agban - Adjame Nord	1	West to East	Inbound
		2	East to West	Outbound
8	Pharmacie Cha Teau - Mosque Adjame	1	West to East	Inbound
		2	East to West	Outbound
9	Bromacote - Nangui Abrogoua	1	South to North	Inbound
		2	North to South	Outbound
10	Carena - Plateau	1	West to East	Inbound
		2	East to West	Outbound
11	Carena - Plateau	1	West to East	Inbound
		2	East to West	Outbound
12	Dabou - Yopougon	1	West to East	Inbound
		2	East to West	Outbound
13	Autoroute du Nord - Attinguie 4	1	North to South	Inbound
		2	South to North	Outbound
14	Ndotre - Prison Civile	1	North to South	Inbound
		2	South to North	Outbound
15	Abobo - Adjame	1	North to South	Inbound
		2	South to North	Outbound
16	Adjame - William Ville	1	North to South	Inbound
		2	South to North	Outbound
17	Angre - Cocody	1	North to South	Inbound
		2	South to North	Outbound
18	Ecole de Police - Deux Plateaux	1	North to South	Inbound
		2	South to North	Outbound
19	Riviera II - Ecole de Police	1	West to East	Inbound
		2	East to West	Outbound
20	Mosque - Universite	1	East to West	Inbound
		2	West to East	Outbound
21	Golf - Cocody	1	East to West	Inbound
		2	West to East	Outbound
22	Treichville - Plateau	1	South to North	Inbound
		2	North to South	Outbound
23	Treichville - Plateau	1	South to North	Inbound
		2	North to South	Outbound
24	Vridi - Treichville	1	South to North	Inbound
		2	North to South	Outbound
25	Port Bouet - Koumassi	1	South to North	Inbound
		2	North to South	Outbound

Note: Inbound is the direction toward the center of Abidjan and outbound is toward the external area surrounding Abidjan

Source: JICA Study Team



Source: JICA Study Team

Figure 2.26 Survey Locations and Durations of Screen Line Surveys

(4) Survey Method

1) Traffic Count and Passenger Loading

The surveyors continuously counted the number of all passing vehicles by 15 minute intervals by vehicle type and by direction. The number of occupants in 10% of the passing vehicles was also counted at the survey station by 15 minute intervals by vehicle type and by direction on the east-west and north-south screen lines.

2) Vehicle Classification

Vehicle types for the Screen Line Survey are the same as that of the Cordon Line Survey, classified into 12 categories as shown in Table 2.16. For the analysis, these categories are also integrated into five modes in this survey.

Table 2.16 Vehicle Classification

Type	Vehicle Type	Remarks	5 Integrated Modes
1	Motorcycle and tricycle	2 or 3 wheel motorized vehicle	Private Vehicle
2	Private car (Sedan)	For private use (sedan, SUV, etc.)	Private Vehicle
3	Private car (Van)	For private use	Private Vehicle
4	Taxi	Meter taxi	Private Vehicle
5	Woro-Woro	Intra-communal and illegal inter-communal shared taxi (5 seats or 8 seats)	Woro-Woro
6	Gbaka/ Small Bus	Intra/ inter-communal mini-bus (approx. 12 – 18 seats)	Gbaka/Small Bus
7	Bus	SOTRA/ Private bus	Bus
8	Coupled-Bus	Coupled SOTRA bus	Bus
9	Small Truck	Lightweight truck, pick-up truck	Truck
10	Medium Truck	2 axles	Truck
11	Large Truck	More than 2 axles	Truck
12	Trailer	Semi-trailer with a tractor unit	Truck

Source: JICA Study Team

3) Passenger Car Unit (PCU)

Passenger car units are set as shown in Table 2.17.

Table 2.17 Passenger Car Units

No.	Mode	PCU	No.	Mode	PCU
1	Motorcycle and Tricycle	0.25	7	Bus	2.00
2	Private Car (Sedan)	1.00	8	Coupled-Bus	3.00
3	Private Car (Van)	1.50	9	Small Truck	1.00
4	Taxi	1.00	10	Medium Truck	2.00
5	Woro-Woro	1.00	11	Large Truck	2.00
6	Gbaka/Small Bus	1.50	12	Trailer	3.00

Source: JICA Study Team

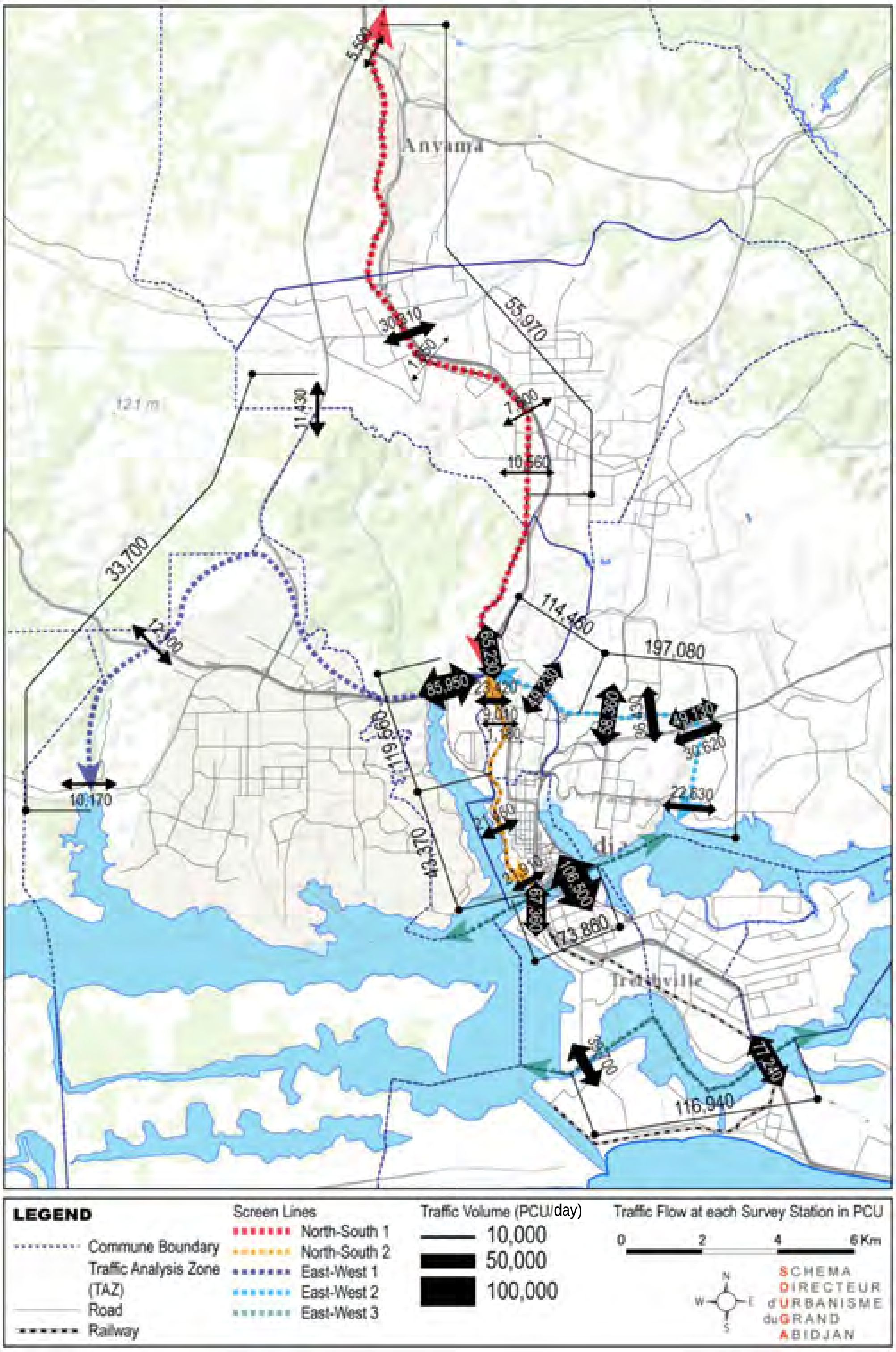
4) Sampling Rate

All passing vehicles were counted and at least 20% of passing vehicles were captured for passenger occupancy observation. The number of passengers and seat capacity shall be counted for vehicle types 1 to 4. Passenger loading level (empty, 25%, 50%, 75%, 100%, 125 %, 150% and more) were captured for vehicle types 5 to 8.

2.5.2 Survey Results

(1) Traffic and Passenger Volume

Traffic and passenger volume are illustrated in Figure 2.27, indicating concentration of the traffic crossing East-West 2 accounting for about 306,000 PCU/day, followed by East-West 3, of which maximum sectional traffic volume on Charles de Gaulle Bridge and Houphouet-Boigny Bridge is about 174,000 PCU/day, and North-South 2 at about 117,000 PCU/day. The heaviest traffic is observed at Charles de Gaulle Bridge of which traffic volume is about 107,000 PCU/day.



Source: JICA Study Team

Figure 2.27 Traffic Flow at each Survey Station in PCU

(2) Vehicle Occupancy

Vehicle occupancy of each vehicle type by screen line is summarized in Table 2.18. Generally, the vehicle occupancy throughout the survey is almost uniform.

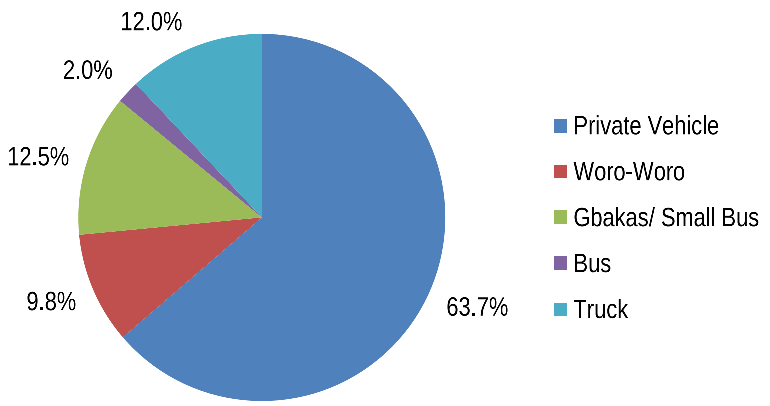
Table 2.18 Vehicle Occupancy at Screen Line

Screen Line	Motorcycle and Tricycle	Private Car (Sedan)	Private Car (Van)	Taxi	Woro-Woro	Gbaka	Bus	Coupled-Bus
North-South 1	1.3	2.1	2.6	2.1	4.3	14.3	50.4	- *
North-South 2	1.3	2.3	3.8	2.6	4.0	14.3	50.7	148.9
East-West 1	1.4	2.4	2.7	2.4	3.8	15.2	63.6	-
East-West 2	1.3	2.1	3.2	2.5	4.3	12.9	47.9	153.5
East-West 3	1.3	2.2	4.0	3.0	4.3	12.2	52.8	137.0
All	1.3	2.2	3.5	2.6	4.2	13.7	52.3	146.9

Note: * No vehicles were observed
Source: JICA Study Team

(3) Vehicle Comparison

In terms of traffic volume in PCU, private vehicles make up the largest portion of traffic with about 64%. On the other hand, in terms of person trips, the percentage of public transport, namely, Woro-Woro, Gbaka and Bus, is about 24% in total as shown in Figure 2.28.



Source: JICA Study Team

Figure 2.28 Modal Composition of Screen Line Survey (Traffic Volume in PCU)

2.6 Intersection Traffic Volume Survey

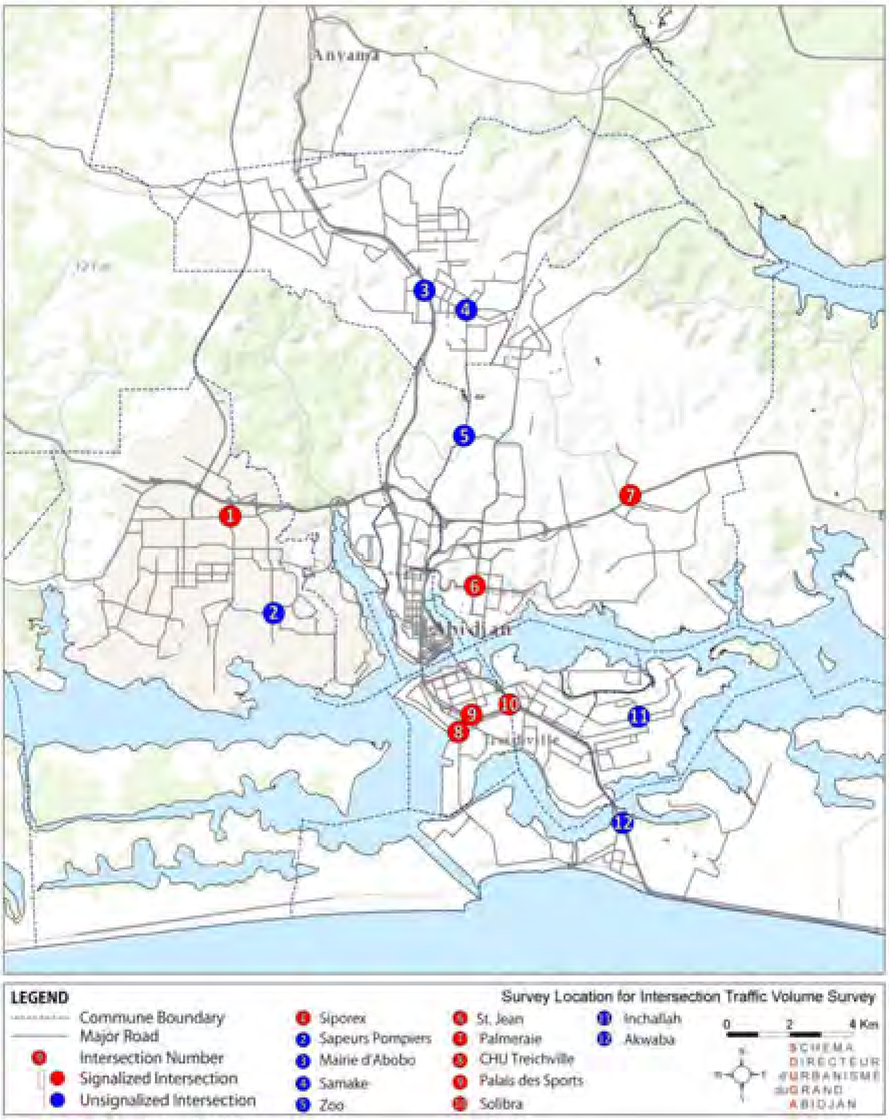
2.6.1 Introduction

(1) Objective

The Intersection Traffic Volume Survey was conducted to understand the present traffic flows at major intersections by obtaining traffic volume data for each direction. The obtained data was used for quantitatively analyzing traffic congestion in terms of intersection saturation, traffic volume and queuing length, etc.

(2) Survey Locations

The surveyed intersections are mostly located on major roads in Greater Abidjan (Figure 2.29).



Source: JICA Study Team

Figure 2.29 Location of Intersection Traffic Volume Survey

(3) Survey Methodology

1) Vehicle Type

Vehicle types for the Intersection Traffic Volume Survey are classified into 12 categories as shown in Table 2.19.

Table 2.19 Vehicle Type for Intersection Traffic Volume Survey

Type	Vehicle Type	Remark
1	Motorcycle and Tricycle	2 or 3 wheel motorized vehicle
2	Private Car (Sedan)	For private use (sedan, SUV, etc.)
3	Private Car (Van)	For private use
4	Meter taxi	Meter taxi
5	Woro-Woro	Intra-communal and illegal inter-communal shared taxi (5 seats or 8 seats)
6	Gbaka/Small Bus	Intra/ inter-communal mini-bus (approx. 12 – 18 seats)
7	Bus	SOTRA/ Private bus
8	Coupled-Bus	Coupled SOTRA bus
9	Small Truck	Lightweight truck, pick-up truck
10	Medium Truck	2 axles
11	Large Truck	More than 2 axles
12	Trailer	Semi-trailer with a tractor unit

Source: JICA Study Team

2) Passenger Car Units (PCU)

Passenger car units (PCU) of each vehicle type are addressed in Table 2.17.

3) Traffic Count

All passing vehicles in each direction (i.e. right-turn, straight or left-turn) were continuously counted by 15 minute intervals by vehicle type for 16 hours from 6:00 to 22:00.

4) Signal Phase Record

Signal phase recording was carried out at each intersection for each hour of the survey period in order to observe the phase pattern and its time duration using a timepiece. Classification of signalized/ unsignalized intersections is shown in Table 2.20.

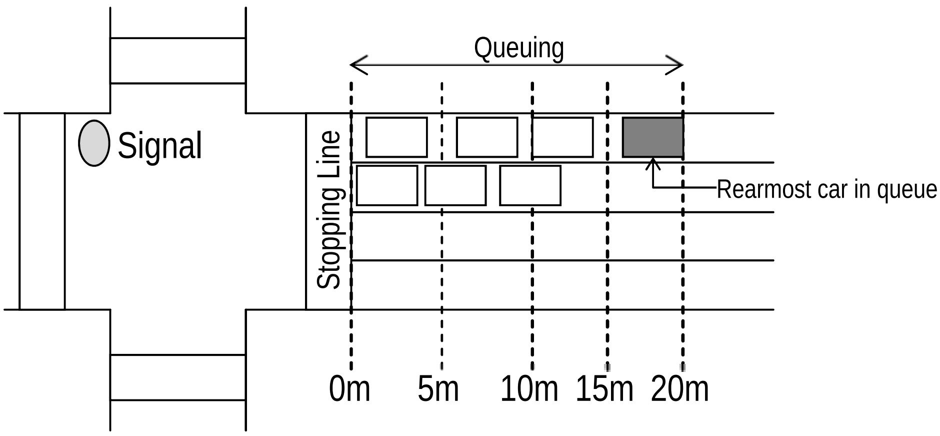
Table 2.20 Signalized/ Unsignalized Intersections

No.	Intersection	Signalized	Unsignalized
1	Siporex	✓	
2	Sapeurs Pompiers		✓
3	Mairie d'Abobo		✓
4	Samake		✓
5	Zoo		✓
6	St. Jean	✓	
7	Palmeraie	✓	
8	CHU Treichville	✓	
9	Palais des Sports		✓
10	Solibra	✓	
11	Inchallah		✓
12	Akwaba		✓

Source: JICA Study Team

5) Traffic Queuing Length

A survey of the length of traffic queuing was carried out at each intersection. Definition of queuing length: the distance between the stop line at the intersection and the rear end of the queuing vehicles (at the moment of traffic signal changing from red to green (Figure 2.30). The queuing length was rounded up by five meters units (e.g. in case of 11m, it is rounded up to 15m). In case of multiple lanes, the length of the longest queue was measured. When vehicles were moving at a very low speed, but not completely stopped, it was regarded as queuing.

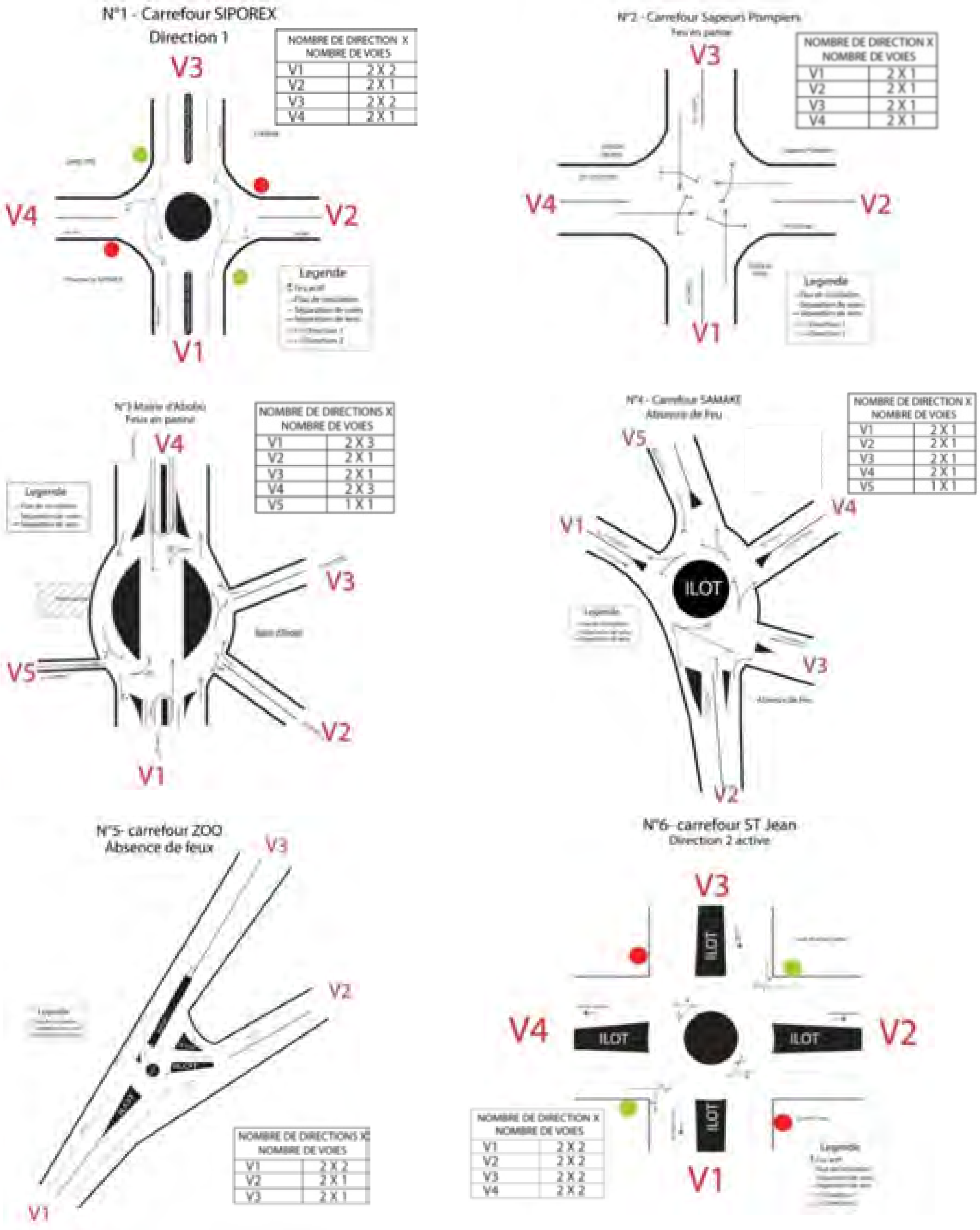


Source: JICA Study Team

Figure 2.30 Definition of Traffic Queuing Length

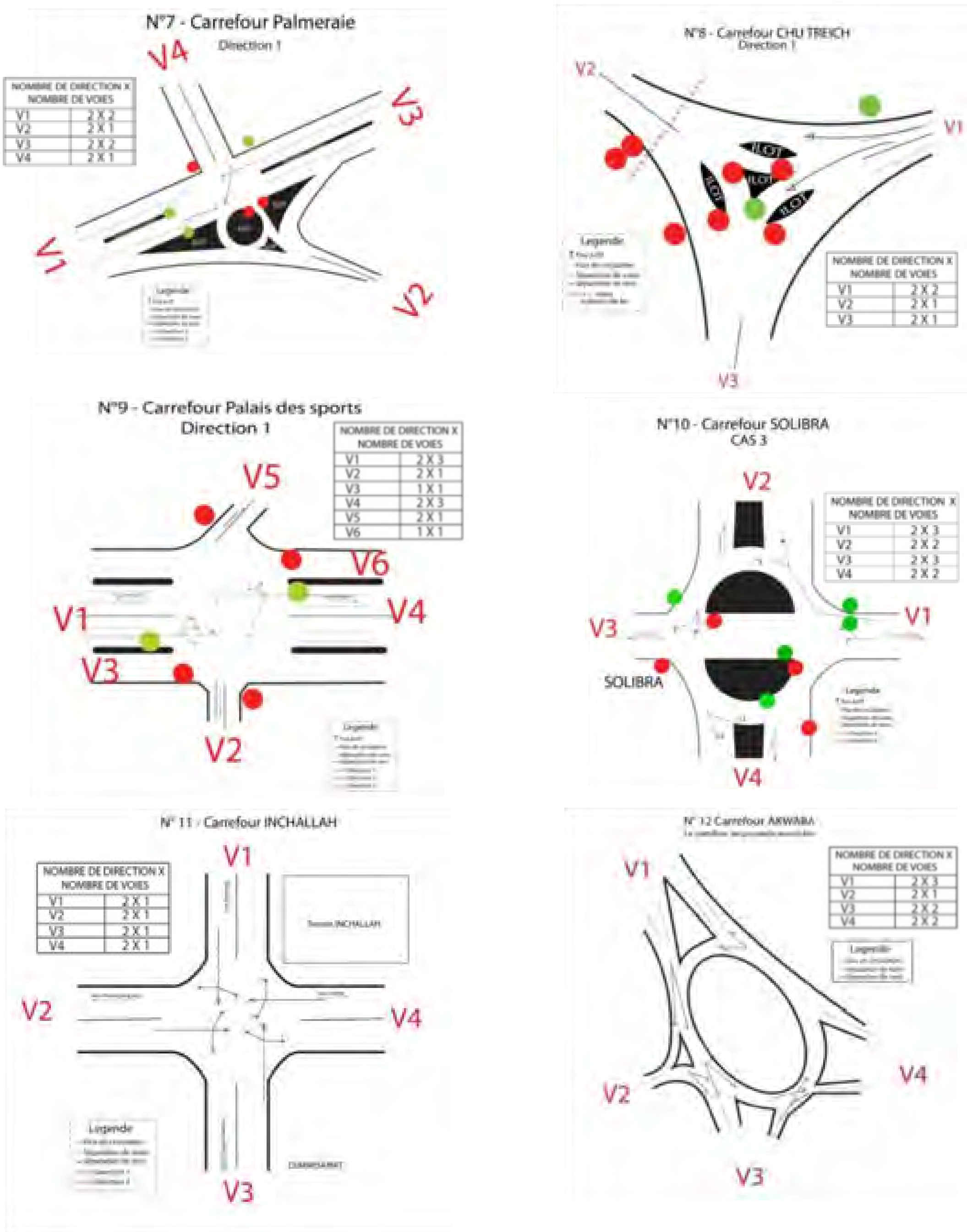
(4) Geometry of the Intersections

The geometry of each intersection is shown in Figure 2.31 and Figure 2.32.



Source: JICA Study Team

Figure 2.31 Geometry of Intersections (1/2)



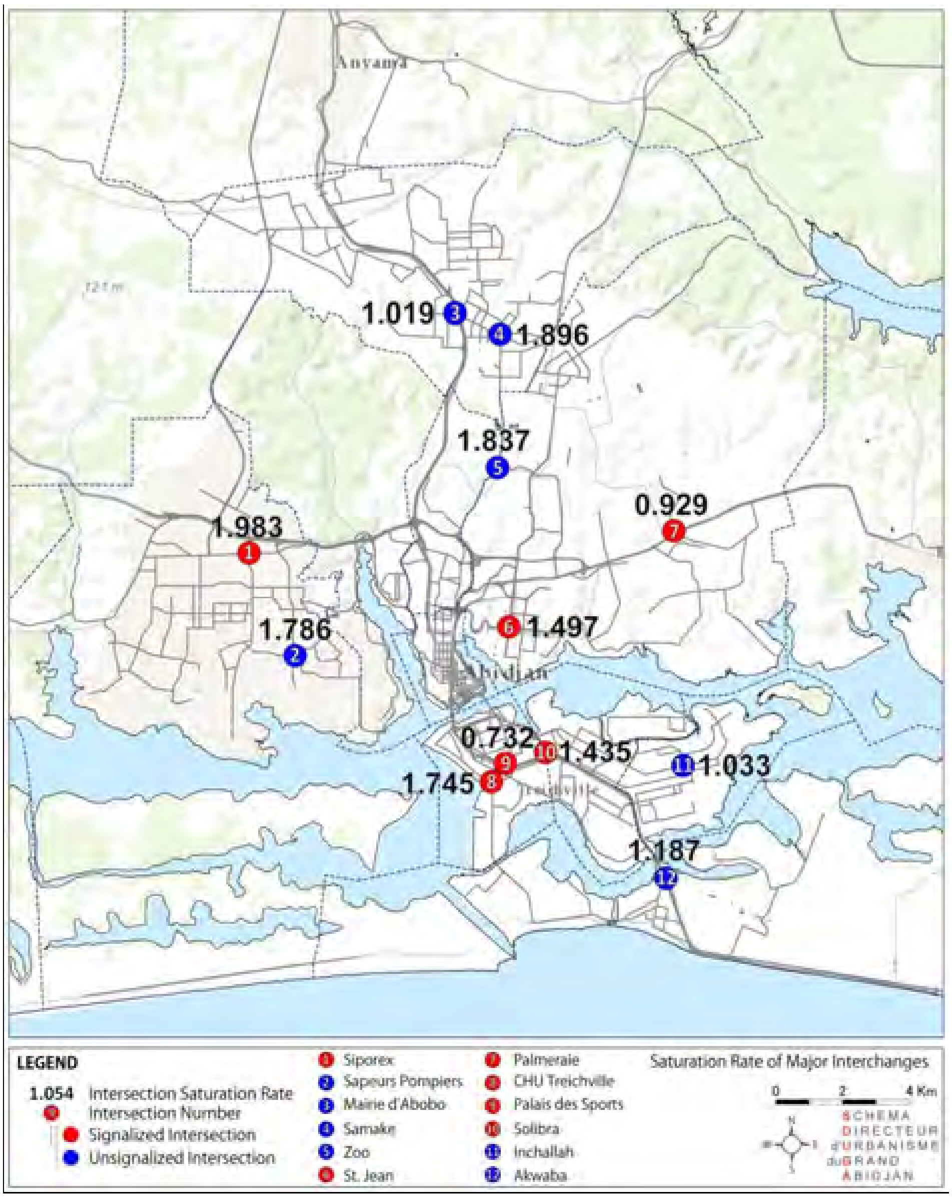
Source: JICA Study Team

Figure 2.32 Geometry of Intersections (2/2)

2.6.2 Survey Results

(1) Degree of saturation at intersection

Degree of saturation at each intersection is shown in Figure 2.33, roughly meaning that intersections with a degree of saturation over 0.9 cannot allow proper traffic flow at the intersection. The top three highest saturation rates of signalized intersections are Siporex, CHU Treichville and St. Jean, accounting for 1.98, 1.75 and 1.50 respectively and those of unsignalized intersections are Samake, Zoo and Sapeurs Pompiers, accounting for 1.90, 1.84 and 1.79 respectively. Saturation rates of all intersections excluding No. 9 (Palais des Sports) exceed 0.9.

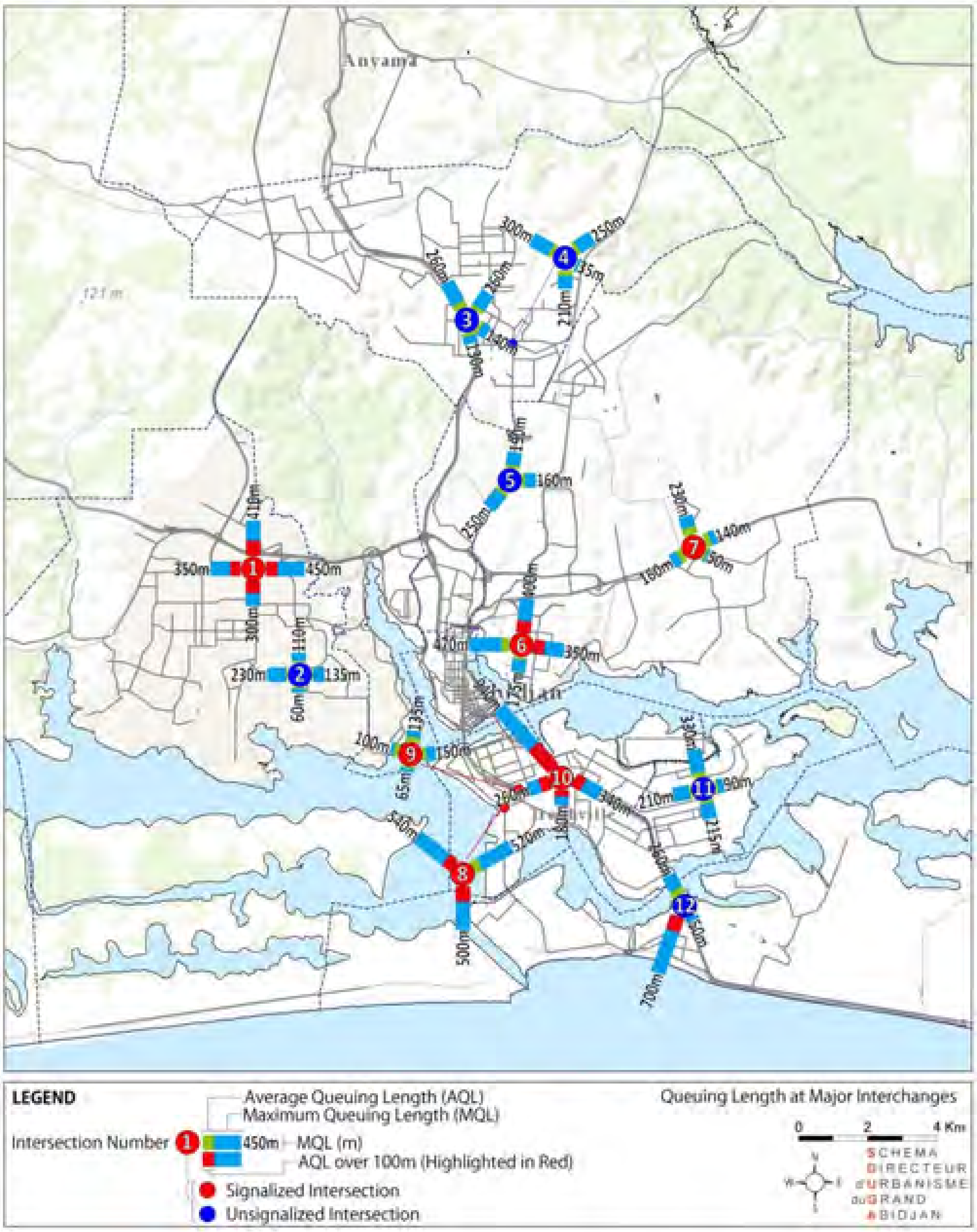


Source: JICA Study Team

Figure 2.33 Degree of Saturation at Each Intersection

(2) Queuing length

Queuing length of each intersection is shown in Figure 2.34 and Table 2.21. The longest queues were observed on the north side of Solibra intersection (No. 10) at 940m in terms of maximum length and 348m in terms of average length during the survey period. Following Solibra, longer maximum queuing lengths were observed at Akwaba (No. 12) at 700m, CHU Treichville (No. 8) at 540m and at St. Jean (No. 6) at 470m. Longer average queuing lengths were observed at Siporex (No. 1) at 178m, Akwaba (No. 12) at 176m and St. Jean (No. 6) at 139m. The average and maximum queuing lengths by direction are also shown in Figure 2.35. Solibra shows a noticeable queuing length.



Source: JICA Study Team

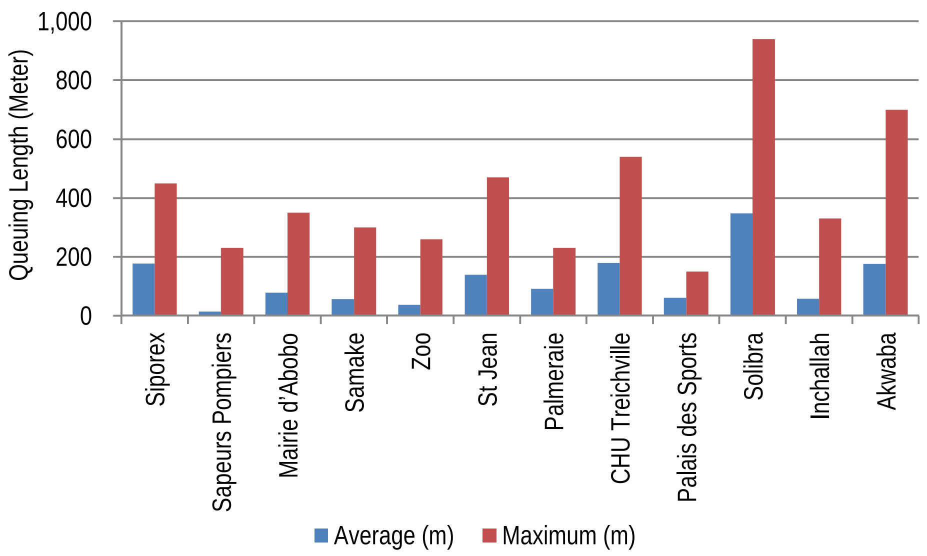
Figure 2.34 Queuing Length of Each Intersection

Table 2.21 Average and Maximum Queuing Length of Each Intersection by Direction

No.	Intersection	Direction	Average (m)	Maximum (m)
1	Siporex	South	145	300
		East	135	450
		North	180	410
		West	120	350
2	Sapeurs Pompiers	South	15	60
		East	10	135
		North	15	110
		West	15	230
3	Mairie d'Abobo	South	40	130
		South-East	35	140
		North-East	50	260
		North	80	350
4	Samake	North-West	50	300
		South	60	210
		South-East	10	35
		North-East	50	250
5	Zoo	South	40	260
		East	30	160
		North	35	190
6	St Jean	South	30	175
		East	125	350
		North	140	400
		West	90	470

No.	Intersection	Direction	Average (m)	Maximum (m)
7	Palmeraie	West	60	160
		South	25	50
		East	65	140
		North	95	230
8	CHU Treichville	East	95	520
		West	120	540
		South	180	500
9	Palais des Sports	West	55	100
		South	25	65
		East	65	135
		North	45	150
10	Solibra	East	125	340
		North	350	940
		West	120	260
		South	75	180
11	Inchallah	North	60	330
		West	20	210
		South	30	215
		East	20	90
12	Akwaba	North	75	260
		West	180	700
		South	5	50
		East	0	0

Source: JICA Study Team



Source: JICA Study Team

Figure 2.35 Average and Maximum Queuing Length of Most Congested Direction

2.7 Public Transport OD Interview Survey

2.7.1 Introduction

(1) Objective

The main objective of the survey is to acquire trip information regarding passengers on the route buses and water-buses within the Survey Area. The trip data is utilized to complement the present passenger travel demand in the form of Origin-Destination matrices.

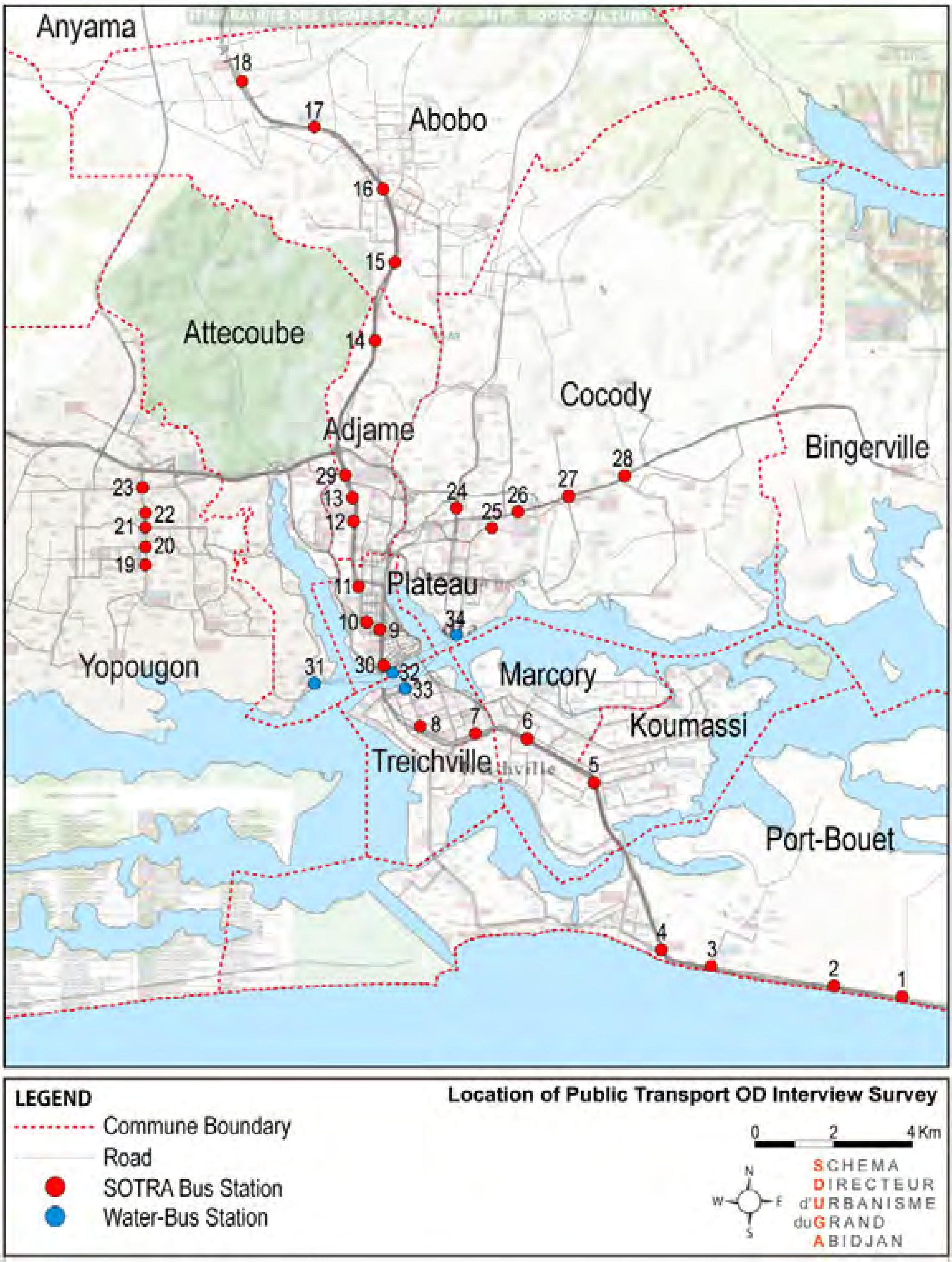
(2) Survey Location

20 major bus stops along the north-south corridor and 10 major bus stops along the east-west corridor were selected in accordance with the number of boarding and alighting passengers. In addition, 4 water-bus stops also were selected as survey locations. The survey locations are shown below.

Table 2.22 List of Survey Stations

ID	Station	ID	Station
North-South Corridor		East-West Corridor	
1	Gonzaqueville (Terminus 67 - 68 - 17)	19	Arrêt SOTRA du 16è Arrondissement
2	4è Arrêt SOTRA Gonzaqueville (devant la Mosquée)	20	Arrêt SOTRA de la Cathédrale Saint André
3	Arrêt Après Carrefour Aéroport - GATL	21	Arrêt SOTRA Pharmacie KENAYA
4	Arrêt 43è BIMA devant la Cité Universitaire Port-Bouet 3	22	Arrêt SOTRA FIGAYO
5	Arrêt du Grand Carrefour de Koumassi	23	Arrêt SOTRA SIPOREX
6	Arrêt en Face de Super Hayat Marcory (Cap Sud)	24	Arrêt SOTRA (150 Logements)
7	Arrêt Collège Moderne Autoroute, Après SOLIBRA	25	Arrêt CHU de Cocody
8	Arrêt du Palais des Sports de Treichville (Après Im. Roche)	26	Arrêt Ecole de Police
9	Arrêt Sorbonne (Face à l'immeuble SIB)	27	Arrêt Cité Universitaire Riviéra II
10	Arrêt Pharmacie Long Champ	28	Arrêt Cap Nord Riviéra
11	Arrêt Camp Galiéni - Musée	Water-Bus Station	
12	Arrêt Lycée Nangui Abrogoua	31	Gare Lagunaire Yopougon AboboDoumé
13	Arrêt Grande Mosquée d'Adjamé	32	Gare Lagunaire Plateau
14	Arrêt Université Abobo - Adjamé	33	Gare Lagunaire Treichville
15	Arrêt ANADOR (Après Université / Casse Abobo)	34	Gare Lagunaire Blokauss
16	Arrêt Pharmacie de la Mé (Après la Mairie)		
17	Arrêt Dépôt 9 SOTRA		
18	Arrêt Terminus Bus SOTRA 76 (Phce Melie - Hevie)		
29	Gare Nord		
30	Gare Sud		

Source: JICA Study Team



Source: JICA Study Team

Figure 2.36 Public Transport OD Interview Survey Locations

(3) Methodology

1) Survey Form

The following survey forms were utilized during the Public Transport OD Interview Survey:

- Form-PTIS1; To record traffic count,
- Form-PTIS2; To record vehicle occupancy,
- Form-PTIS3; To record boarding/alighting passenger count, and
- Form-PTIS4; To record passenger OD.

2) Bus Count and Occupancy

The number and occupancy of all departing buses and water-buses were captured including following items:

- Hourly Traffic Volume of Buses and Water Buses, and
- Passenger Occupancy Rates by bus Type.

3) Bus Passenger Count

Hourly number of bus and water bus passengers boarding and alighting at bus stops or water bus stations was captured. It was also utilized to expand the result of the sampled bus passenger interviews.

4) Bus Passenger and Water-Bus Passenger Interviews

Interviews with passengers of the surveyed buses and water-buses were conducted including the following items:

- Address of origin/destination,
- Trip purpose,
- Access/egress mode of transport,
- Bus type, and
- Boarding/alighting station.

It should be noted that alighting station of boarding passengers and boarding station of alighting passengers could not be obtained due to the limited amount of information available from the respondents.

5) Survey Period

The Public Transport OD Interview Survey was conducted on one weekday (Tuesday, Wednesday or Thursday) for 16 hours (6:00 AM to 10:00 PM) at the designated survey stations.

6) Vehicle Type

Passengers of the SOTRA buses, buses operated by private companies, Gbaka, Woro-Woro and water-buses that have fixed routes on the corridor were surveyed. The following Passenger Car Units (PCU) and capacity were set by the type of vehicle (see Table 2.23). Private company bus is the buses used for designated users such as employees of a specific company, factory or government-affiliated agency, students of a specific school, and so forth. SOTRA private bus is the buses rent by SOTRA for designated users as aforementioned.

Table 2.23 Capacity and PCU Setting

Mode	Capacity	PCU
SOTRA ordinary Bus	70	2
SOTRA Coupled Bus	180	3
SOTRA Private Bus	70	2
SOTRA Express	70	2
Private Company Bus	70	2
Gbaka/ Small Bus	18	1.5
Woro-Woro	5	1
Water Bus	50	N/A

Source: JICA Study Team

7) Sampling

Sampling rate for the Public Transport OD Interview Survey was set as given in Table 2.24.

Table 2.24 Sampling Rate for Each Vehicle Type

Vehicle Type	Sampling Rate
Bus	20 % of the total boarding passengers at each surveyed bus stop
Water-Bus	20 % of the total boarding passengers at each surveyed water bus station

Source: JICA Study Team

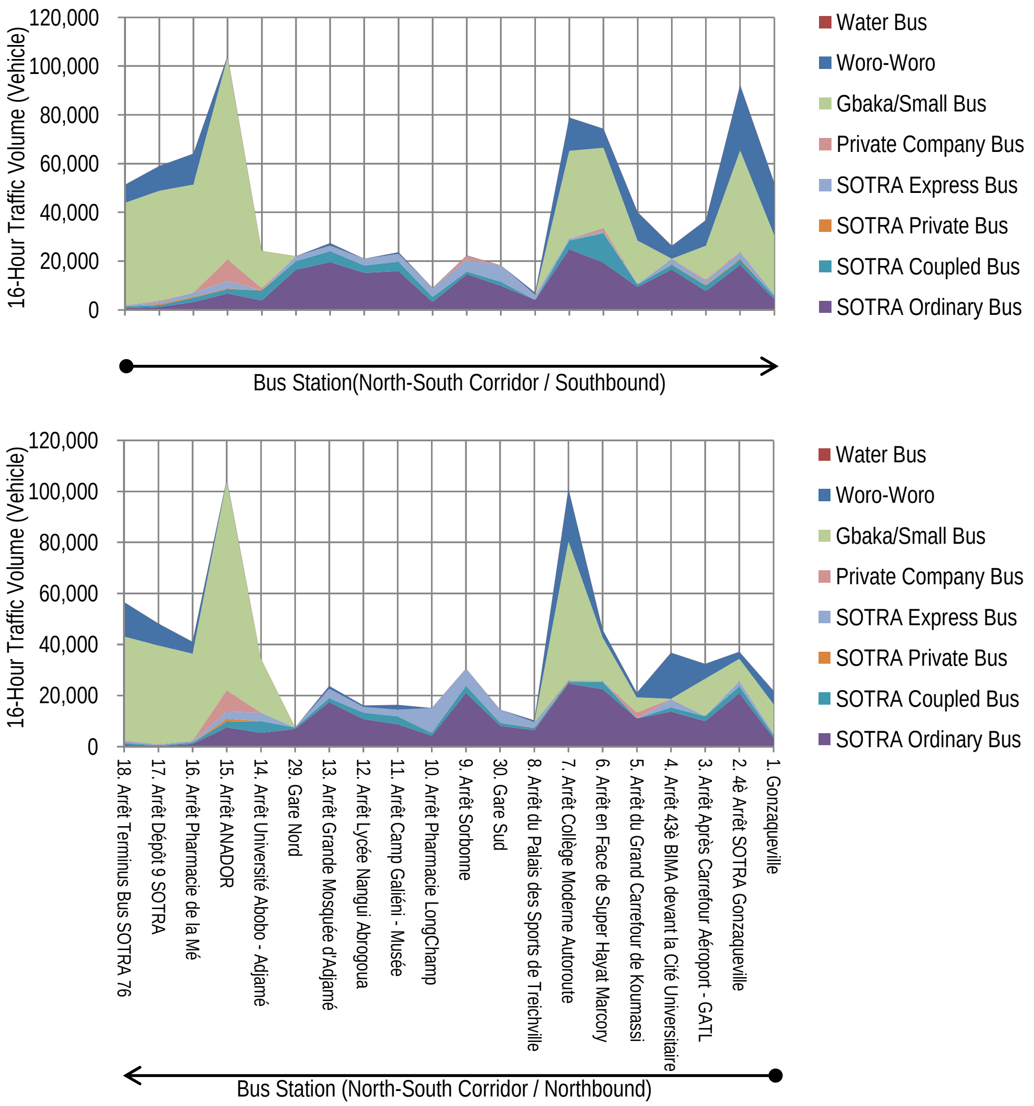
2.7.2 Survey Results

(1) Passenger Volume

Passenger volume in each section on the North-South Corridor was estimated from the number of vehicles multiplied by the average vehicle occupancy by direction. As shown in Figure 2.37, the share of SOTRA buses between Adjame and Plateau increased since Gbaka and Woro-Woro are not allowed to operate in this section. Larger passenger volume is observed in the northern part compared to that of the southern part, accounting for about 209,000 passengers/16-hour at No.15 (Arrêt ANADOR), where the dominance of Gbaka is greater than that of Woro-Woro since Gbaka carry a larger number of passengers compared to that of Woro-Woro. No.15 (Arrêt ANADOR), a relatively larger number of passengers were observed in private company buses, which are mainly composed of private companies such as bank and governmental agencies, since this location is used as a kind of transportation hub for public transport modes other than SOTRA bus. In that sense, the largest number of Gbaka/small bus passengers was also observed in this location among stations along with north-south corridor.

In the north-south corridor, the following facts are mainly found:

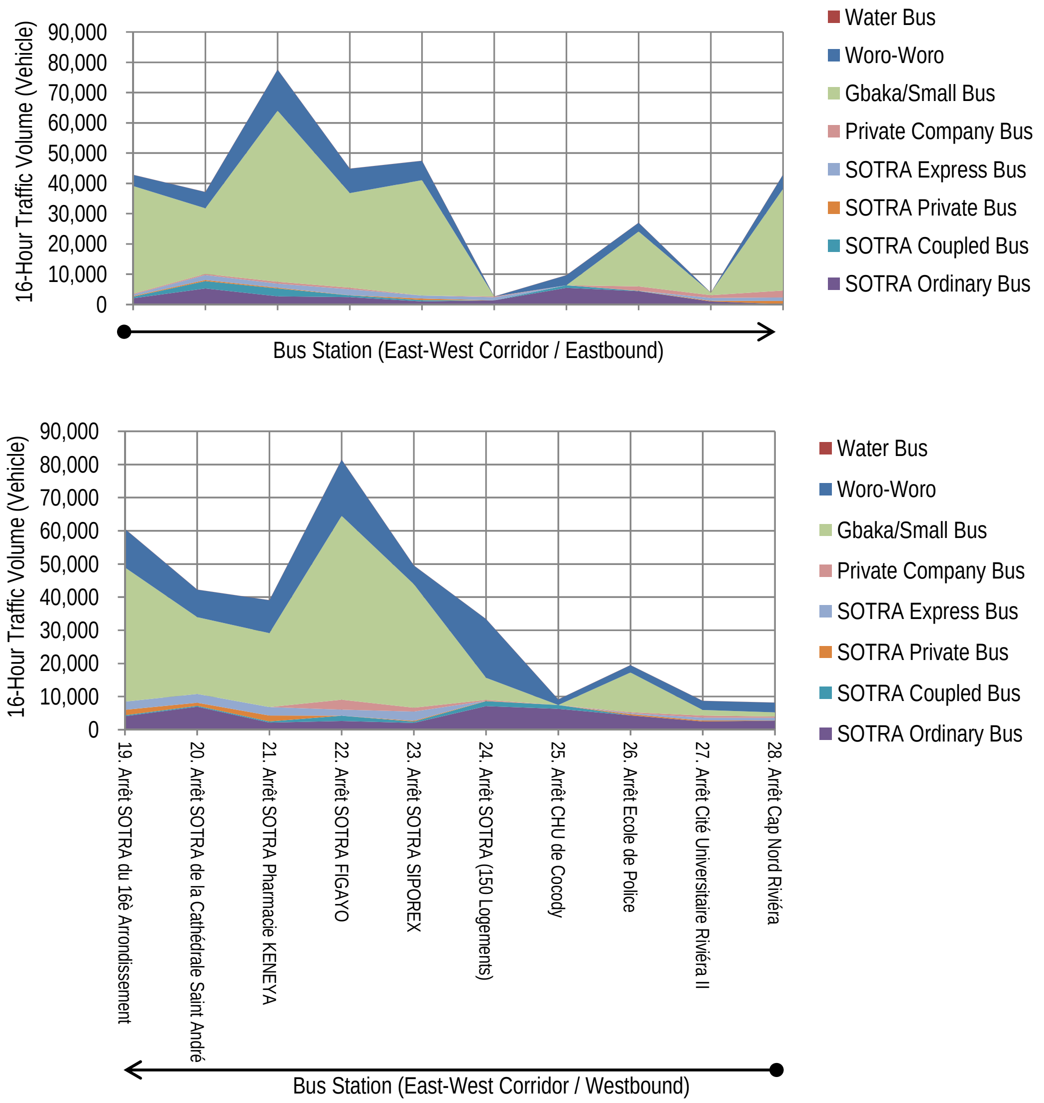
- Larger traffic volume of Woro-Woro is observed in the southern part;
- Highest passenger volume is observed in the northern part due to the high capacity of Gbaka; and
- SOTRA buses provide the means of transport in Adjame and Plateau due to lack of Gbaka and Woro-Woro in these communes.



Source: JICA Study Team

Figure 2.37 Estimated Passenger Volume on North-South Corridor

Estimated number of passengers on the East-West Corridor is shown in Figure 2.38. Compared to traffic volume, Gbaka dominates a larger part of passenger volume due to its large capacity compared to Woro-Woro. It can be said that the major part of traffic demand in the western part, that is Yopougon, is served by Gbaka.



Source: JICA Study Team

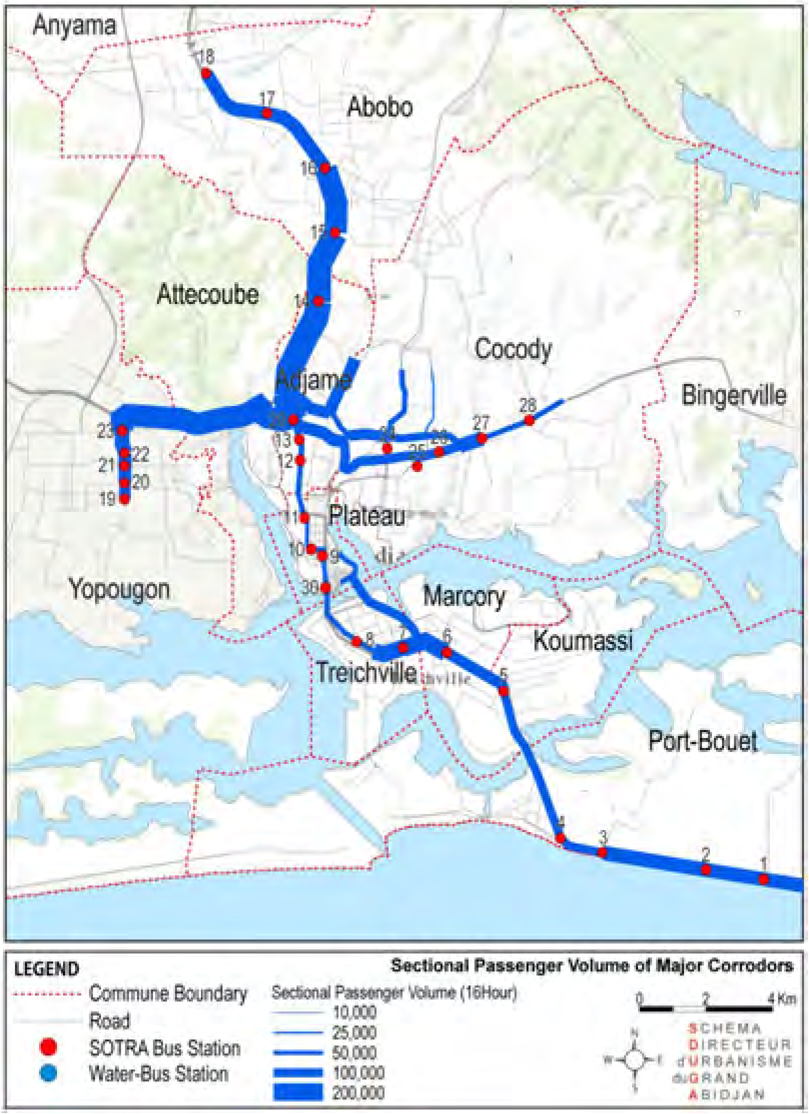
Figure 2.38 Estimated Passenger Volume on East-West Corridor

(2) Sectional Passenger Volume of North-South and East-West Corridors

Sectional passenger volumes of the north-south and east-west corridors are shown in Figure 2.39. To supplement this information, passenger volumes from other transport surveys, such as the screen line survey, were added to depict more accurate passenger flow since the location of this survey captures a part of the traffic flow from limited bus routes.

The largest sectional passenger volume is observed in the northern part of the north-south corridor between No.29 (Gare Nord) and No.14 (University Abobo - Adjame), accounting for more than 300,000 passengers in two directions, followed by the western part of the east-west corridor between No.23 (Siporex) and No.29 (Gare Nord) accounting for about 262,000 passengers in two directions. Passenger volume between No.29 (Gare Nord) and stations in Treichville is smaller than other sections, which may be due to traffic regulations for Gbaka and Woro-Woro. It should be noted that traffic passing through Boulevard de Gaulle and Boulevard de la Paix was not captured during the survey which may contain a part of the traffic diverged from major traffic corridors.

Passenger volumes in the eastern part and southern part are smaller than the other parts. The largest sectional passenger volume is estimated at about 200,000 passengers in two directions around Solibra intersection. It may be necessary to connect cross-strait transport in the north-south corridor to ensure connectivity across the lagoon.



Source: JICA Study Team

Figure 2.39 Sectional Passenger Volume

2.8 Parking Facility Survey

2.8.1 Introduction

(1) Objective

The objective of the survey is to determine the parking facility conditions, parking duration by purpose and other necessary data in the Greater Abidjan. The data obtained provides necessary information to consider parking plans and improvement schemes in this Study. The survey also intends to clarify any generation of trips at large-scale facilities and also count the number of persons entering and leaving the attached buildings every hour.

(2) Survey Location

The survey areas for the Parking Facility Survey are areas around large-scale facilities in Plateau. There are a total of 15 locations to be surveyed as shown in Table 2.25 and Figure 2.40.

Table 2.25 Survey Locations of Parking

Facility	No.	Survey Locations
Government Office Building	1	Tour C in Cite Administrative
	2	CCIA
	3	SCIAM
	4	Tour D in Cite Administrative
	5	Hotel de Ville (Government Office)
Private Office Building	6	Jeceda
	7	Pharmacie Long Champ
	8	Harmonie
	9	Nour Al Hyatt
	10	Nabil
Commercial Building	11	BICICI
	12	Hotel Ibis
	13	Super Trade Center
	14	Heveas
	15	SGBCI

Source: JICA Study Team

Source: JICA Study Team

Figure 2.40 Parking Facility Survey Locations

(3) Survey Methodology

1) Facility Survey

The following items were surveyed to obtain general information regarding each survey facility;

- Name of facilities and operating hours,
- Floor area and size/parking capacity by type,
- Average daily number of parked cars, and
- Tariff for parking.

2) Count Survey

The following items were surveyed to obtain the number of vehicles visiting and leaving the facilities;

- Number of entering and leaving vehicles at entrances and exits of the parking facilities every hour, and
- Number of persons entering and leaving the attached buildings every hour.

3) Interview Survey

An interview survey was conducted for the drivers of sampled parking vehicles during the survey period to ask about the following items when they are entering the parking facilities. Sampling rate of the interviews was targeted to exceed 20 percent of entering and leaving vehicles every hour. Items included in the interview during the survey were;

- Vehicle type,
- Visitor/worker,
- Purpose of parking and Parking duration (from what time to what time),
- Parking fee and its payer,
- Frequencies of using the facility,
- Problems with the parking facilities, and
- Origin of the trip.

4) Destination for parking and distance to destination (on-street parking only) and Survey Period

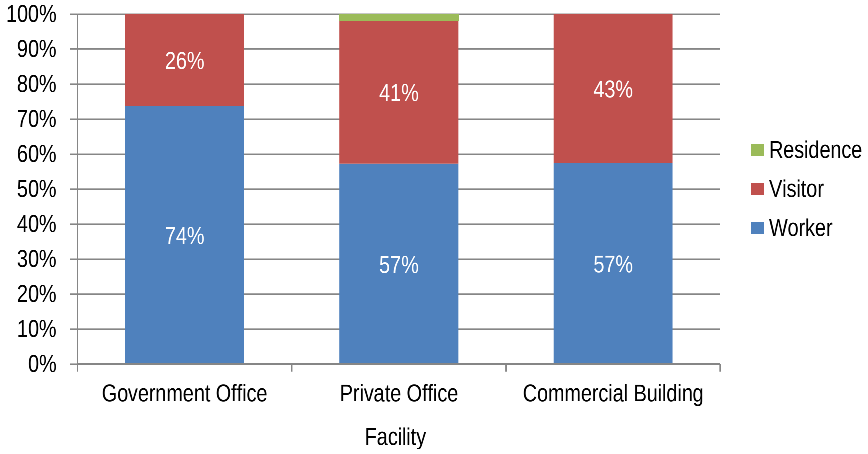
The Parking Facility Survey at each location was conducted on one weekday (Tuesday, Wednesday or Thursday) from 6:00 to 22:00.

2.8.2 Survey Results

(1) Parking Users' Profile

1) Status of Respondents

As shown in Figure 2.41, almost 74% of the respondents in government offices are workers in the facilities attached to the parking. As for private office buildings and commercial buildings, 41% and 43% of the respondents are visitors respectively.

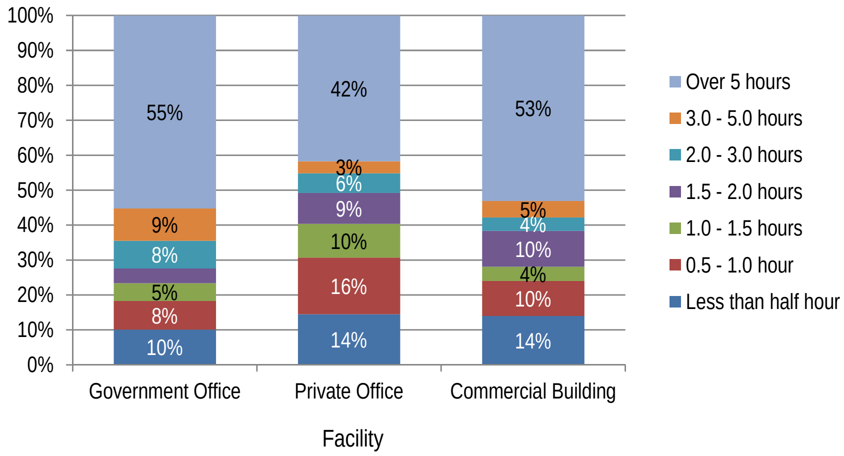


Source: JICA Study Team

Figure 2.41 Status of Respondents

2) Parking Duration

Almost of half of the respondents use the parking for over 5 hours in government offices and commercial buildings. Average parking durations are 3.6 hours by government office users, 2.8 hours by private office users and 3.3 hours by commercial building users (See Figure 2.42 and Figure 2.43 and Table 2.26), a slightly shorter duration is observed in private office users.



Source: JICA Study Team

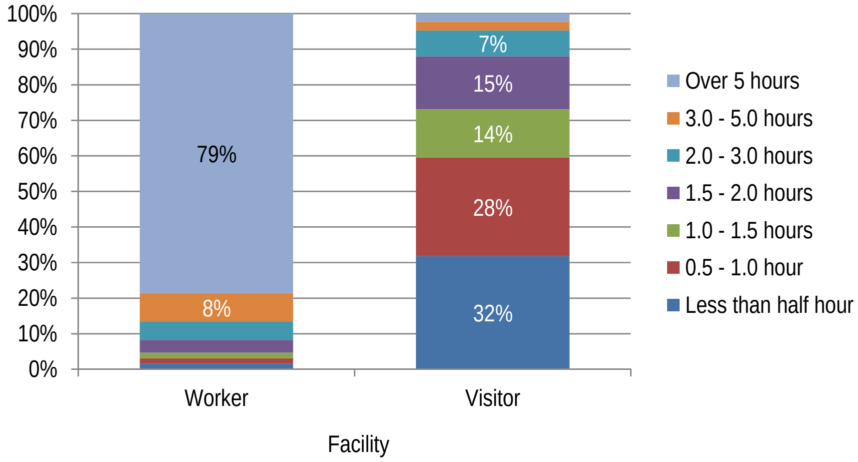
Figure 2.42 Parking Duration

Table 2.26 Average Parking Duration by Facility Type

Facility	Average Parking Duration (Hour)
Government Office	3.56
Private Office	2.80
Commercial Building	3.28

Source: JICA Study Team

Parking duration by the status of the respondent and by visiting purpose is shown in Figure 2.43. Naturally, average parking duration of workers is longer than that of visitors, likewise that of respondents that visited the facility from/to workplace or school.

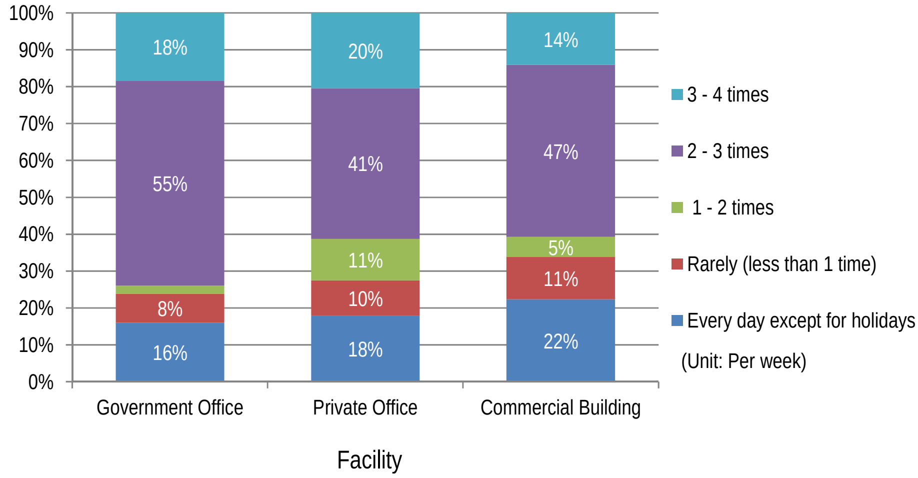


Source: JICA Study Team

Figure 2.43 Parking Duration by Status of Respondent

3) Frequency of Parking Use

Frequency of parking use is shown in Figure 2.44. The majority of usage frequency is two to three times per week, followed by every day except for holidays and more than five times.

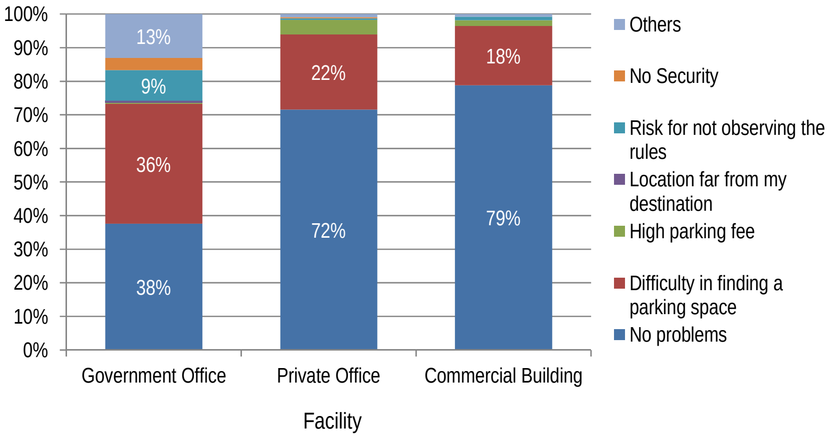


Source: JICA Study Team

Figure 2.44 Frequency of Parking Use

4) Problems with parking

Major problems with parking are typified by the difficulty in finding a parking space, accounting for 36% for government office users, 22% for private office users and 18% for commercial building users, which does not mean that there is a shortage of parking spaces but that there is a difficulty in finding access to parking. Some government office users, accounting for 36%, feel that their parking facilities should be provided with greater security (see Figure 2.45)

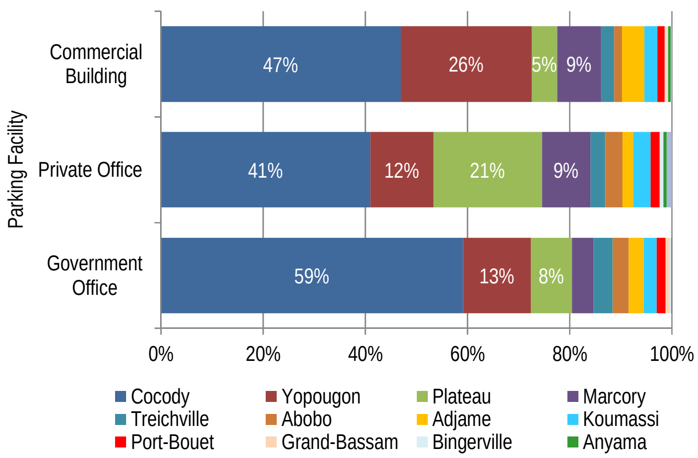


Source: JICA Study Team

Figure 2.45 Problems with Parking

5) Origin Communes

Origin communes of respondents are shown in Figure 2.46. For government office users, 59% came from Cocody, followed by users from Yopougon and Plateau, accounting for 13% and 8% respectively. For private office users, 41% of them came from Cocody, followed by Plateau and Yopougon, accounting for 21% and 12% respectively. For commercial building users, 47% of them came from Cocody, followed by Yopougon and Marcory, accounting for 26% and 9% respectively.



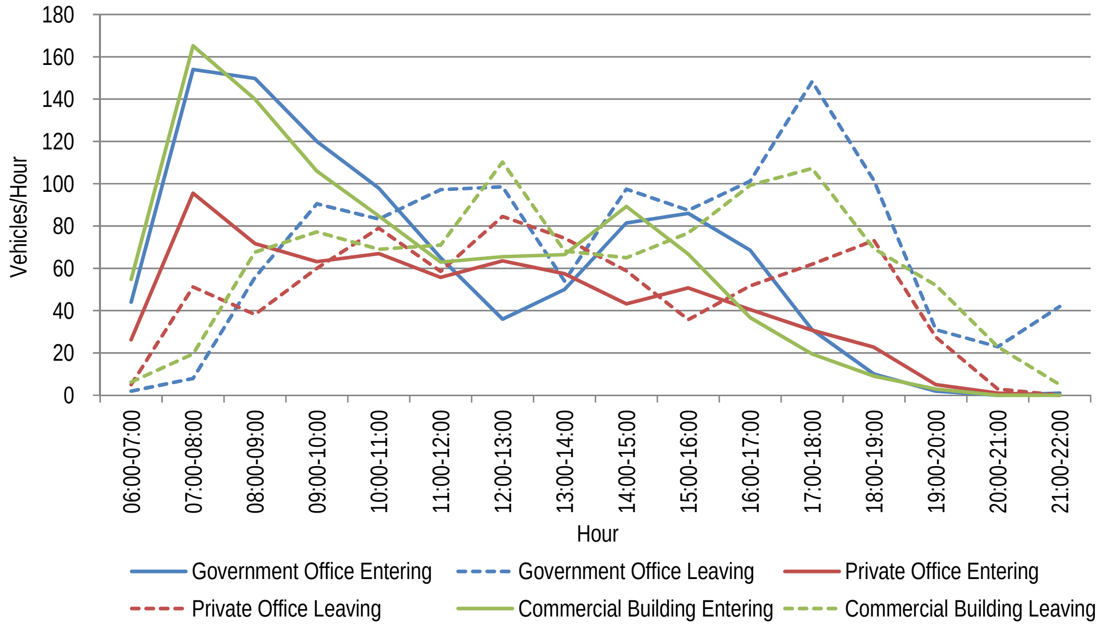
Source: JICA Study Team

Figure 2.46 Origin Communes by Facility Type

(4) Parking Demand

1) Entering/Leaving Vehicles

Peak parking use is high at governmental and commercial offices compared to that of private offices, probably due to the fixed working hours (see Figure 2.47). It also shows a clear difference in the number of vehicles between peak and off-peak hours compared to that of private offices. The number of leaving vehicles at Hotel de Ville suddenly increases at 22:00 which may be the closing time of the parking facilities. Peak hour of entering and leaving by facility type is shown in Table 2.27 indicating similar peak hours for all types of facilities.



Source: JICA Study Team

Figure 2.47 Entering/Leaving Vehicles by Facility Type

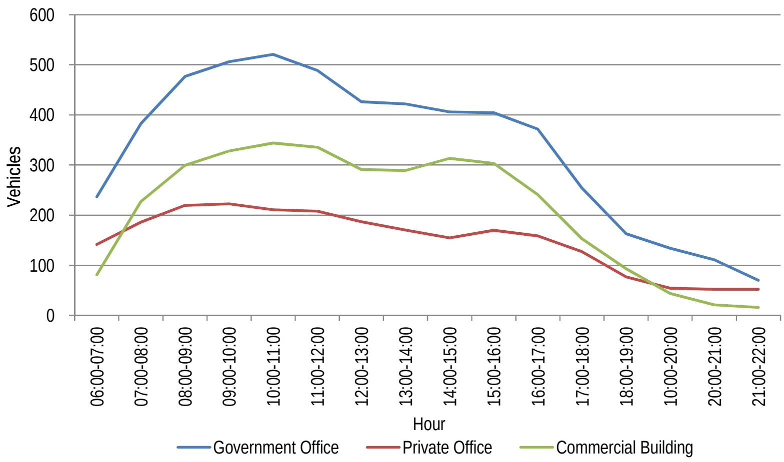
Table 2.27 Peak Hour of Entering/Leaving by Facility Type

Facility Type	Enter/Leave	Peak Hour
Government Office	Entering	07:00-08:00
	Leaving	17:00-18:00
Private Office	Entering	07:00-08:00
	Leaving	18:00-19:00
Commercial Building	Entering	07:00-08:00
	Leaving	17:00-18:00

Source: JICA Study Team

2) Parking Occupancy Ratio

The number of vehicles remaining each hour is calculated by comparing entering and leaving vehicles at the parking facility including the estimated number of vehicles that were in the parking facility before beginning to conduct the survey. Each facility type shows a similar pattern of the number of vehicles occupying the parking (see Figure 2.48). The percentage of vehicles remaining in peak hour compared to the total hourly number of vehicles remaining, defined as peak ratio, is shown in Table 2.28. Peak hours of which peak ratio exceeds 9.0% are observed during 9:00 – 12:00 at government offices indicating 9.7% (10:00 – 11:00) as its maximum, 8:00 – 10:00 at private office indicating 9.3% (9:00 – 10:00) as its maximum and 9:00 – 12:00 and 14:00 – 16:00 at commercial building indicating 10.2% (10:00 – 11:00) as its maximum.



Source: JICA Study Team

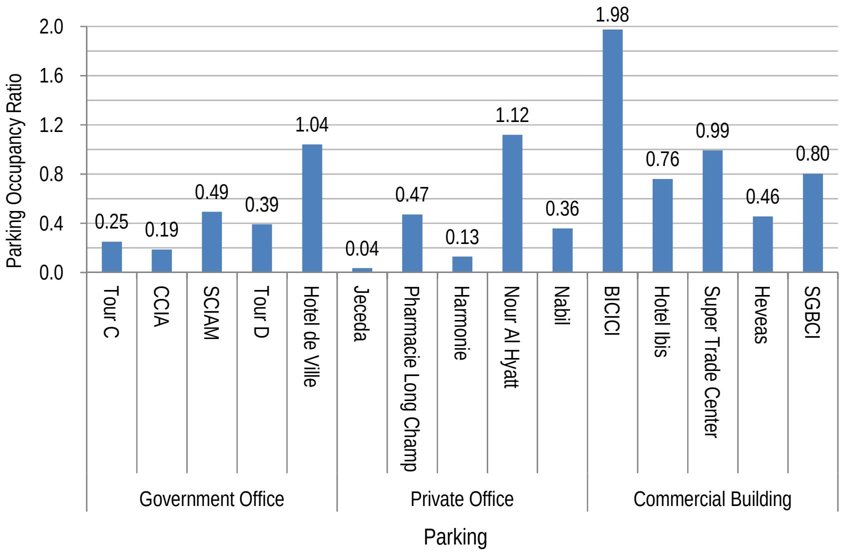
Figure 2.48 Vehicles Remaining by Facility Type

Table 2.28 Peak Ratio

Hour	Government Office	Private Office	Commercial Building
06:00-07:00	4.4%	5.9%	2.4%
07:00-08:00	7.1%	7.8%	6.7%
08:00-09:00	8.9%	9.2%	8.9%
09:00-10:00	9.4%	9.3%	9.7%
10:00-11:00	9.7%	8.8%	10.2%
11:00-12:00	9.1%	8.7%	9.9%
12:00-13:00	7.9%	7.8%	8.6%
13:00-14:00	7.9%	7.1%	8.6%
14:00-15:00	7.6%	6.5%	9.3%
15:00-16:00	7.5%	7.1%	9.0%
16:00-17:00	6.9%	6.6%	7.1%
17:00-18:00	4.7%	5.3%	4.5%
18:00-19:00	3.0%	3.2%	2.8%
10:00-20:00	2.5%	2.3%	1.3%
20:00-21:00	2.1%	2.2%	0.6%
21:00-22:00	1.3%	2.2%	0.5%

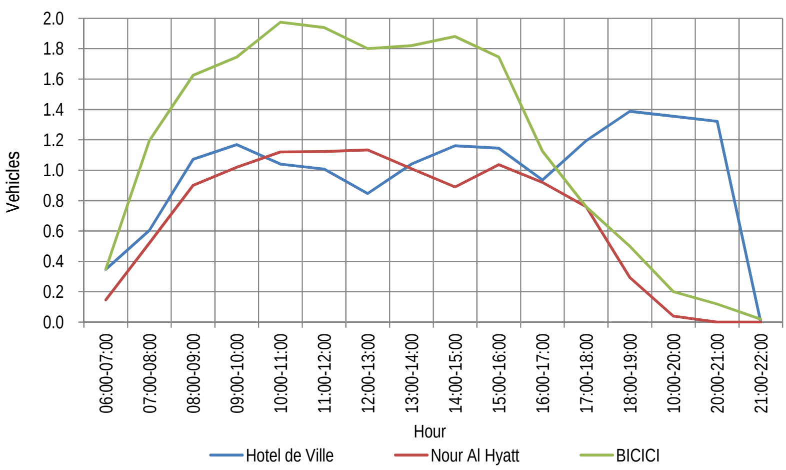
Note: Cells with peak ratio more than 9.0% are hatched
Source: JICA Study Team

Parking occupancy ratio in peak hour is calculated by dividing the number of remaining vehicles by parking capacities, roughly meaning that parking with the value more than 1.0 cannot allow proper use of the parking. As shown in Figure 2.49, high parking occupancy ratios exceeding 1.0 were observed in only three parking facilities in the designated area. However, it does not mean parking capacity is adequately provided in Plateau since illegal on-street parking occupying the carriage way is present throughout Plateau. BICICI shows an extensively high occupancy rate at 1.98, for which the reason is not clear since usage of this parking was strictly prohibited by the management. Hourly occupancy ratio is also shown in Figure 2.50, indicating that occupancy ratios show relatively higher values twice a day. In Hotel de Ville, hourly occupancy ratio exceeds 1.0 during 8:00 – 12:00, 13:00 – 16:00 and 17:00 – 21:00. In Nour Al Hyatt, it is observed during 9:00 – 14:00 and 15:00 – 16:00. In BICICI, it is observed during 7:00 – 17:00.



Source: JICA Study Team

Figure 2.49 Parking Occupancy Ratio in Peak Hour



Source: JICA Study Team

Figure 2.50 Distribution of Hourly Occupancy Ratio in Overloaded Parking Facilities

2.9 Transportation Opinion Survey

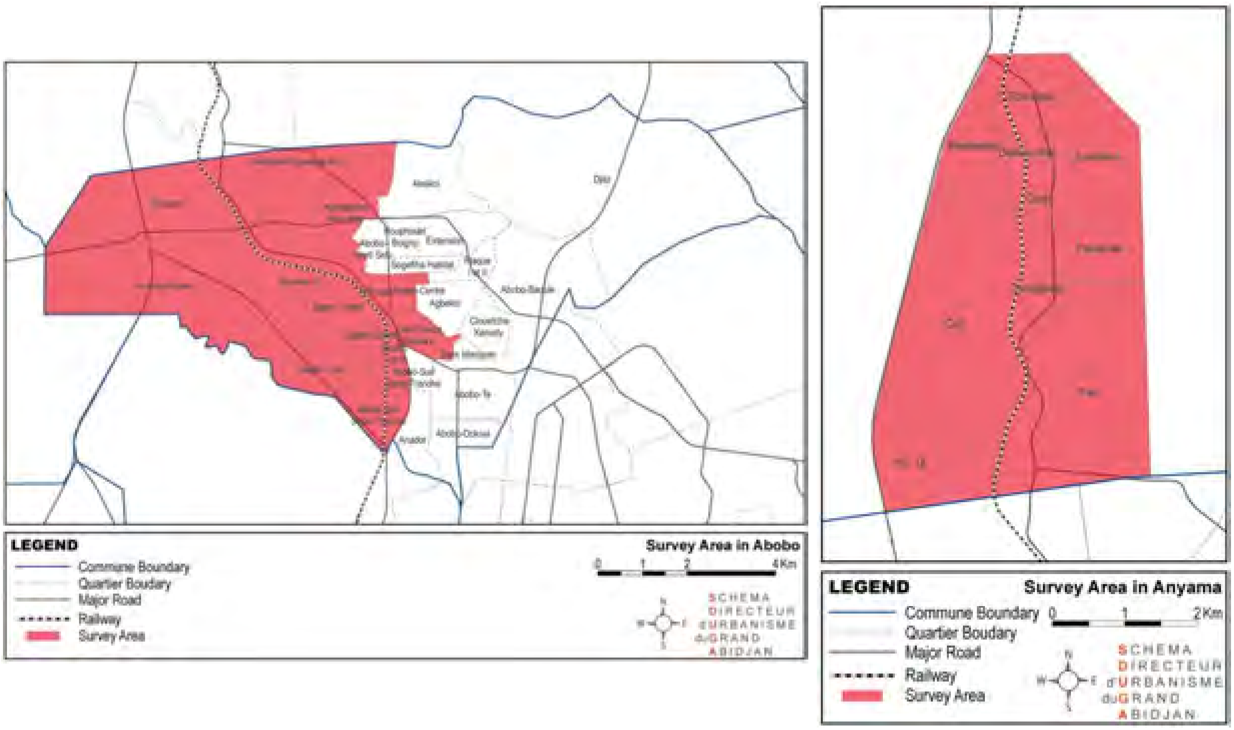
2.9.1 Introduction

(1) Objective

In order to estimate the demand for a new public transport system such as a commuter rail, the Transport Opinion Survey (TOS) was conducted to understand peoples' stated preference for selecting a particular transportation mode under hypothetical conditions which cannot be predicted through analysis of the existing trip data, and to develop a mode choice model.

(2) Survey Location

The Transport Opinion Survey was conducted in targeted quartiers along the future mass transit corridor (Anyama – Abobo – Port Bouet commuter railway) as illustrated in Figure 2.51.



Source: JICA Study Team

Figure 2.51 Survey Area of Transport Opinion Survey

(3) Sampling

The final targeted number of effective samples was assumed to be some 1,000 households (200 samples in Anyama and 800 samples in Abobo), which were randomly selected from quartiers along the targeted future mass transit corridor in Anyama and Abobo.

(4) Survey Method

Since the volume of questions is relatively large and the method of filling out the survey form is rather complicated, the survey was conducted by the "Leaving survey forms and Self filled in" method in the target quartiers, explaining the survey objective and the method for filling out the survey form, and asking the resident to fill it out. Respondents to the survey were basically all the members of the household aged 12 years or more.

(5) Survey Form

The major items contained in the questionnaire are shown below:

- Household Information,
- Address/contact number,
- Number of household members,
- Number of vehicles of the household by type,
- Type and ownership of living quarters,
- Electricity consumption,
- Monthly household income,
- Personal attributes,
  Social status: 1. Employer, 2. Employees (Industry:) 3. Student, pupils (Type of school:) 4. Housekeeper, 5. Retiree, 6. Others ( )
- Gender: 1. Male / 2. Female,
- Purpose of the target trip to travel to downtown (Plateau and Adjame),
  (Go to work, go to school, business, shopping, private matters)
- Type of facility at destination,
- Address of destination of the trip ( ),
- Transportation mode from the origin to the destination ,
  (conventional bus, minibus, taxi, passenger car, walk)
- If the trip involves travel by more than one mode, for instance, access or egress, then this information must be included as well,
- Travel time from the origin to the destination,
- The travel time should include access and egress time separately,
- Expected travel cost to the destination (if known),
- The travel cost should include access and egress cost separately,
- Preference for the planned mass transit under different conditions of fare and service settings,
  - For respondents living in Anyama, willingness to use the mass transit if the fare to downtown were 700/900/1,100 FCFA for a one way trip lasting 40 minutes;
  - For respondents living in Abobo, willingness to use the mass transit if the fare to downtown were 500/700/900 FCFA for a one way trip lasting 20 minutes; and
- Factors affecting behavioral choice on transport mode: transfers, travel time, reliability of travel time, affordability and amenities.

(6) Survey Period

The survey of the residents was carried out in the daytime and in the evening.

2.9.2 Survey Results

(1) Location of Respondent's Residence

Total number of sampled households is 1,000 which consist of 800 households from Abobo and 200 households from Anyama as shown in Table 2.29. Analysis in this survey is done only for respondents who visit downtown (Adjame or Plateau), accounting for 3,336 answerers.

Table 2.29 Survey Location of Transport Opinion Survey

Commune	Quartier	Households
Abobo		800
	112 Hectares	129
	Abobo Sud 2eme Tranche	57
	Abobo-Centre	43
	Agnissankoi Avocatier	115
	Agoueto	62
	Anonkoi	12
	Anonkoi Koute	56
	Avocatier N'Guessankoi	32
	Banco 1 et 2	79
	N'Ponon	46
	Sagbe-Centre	75
	Sagbe-Nord	37
	Sagbe-Sud	57
Anyama		200
	CEG	8
	Christiankoi	33
	Derriere Rail	12
	Gare	38
	Palmeraie	31
	PK 18	6
	Ran	11
	Residentiel	8
	Schneider	30
	Zossonkoi	23
Total		1,000

Source: JICA Study Team

(2) Trip Information

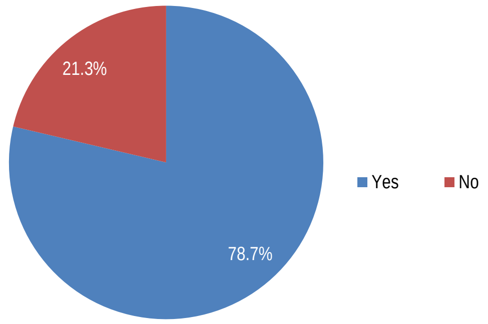
1) Samples

Total number of respondents is 4,240, about 79% of them visit downtown (Adjame or Plateau) at least once per month (see Table 2.30 and Figure 2.52).

Table 2.30 Number of Samples Visiting Downtown

Answer	Frequency	%
Yes	3,336	79%
No	904	21%
Total	4,240	100%

Source: JICA Study Team

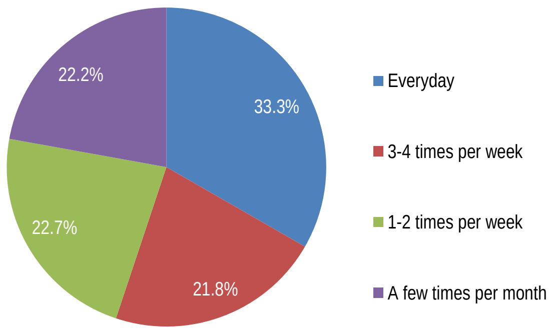


Source: JICA Study Team

Figure 2.52 Respondents Visiting Downtown

2) Frequency

Among respondents visiting downtown, 33% of the respondents visit downtown every day (see Figure 2.53), followed by those who visited downtown one to two times per week, a few times per month and three to four times per week respectively (see).

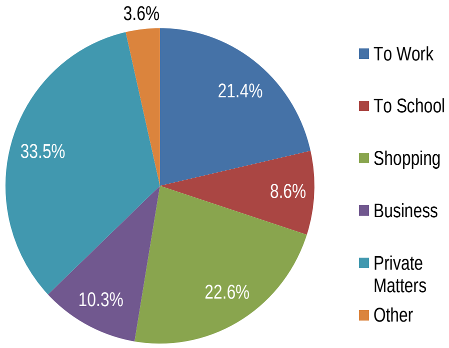


Source: JICA Study Team

Figure 2.53 Frequency of Visiting Downtown

3) Purpose

"Private Matters" takes the largest share of trip purpose among respondents going downtown, followed by "To Work", "Shopping", "Business" and "To School" trips, accounting for about 34%, 23%, 21%, 10% and 9% respectively (see Figure 2.54).

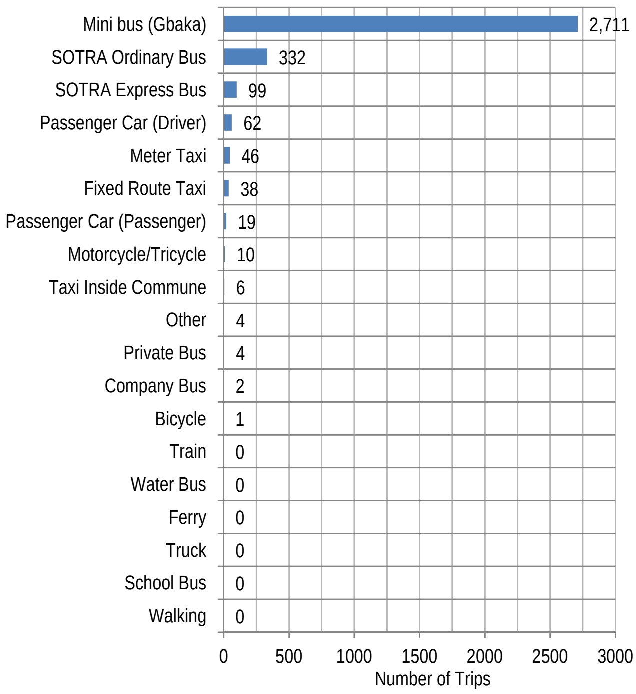


Source: JICA Study Team

Figure 2.54 Purpose of Trips (TOS)

4) Transport Mode

Transport mode is obviously dominated by Gbaka, accounting for about 81% of trips, followed by SOTRA buses (ordinary bus and express bus), accounting for about 13% of trips (see Figure 2.55). In other words, about 94% of trips are made by some public transport mode.



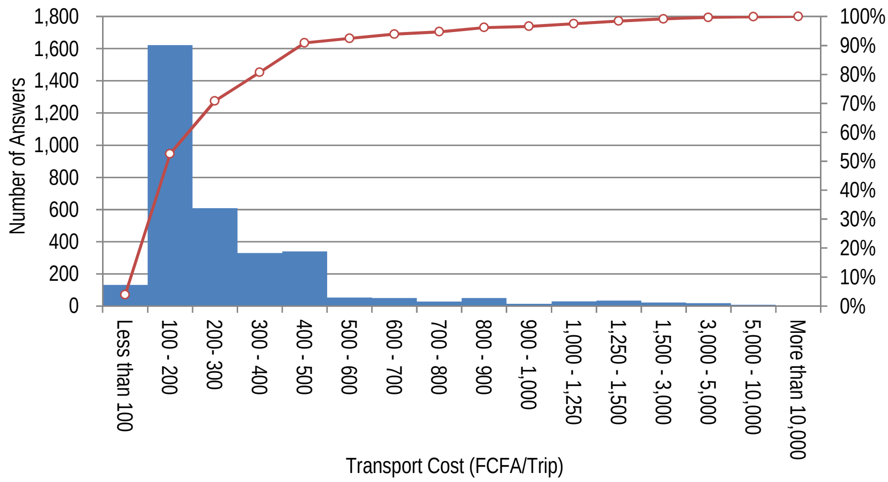
Source: JICA Study Team

Figure 2.55 Representative Transport Mode

(3) Transportation Expense to Travel to Downtown

1) Distribution

Distribution of transportation expense per trip to go to downtown is shown in Figure 2.56. About 49% of the respondents paid 100 – 200 FCFA for a trip the downtown and 90% paid less than 500 FCFA.

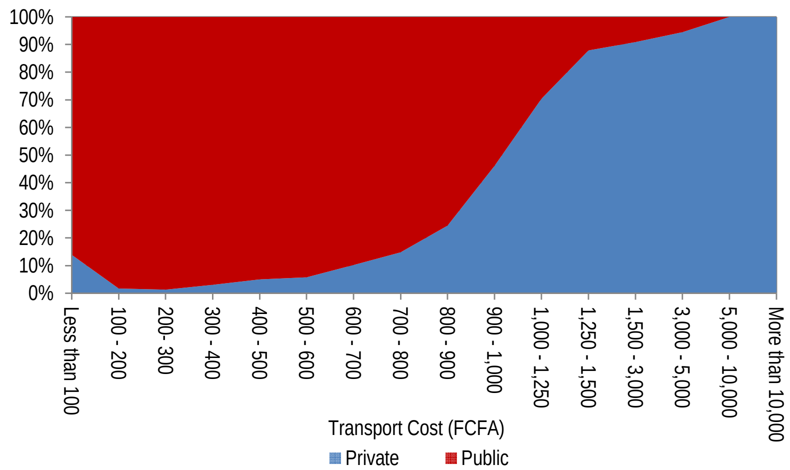


Source: JICA Study Team

Figure 2.56 Transportation Expense to Travel to Downtown

2) By Transport Mode

Share of private and public transportation by transportation expense is shown in Figure 2.57. It is obvious that the share of private transport increases as the cost rises.

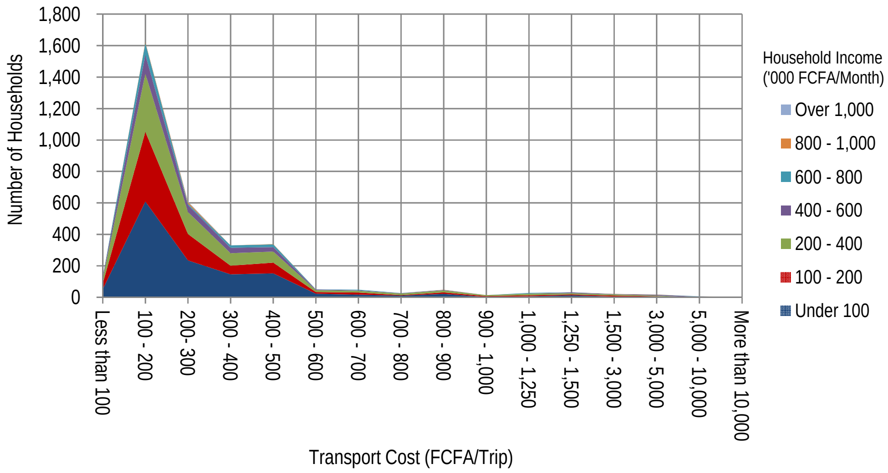


Source: JICA Study Team

Figure 2.57 Share of Private and Public Transport Modes by Transportation Expense

3) By Household Income

Transportation by household income is shown in Figure 2.58. Higher income households seem to spend more money for transport. However, the number of samples is not sufficient to properly show a relationship between these two factors.



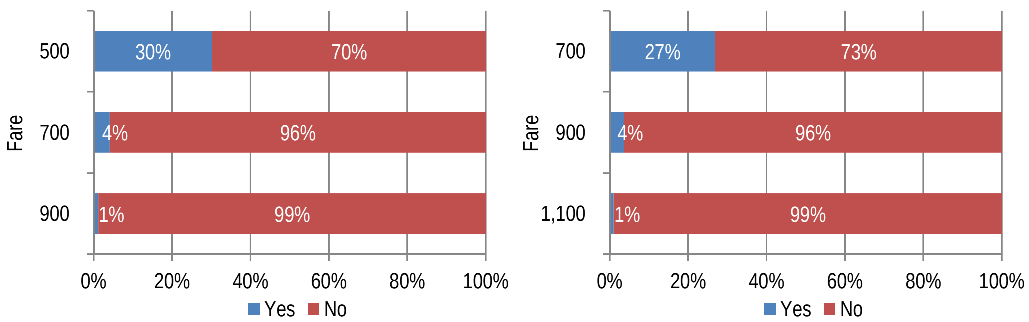
Source: JICA Study Team

Figure 2.58 Transportation Expense by Household Income Group

(4) Stated Preferences

1) Willingness to Use New Mass Transit

Willingness to pay for new mass transit is shown in Figure 2.59 (Left figure for Abobo and right for Anyama). The lowest fare is set based on current fee of public transport such as Gbaka and Woro-Woro. Respondents in both Abobo and Anyama show similar ratios in their answers, that is, about 30% of respondents going to downtown are willing to use new mass transit under the latest fare. However, it drastically decreases to about 4% under the middle fare and to about 1% under the highest fare. Among the respondents, 8 people (less than 1 % of the number of respondents that would pay a fare of 500 FCFA) living in Abobo said that they are totally unwilling to use mass transit and 26 of those living in Anyama (about 6% of the respondents that would pay a fare of 700 FCFA) said the same.

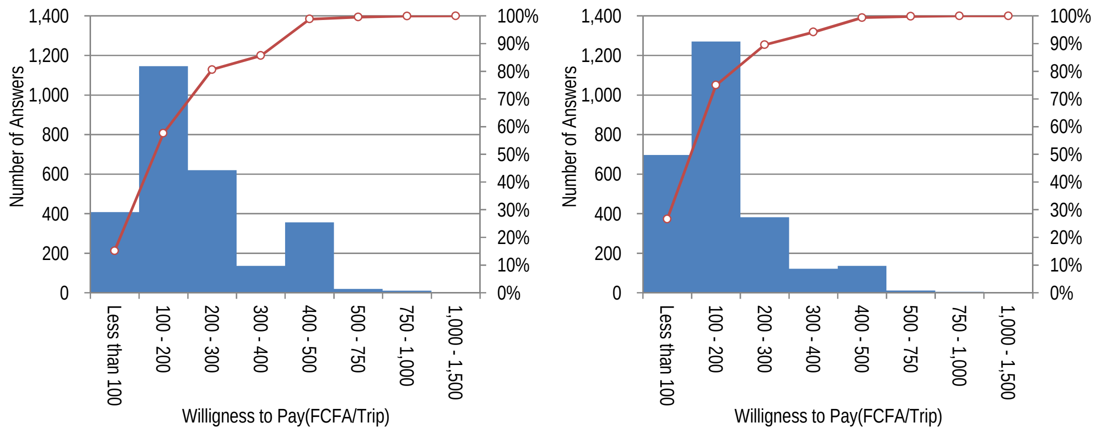


Source: JICA Study Team

Figure 2.59 Willingness to Use New Mass Transit (Left: Abobo / Right: Anyama)

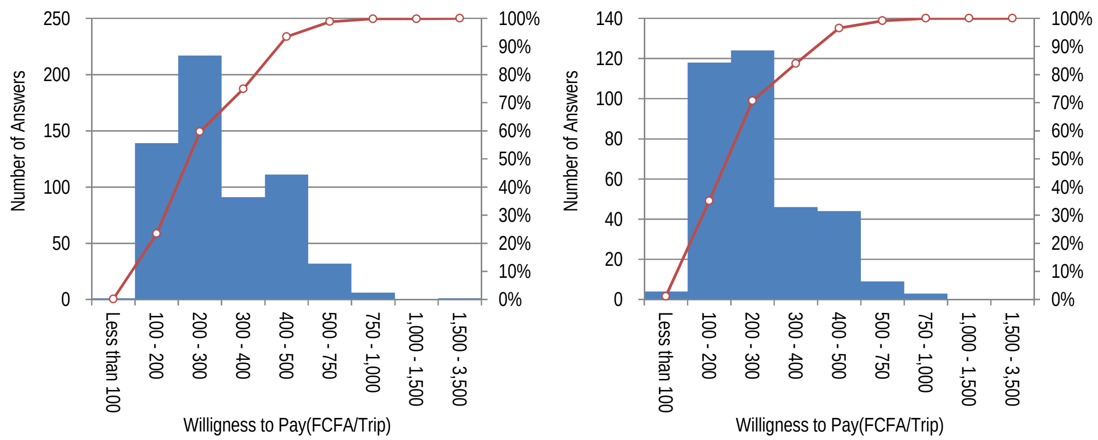
2) Willingness to Pay (WTP)

Willingness to pay for the new transit by travel time is shown in Figure 2.60 and Figure 2.61. Willingness to pay for 40 and 60 minute trips for respondents in Anyama and for 20 and 40 minute trips for respondents in Abobo does not show a significant difference between both groups. Average amount of willingness to pay for 20 minute (difference of WTP between 60 and 40 minutes for Anyama or 40 and 20 minutes for Abobo) is calculated as 308 FCFA/Hour[10] as hourly time value.



Source: JICA Study Team

Figure 2.60 Willingness to Pay of Respondents Living in Abobo (Left: 40 Minutes, Right: 60 Minutes)



Source: JICA Study Team

Figure 2.61 Willingness to Pay of Respondents Living in Anyama (Left: 40 Minutes, Right: 60 Minutes)

10 Total amount of difference in willingness to pay between 40 minute trips and 60 minute or 20 and 40 minute trips is divided by the total number of valid responses and converted to 60 minute value to calculate average hourly time value.

2.10 Travel Speed Survey

2.10.1 Introduction

(1) Objective

The main objective of the survey is to obtain information on the current road traffic situation and identify bottlenecks to traffic flow in the Greater Abidjan.

(2) Survey Routes

Totally, 12 survey routes were selected within the Greater Abidjan. The survey routes shown in Figure 2.62 and Figure 2.63 were finalized after the preliminary field survey and discussion with counterpart members. Routes 1 and 2 and some certain sections of other routes were omitted from the bus survey since SOTRA buses are not operated in the area.

Source: JICA Study Team

Figure 2.62 Survey Routes (Area of AAD)

Source: JICA Study Team

Figure 2.63 Survey Routes (Central Abidjan)

(3) Survey Method

1) Survey Tasks and Items

Within the scope of this Travel Speed Survey, the following activities were conducted.

i) Travel Time Survey for Private Vehicles

The survey was carried out to record the time needed by an average private vehicle to traverse sections of a specified route while at the same time collecting information on location, duration and cause of delays.

ii) Travel Time Survey for Buses

The survey was carried out to record the travel time in an average bus to traverse a specified bus route coinciding (either partially or fully) with the survey route.

2) Methodology

The survey for private vehicles was carried out via a moving observer method to observe the average vehicular speed on selected routes. Under this method, the drivers of test-cars were instructed to drive at the average speed of the general traffic flow.

The travel time recorder looks for specific check points indicated on the route map and records the cumulated time from the starting point using a stopwatch. Travel distance was recorded from the distance meter of the test-car. Another surveyor was instructed to record the stopped and slow times (less than 10km/h), i.e. the period for which the car is stationary or moving very slowly while in the survey route. Time for deceleration is not included in slow time. Slow time was recorded only when the test-car moved forward but there were still queues in front. At the same time, reasons for stops and slow were recorded by the surveyor.

3) Survey Day and Time

The travel speed survey on each route was conducted for two days on weekdays (Tuesday, Wednesday, or Thursday). For the same survey route, the bus survey and private vehicle survey were carried out on the same day. There are three measurement runs per route representing morning, noon and afternoon peak period traffic conditions.

4) Survey Forms

The following survey forms were utilized during the travel time survey:

· Form TSS-1; To record the travel time and travel delays

2.10.2 Survey Result

There is a considerable variation in travel times of private cars and buses depending on time, section length and general traffic condition. Table 2.31 summarizes the travel times and speeds on each survey route for morning and evening peak periods. It should be noted that travel conditions in Abidjan are changing rapidly and it tends to be difficult to obtain an unbiased sample of travel times.

In morning peak travel speed by private car, the lowest average travel speed was observed on Route 5 (Carrefour St Jacques - Carrefour Lavoisier), followed by Route 9 (Rd Gendamérie Abobo - Place de la République) and Route 2 (2ème Pont Yopougon - Poste à Péage), accounting for 21.2 km/h, 22.3 km/h and 26.4 km/h respectively. In evening peak, the lowest travel speed was observed on Route 10 (Carrefour Samake - Carrefour Solibra) at 9.3 km/h, followed by Route 5 (Carrefour St Jacques - Carrefour Lavoisier) and Route 6 (Carrefour Indénié - Centre de Santé Adjamé/Bingerville), accounting for 12.4 km/h and 21.3 km/h respectively.

Average travel speed of buses is comparatively slower than those of private car because the buses stop regularly at bus stations. In morning peak, the lowest average travel speed was observed at Route 5 (BMW - Petro Ivoire), followed by Routes 12 (Grands Moulins - Pont Vridi) and 4 (Samaké - Cité Biabou Washington), accounting for 11.7 km/h, 12.1 km/h and 14.9 km/h respectively. In evening peak, the lowest travel speed was also observed on Route 5 (Carrefour Samake - Carrefour Solibra) at 9.9 km/h, followed by Routes 3 (Rond Point Gendarmerie – Agripac) and 12 (Grands Moulins - Pont Vridi), accounting for 11.7 km/h and 12.4 km/h respectively.

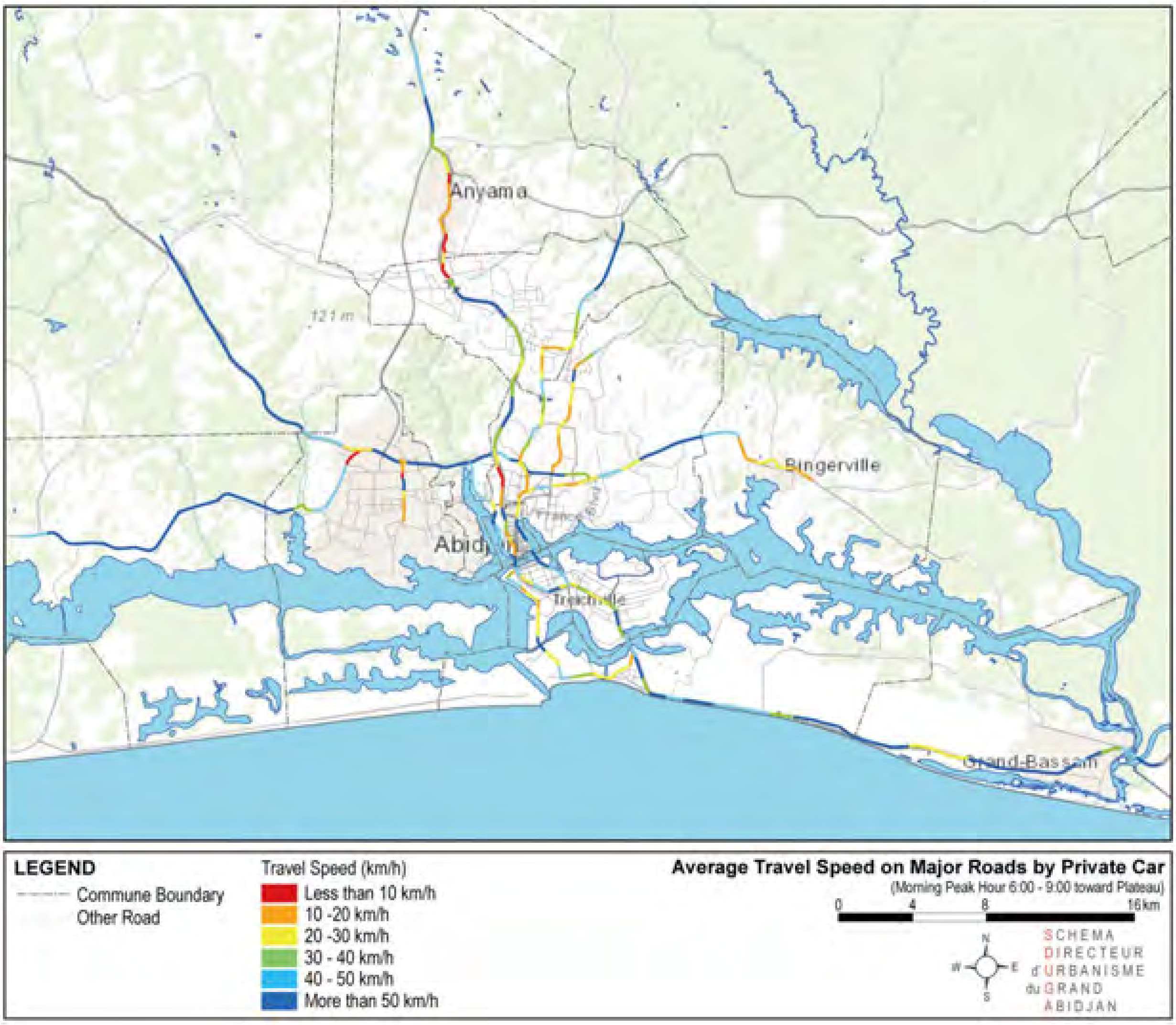
The results are illustrated in Figure 2.64 to Figure 2.69.

Table 2.31 Summary of Travel Speed Survey of Private Car

Route No.	Section	AM Peak toward Plateau			PM Peak from Plateau		
		Distance (Km)	Travel Time (Min)	Average Speed (Km/h)	Distance (Km)	Travel Time (Min)	Average Speed (Km/h)
Private Car							
1	Carrefour Gesco - Sortie Songon Agban (Pétro Oil)	21.7	26.7	48.8	21.7	25.7	50.7
2	2ème Pont Yopougon - Poste à Péage	19.6	18.9	62.2	19.6	25.0	47.0
3	Rd Point Gendamrie Abobo - Carrefour Adzopé/Agboville	18.0	40.9	26.4	17.8	36.3	29.4
4	Rd point Samake - Carrefour Débarcadaire	9.6	14.7	39.1	7.4	10.3	43.2
5	Carrefour St Jacques - Carrefour Lavoisier	7.2	20.4	21.2	7.2	34.8	12.4
6	Carrefour Indénié - Centre de Santé Adjamé/Bingerville	16.7	34.2	29.3	17.4	49.1	21.3
7	Station Akwaba - Carrefour Mondoukou	30.4	36.2	50.4	30.6	37.3	49.2
8	Carrefour Aanguidiba - Echangeur Ecole de Police	12.6	21.6	34.9	12.6	27.5	27.5
9	Rd Gendamérie Abobo - Place de la Répulique	12.9	34.7	22.3	12.9	31.0	25.0
10	Carrefour Samake - Carrefour Solibra	14.8	30.0	29.6	14.8	1.6	9.3
11	Manufacture Cuire - Fin Pt FHB	6.5	8.9	43.8	6.5	11.3	34.5
12	Sortie Pt FHB - Début Pt HB	20.8	41.4	30.1	20.8	40.9	30.5
Bus							
3	Rond Point Gendarmerie - Agripac	4.0	12.6	19.1	4.0	20.6	11.7
4	Samaké - Cité Biabou Washington	5.9	23.6	14.9	5.7	17.6	19.5
5	BMW - Petro Ivoire	5.5	28.1	11.7	5.6	33.7	9.9
6	Lycée Technique - Terminus Bingerville	16.6	33.9	29.4	11.4	18.4	37.2
7	Terminus Gonzagueville - Akwaba	9.0	31.7	17.1	7.2	26.6	16.2
8	Saguidiba - 160 Logements	19.9	28.2	42.3	10.0	26.8	22.5
9	Gendarmerie Abobo - Place de la Republique	13.3	46.4	17.1	13.4	53.6	15.0
10	Samaké - Carrefour Solibra	13.5	21.6	37.5	14.0	37.7	22.4
11	Carrefour Banco - Fin Pont FHB	6.5	21.7	18.0	6.5	21.8	17.9
12	Grands Moulins - Pont Vridi	17.6	87.0	12.1	14.1	68.4	12.4

Note: Routes 1 to 3 are out of the operational area of SOTRA Buses

Source: JICA Study Team

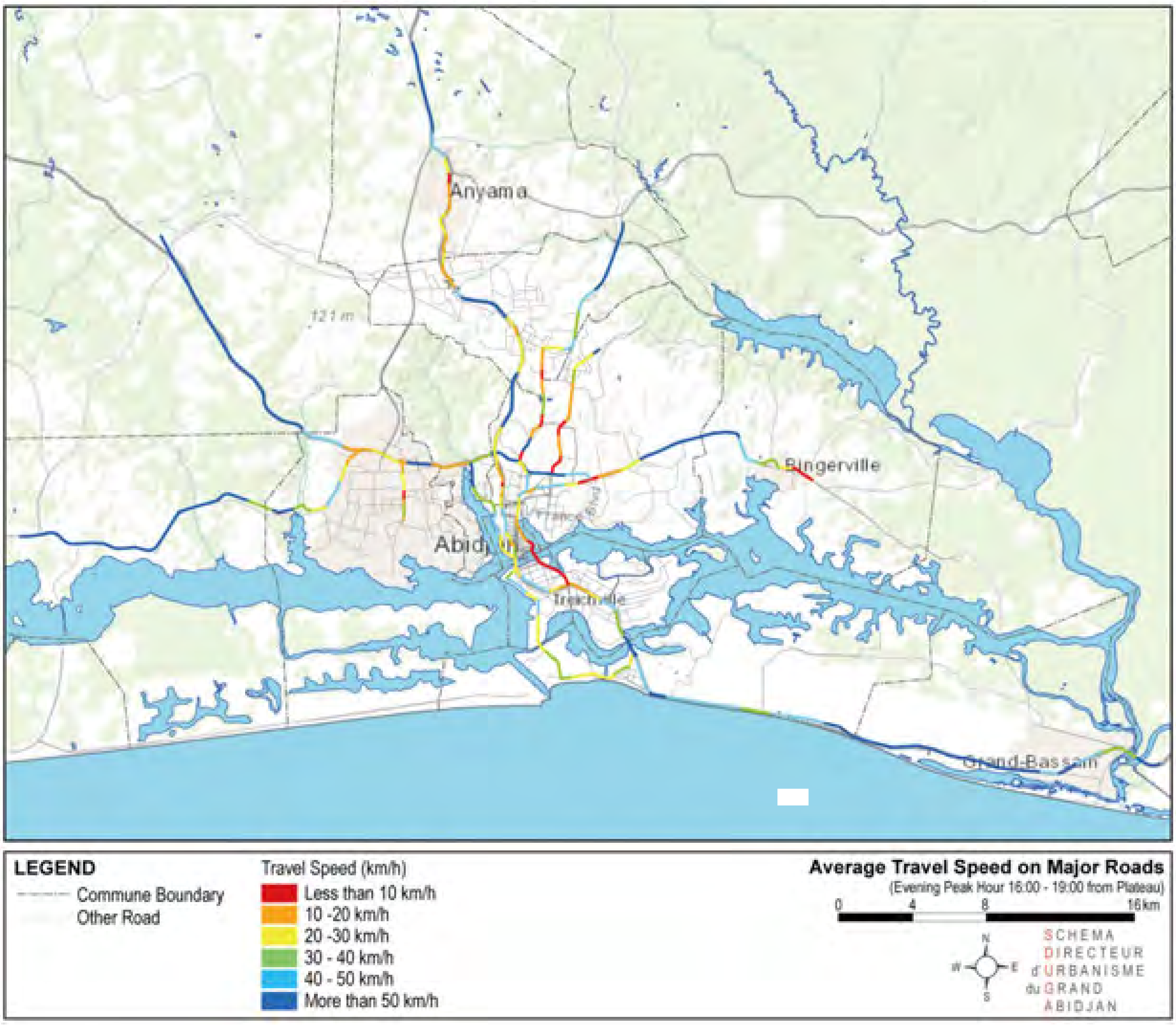


Source: JICA Study Team

Figure 2.64 Travel Speed in Morning Peak by Private Car (1/2)

Source: JICA Study Team

Figure 2.65 Travel Speed in Morning Peak by Private Car (2/2)



Source: JICA Study Team

Figure 2.66 Travel Speed in Evening Peak by Private Car (1/2)

Source: JICA Study Team

Figure 2.67 Travel Speed in Evening Peak by Private Car (2/2)

Source: JICA Study Team

Figure 2.68 Travel Speed in Morning Peak by Bus

Source: JICA Study Team

Figure 2.69 Travel Speed in Evening Peak by Bus

2.11 Cargo Transport Survey

2.11.1 Introduction

(1) Objective

The main objective of the Cargo Transport Survey is to understand movement and volume of present cargo transport within the Survey Area in order to create truck OD matrices.

(2) Type of Survey

Within the scope of the survey, the following two activities were conducted;

- Truck vehicle count

Truck vehicle count survey was carried out to record the number of trucks at observation sites over a 16-hour period.

- Truck OD interview

Truck OD interview survey was carried out to observe the vehicular trip characteristics (origin-destination, carrying commodity, etc.) of trucks through a sampling procedure.

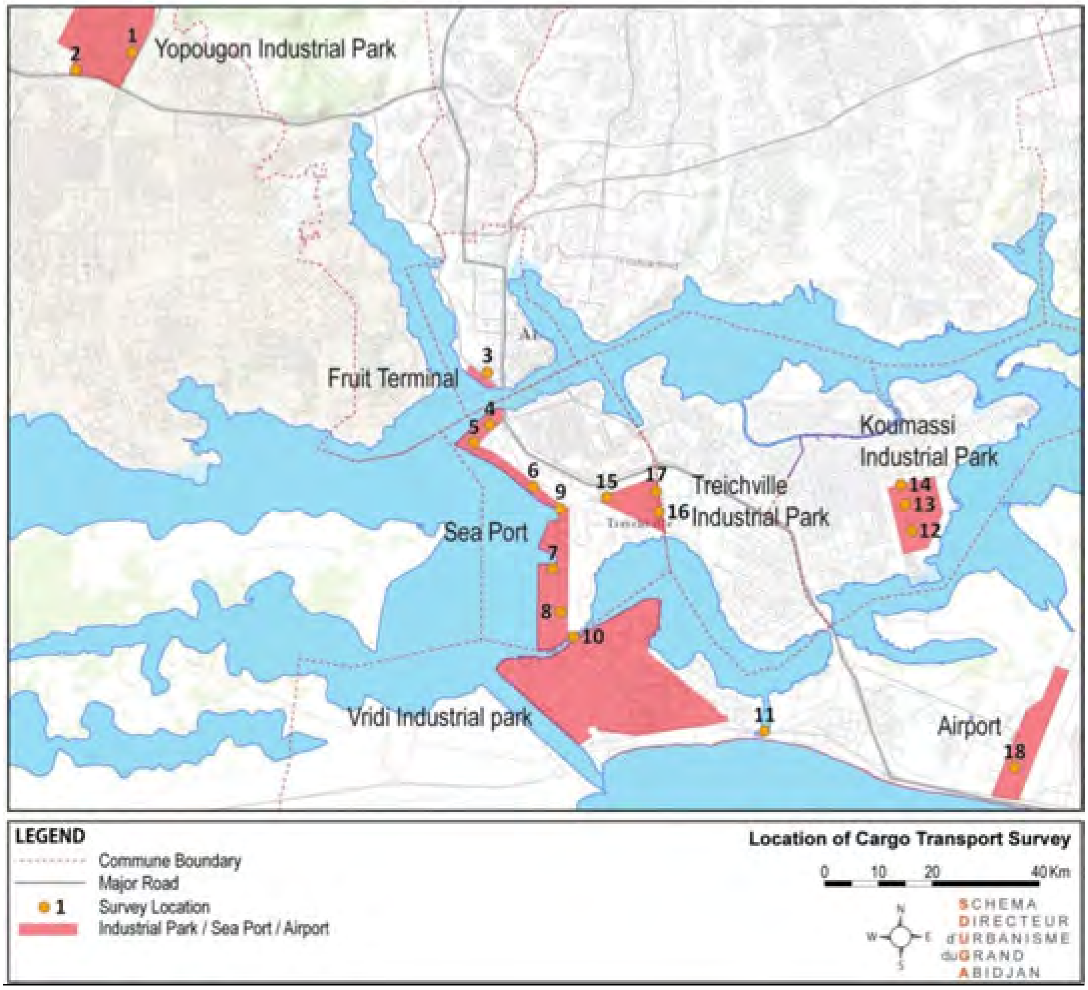
(3) Survey Locations

The survey locations, which are the major logistic facilities within the Survey Area, are given in Table 2.32 and Figure 2.70 where inbound/outbound trucks to/from the industrial parks were captured.

Table 2.32 Survey Locations for Cargo Transport Survey

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Facility</th><th rowspan="2">Survey Location</th><th colspan="2">Duration</th></tr>
<tr><th>OD Interview</th><th>Traffic Count</th></tr>
<tr><td>1</td><td>Yopougon Industrial Park</td><td>2 Gates (No.1-2) including Yopougon truck terminal</td><td>16h</td><td rowspan="7">24h</td></tr>
<tr><td>2</td><td>Fruit Terminal</td><td>1 Gate (No. 3)</td><td>24h</td></tr>
<tr><td>3</td><td>Sea Port</td><td>6 Gates (No.4-9) including container terminal and fishing port</td><td>24h</td></tr>
<tr><td>4</td><td>Vridi Industrial Park</td><td>2 Gates (No.10-11)</td><td>16h</td></tr>
<tr><td>5</td><td>Koumassi Industrial Park</td><td>3 Gates (No.12-14)</td><td>16h</td></tr>
<tr><td>6</td><td>Treichville Industrial Park</td><td>3 Gates (No.15-17)</td><td>16h</td></tr>
<tr><td>7</td><td>Felix Houphouet Boigny International Airport</td><td>1 Gate (No.18) beside cargo terminal</td><td>24h</td></tr>
</table>

Source: JICA Study Team



Source: JICA Study Team

Figure 2.70 Survey Locations for Cargo Transport Survey

(4) Survey Methodology

1) Vehicle types

Vehicle types for the Cordon Line Survey are classified into five categories as shown in Table 2.33.

Table 2.33 Vehicle Type

Type	Vehicle Type	Remark
1	Small Truck	Lightweight truck, pick-up truck less than 5 tons
2	Small Truck	Lightweight truck 5 – 10 tons
3	Medium Truck	2 axles
4	Large Truck	More than 2 axles
5	Trailer	Semi-trailer with a tractor unit

Note: Type 1 and 2 are aggregated as Small Truck in the analysis
Source: JICA Study Team

2) Survey Method

The following items were recorded during each of the survey activities;

- Passenger car & truck count

  Surveyors continuously counted the number of vehicles by vehicle type and by direction. The number of all passing trucks was recorded on the survey sheet every hour at the gates in each facility.

- Truck OD interview

  Truck type, loading condition, commodity, origin and destination were included in the interview.

3) Survey day and duration

The cargo transport survey was conducted for one weekday. The survey was conducted for 24 hours for counting and 16 or 24 hour for interviewing.

(4) Survey forms

The following survey forms were utilized during the cargo transport survey

- Form CTS-1: to record hourly count of passenger cars and trucks; and,
- Form CTS-2: to record trip characteristics by interview

The following items were included in the interview;

- Vehicle type,
- Origin/destination,
- Facility of origin/destination,
- Type of loading commodity,
- Loading condition, and
- Terminal of the cargo.

2.11.2 Survey Results

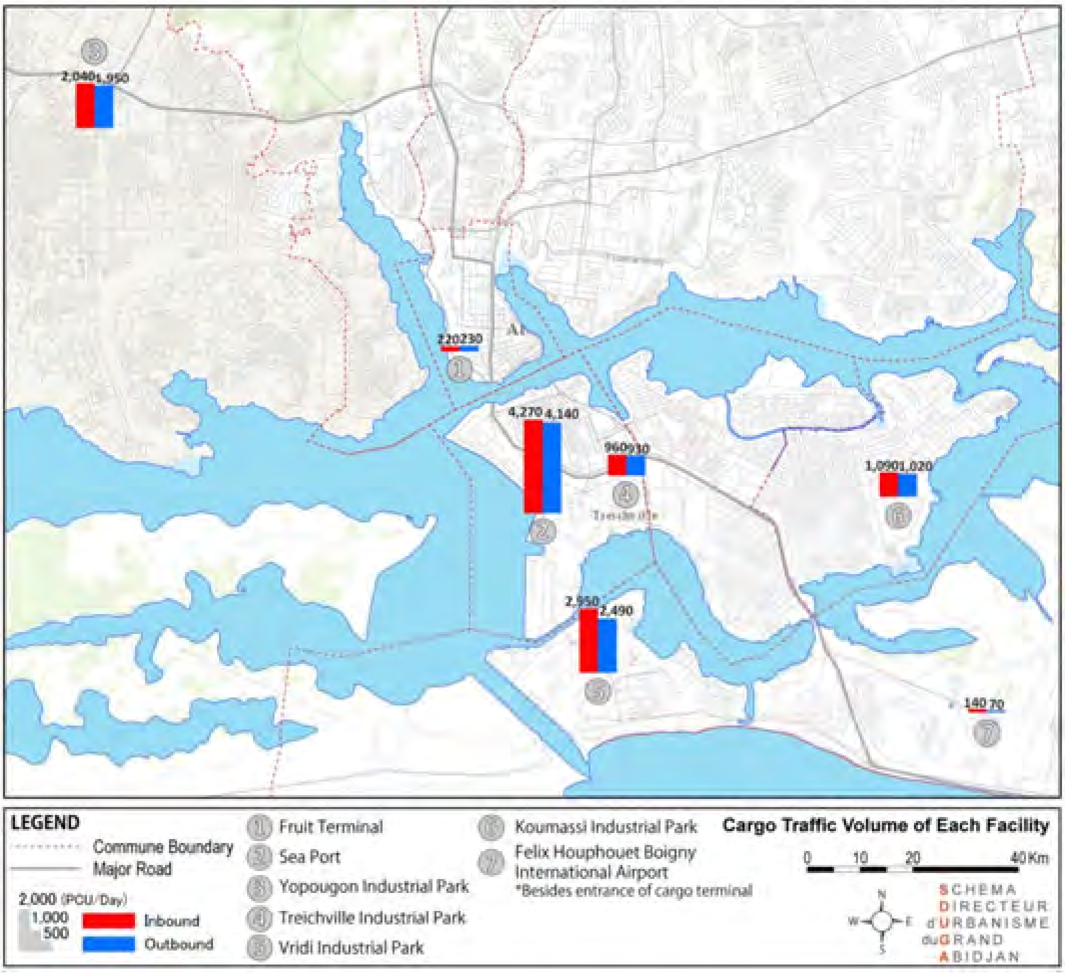
(1) Traffic Volume

Traffic count survey data was collected for 24 hours at each survey location. The largest truck traffic volume was observed at the sea port, accounting for about 8,400 PCU/day for the total inbound/outbound traffic observed at each gate, followed by Vridi industrial park and Yopougon industrial park, accounting for about 5,400 PCU/day and about 4,000 PCU/day respectively (see Table 2.34 and Figure 2.71). It should be noted that a certain amount of through traffic is included in Vridi industrial park since its location spreads extensively along Boulevard de Petit Bassam, which connects the sea port area in Treichville and the airport.

Table 2.34 Traffic Volume by Truck Type (PCU)

Facility		Direction	Truck Type					
			Small Truck (< 5t)	Small Truck (< 10t)	Medium Truck	Larger Truck	Trailer	Total
1	Yopougon Industrial Park	Inbound	458	372	316	850	48	2044
		Outbound	465	253	322	866	45	1951
		Both	923	625	638	1716	93	3995
			23.1%	15.6%	16.0%	43.0%	2.3%	100.0%
2	Fruit Terminal	Inbound	18	5	6	178	12	219
		Outbound	20	6	10	166	30	232
		Both	38	11	16	344	42	451
			8.4%	2.4%	3.5%	76.3%	9.3%	100.0%
3	Sea Port	Inbound	138	346	122	3094	567	4267
		Outbound	199	334	128	2974	507	4142
		Both	337	680	250	6068	1074	8409
			4.0%	8.1%	3.0%	72.2%	12.8%	100.0%
4	Vridi Industrial Park	Inbound	371	305	654	1138	480	2948
		Outbound	313	241	490	1120	321	2485
		Both	684	546	1144	2258	801	5433
			12.6%	10.0%	21.1%	41.6%	14.7%	100.0%
5	Koumassi Industrial Park	Inbound	368	168	376	146	27	1085
		Outbound	327	223	272	154	45	1021
		Both	695	391	648	300	72	2106
			33.0%	18.6%	30.8%	14.2%	3.4%	100.0%
6	Treichville Industrial Park	Inbound	370	159	76	292	66	963
		Outbound	413	114	58	302	45	932
		Both	783	273	134	594	111	1895
			41.3%	14.4%	7.1%	31.3%	5.9%	100.0%
7	Felix Houphouet Boigny International Airport	Inbound	98	13	22	2	0	135
		Outbound	33	25	8	0	0	66
		Both	131	38	30	2	0	201
			65.2%	18.9%	14.9%	1.0%	0.0%	100.0%
Total		Inbound	1821	1368	1572	5700	1200	11661
		Outbound	1770	1196	1288	5582	993	10829
		Both	3591	2564	2860	11282	2193	22490
			16.0%	11.4%	12.7%	50.2%	9.8%	100.0%

Source: JICA Study Team

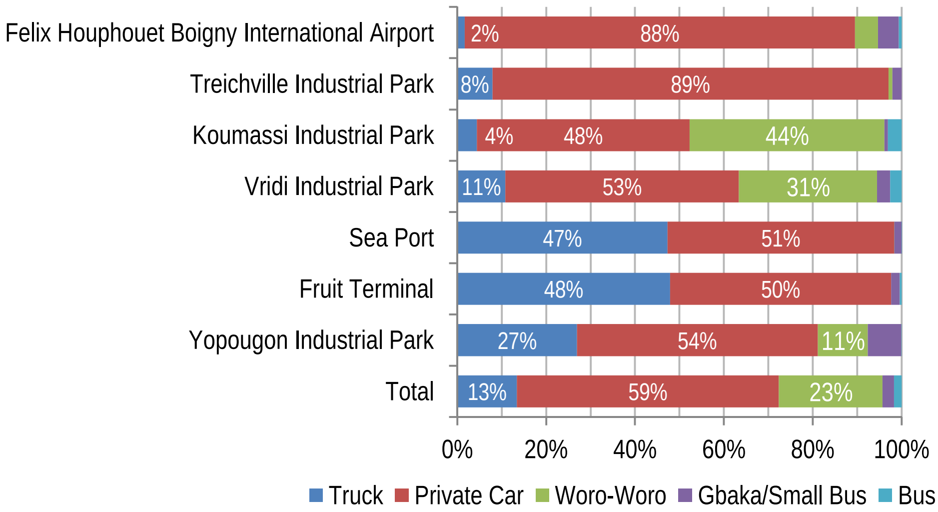


Source: JICA Study Team

Figure 2.71 Truck Traffic Volume by Facility

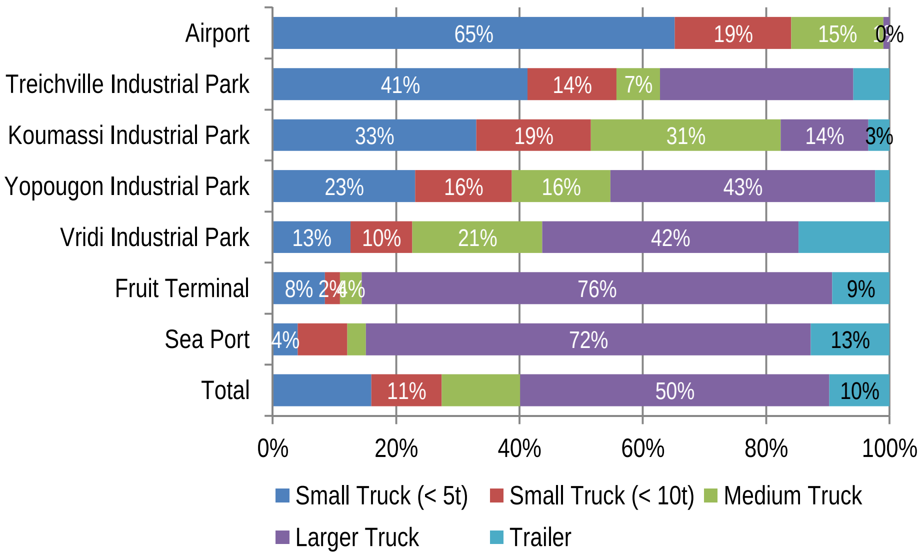
(2) Vehicle Composition

Large portions of small and medium trucks were observed at the industrial parks. The share of trucks is also shown in Figure 2.72, indicating that a large portion of trucks, almost half of its share, were observed only at the sea port and fruit terminal and followed by Yopougon industrial park, accounting for about 27%. Vehicle composition at each facility is shown in Figure 2.73. Large truck dominates almost half of cargo traffic in total. The largest portion of large truck was observed at the fruit terminal followed by the sea port, accounting for 76% and 72% respectively.



Source: JICA Study Team

Figure 2.72 Vehicle Composition by Facility (PCU)



Source: JICA Study Team

Figure 2.73 Truck Composition by Facility (PCU)

(3) Trip Production/Attraction and Traffic Flow

The estimated number of truck trips between communes are shown in Figure 2.74, indicating that the largest traffic volume is observed around the port area and a portion of trucks go to/come from Anyama.

Source: JICA Study Team

Figure 2.74 Desire Line of Trucks

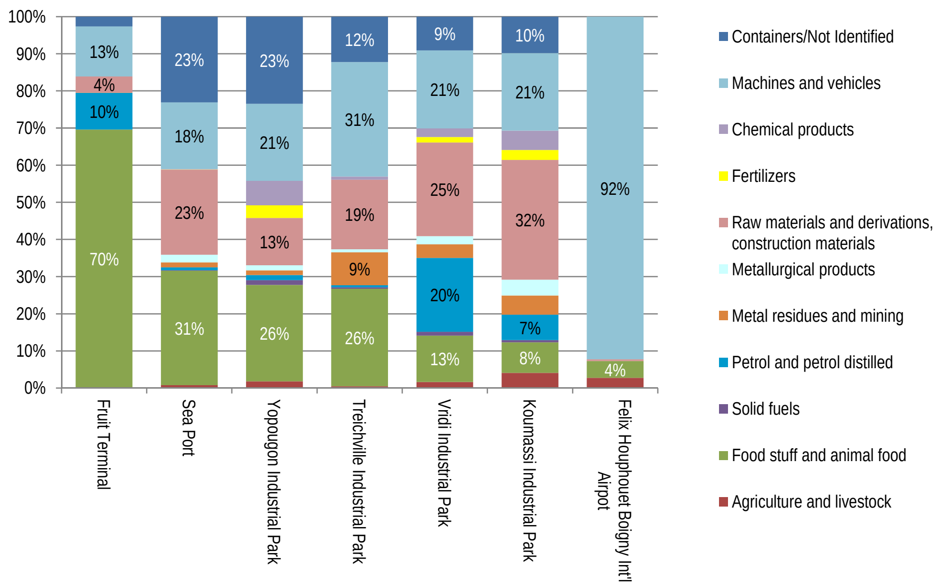
(4) Characteristics of Cargo Transport

1) Commodities

The shares of commodities carried to/from each facility are shown in Figure 2.75. Naturally, a high portion of food stuff is dominant in the fruit terminal, accounting for about 70%, followed by the sea port, and Yopougon and Treichville industrial parks, of which shares are accounting for about 31%, 26% and 26% respectively. The highest share of raw materials is observed at Koumassi industrial park, accounting for 32%, followed by Vridi industrial park and the sea port, of which shares are about 25% and 23% respectively.

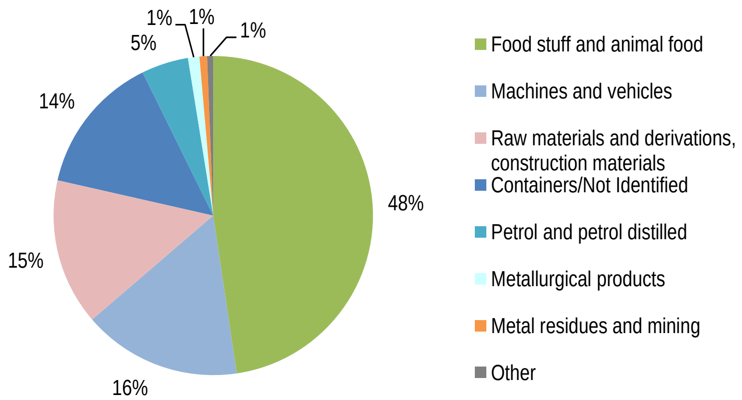
Commodities observed in the port (sea port and fruit terminal), those transferred by railway mainly to the sea port provided by SITARAIL and shipped commodities information provided by Abidjan Port Authority are shown in Figure 2.77 to Figure 2.78. According to the survey result (see Figure 2.76), the largest share of commodities is taken by food stuff and animal food, accounting for about 48%, followed by machines and vehicles, raw materials, derivations and construction materials, and containers/not identified, of which shares are about 16%, 15% and 14% respectively. On the other hand, as for share of commodities transferred by railway, the second and third largest shares are taken by containers, and petrol and petrol distilled, accounting for about 29% and 23% respectively. It may be because railway tends to be used for carrying petrol and containers, whereas trucks tend to be used for carrying machines, raw and construction materials. According to Abidjan Port Authority, the largest share of shipped commodities is taken by petrol and petrol distilled, accounting for about 41%, followed by containers (39%) and food stuff and animal food (10%). It shows high percentage of petrol and petrol distilled and containers compared to others. It may be due to the following reasons:

- The survey result (Figure 2.76) is tabulated in vehicle and others (Figure 2.77 and Figure 2.78) are in tonnage;
- Some petrol and petrol distilled are transported from the port to oil storage base via petroleum pipeline; or
- Some loaded/unloaded containers are kept in the port.



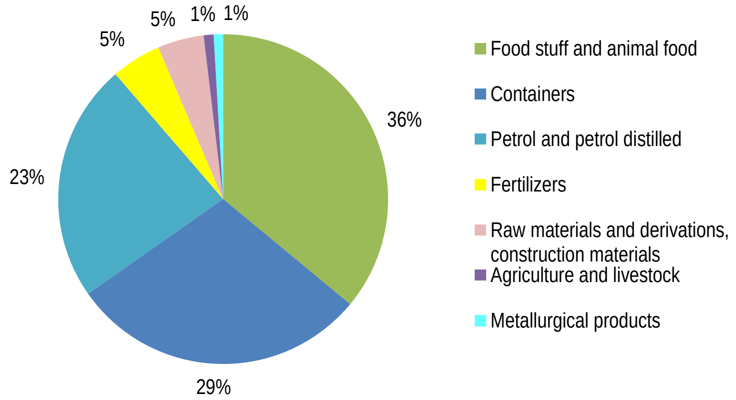
Source: JICA Study Team

Figure 2.75 Commodities Carried to/from Each Facility in Vehicle



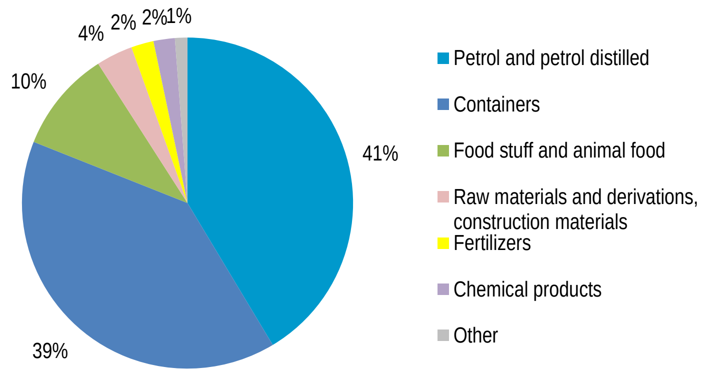
Source: JICA Study Team

Figure 2.76 Composition of Commodities Carried to/from Port by Trucks in Vehicle (Sea Port and Fruit Terminal)



Source: SITARAIL

Figure 2.77 Composition of Commodities Carried to/from Port by Railway in Tonnage

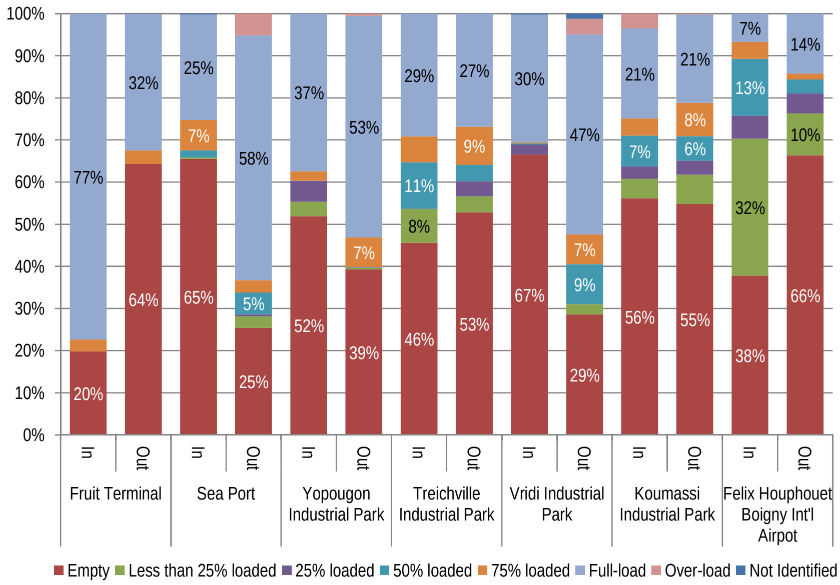


Source: Abidjan Port Authority

Figure 2.78 Composition of Commodities Loaded/Unloaded at the Port in Tonnage

2) Loading Condition

Loading condition of inbound and outbound trucks is shown in Figure 2.79. The major part of empty outbound trucks is observed in the fruit terminal and the airport whereas that of inbound trucks is observed in the sea port, Yopougon industrial park and Vridi industrial park. The share of empty trucks in both directions is high in Koumassi and Treichville industrial parks.

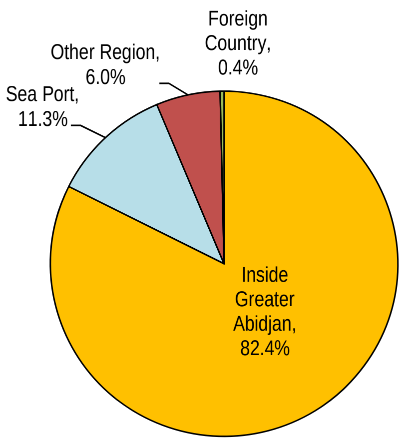


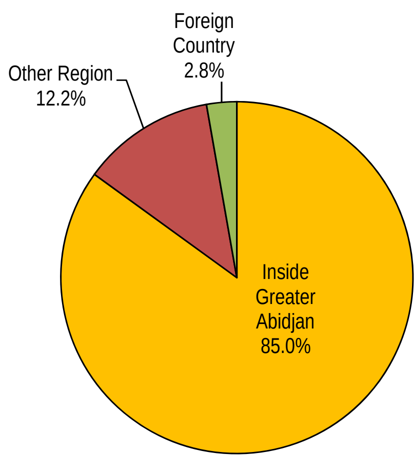
Source: JICA Study Team

Figure 2.79 Loading Condition of Inbound/Outbound Trucks

(5) Distribution of Trucks

Distribution of trucks to/from industrial parks and the sea port is shown in Figure 2.80. Distribution inside Greater Abidjan is dominant in both groups, accounting for about 82% and about 85% respectively. As for the industrial parks, about 11% of trucks are related to the sea port, about 6% to other regions and only about 0.4% to foreign countries. On the other hand, about 12% of inbound/outbound trucks at the ports are related to other regions and about 3% to foreign countries.





Source: JICA Study Team

Figure 2.80 Distribution of Trucks
(Left: To/from Industrial Park, Right: To/from Sea Port, Fruit Terminal and Airport)

2.12 Road Inventory Survey

2.12.1 Introduction

(1) Survey Objective

Road characteristics should normally be obtained from existing digital road inventory data. However, preliminary discussions with concerned agencies have revealed that the limited existing road inventory data alone cannot provide a sufficient level of network detail for the project. The road inventory is a basic database for understanding existing road infrastructure, as well as for any proposed future plans.

The objective of the Road Inventory Survey is to identify the characteristics of the road network to contribute to the network building required in the development of a transport model for the project, so that the model should be able to reflect the real road network conditions as much as possible.

This survey was implemented within Greater Abidjan, which is defined as the area containing 19 communes, namely, Abobo, Attecoube, Yopougon, Adjame, Plateau, Cocody, Koumassi, Marcory, Treichville, Port-Bouet, Bingerville, Anyama, Songon, Alepe, Dabou, Jacqueville, Bonoua, Grand-Bassam and Azaguie. These communes are subdivided into some 377 quartiers.

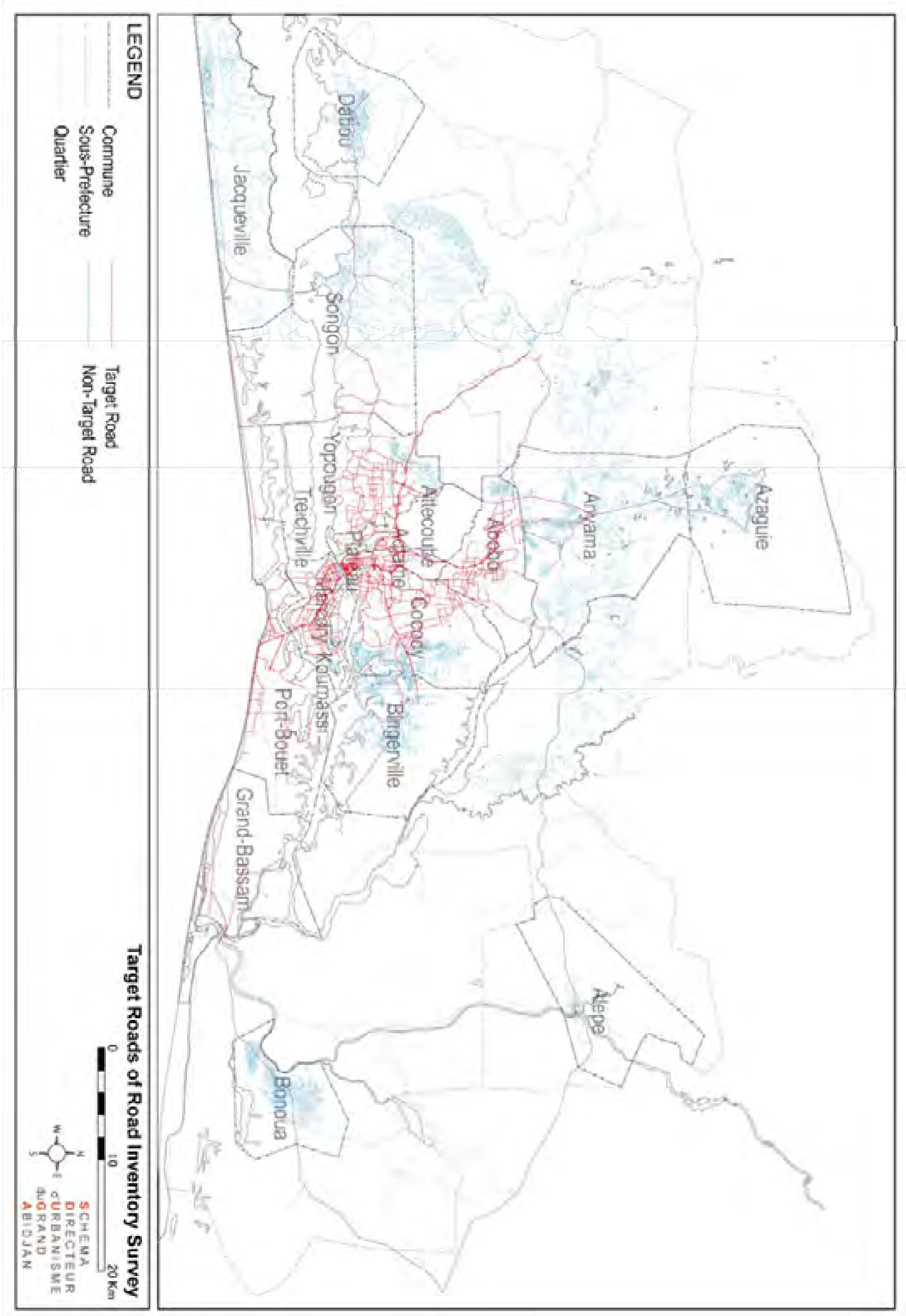
(2) Survey Locations

1) Selection of Target Roads

As stated earlier, the survey extent is defined by the 19 communes and some major roads connecting the survey area with the surrounding regions. Survey roads are i) Road Divided by median, ii) all roads in Plateau and iii) Roads that link all 377 quartiers to each other.

2) Target Roads

To meet the requirements above, the target roads are shown in Figure 2.81, of which the total length is about 1,020 km.



Source: JICA Study Team

Figure 2.81 Target Roads of Road Inventory Survey

(3) Data Collection

1) Survey Items

The following data was required for each road link by direction:

- Connecting nodes on both ends,
- Side friction level caused by roadside activities (level 1: high, level 2: medium, level 3: low, to be defined by the Consultant),
- Roadside parking (yes/no, one side or two sides),
- Pavement width (m) (0, if unpaved),
- Sidewalk width (m) (0, if no sidewalk),
- Shoulder width (m),
- Right of Way width (m),
- Road Condition (surface roughness index, to be defined by the Consultant),
- Terrain (flat, hilly, etc.),
- Number of marked lanes,
- Number of adjacent service lanes,
- Median (yes/no),
- Traffic regulation (one way or both ways),
- Classification (national, district, commune, private, to be defined by the Consultant), and
- Route number (if any).

The following data is required for each node or intersection:

- Number of legs entering the intersection,
- Number of lanes entering and leaving on each leg, and
- Intersection control (signalized, roundabout, traffic control, no control).

2) Survey Form

The following survey forms were utilized during the Road Inventory Survey:

- Form-RIS1: To record link attribute information, and
- Form-RIS2: To record node attribute information.

3) Survey Implementation and Limitation of Data Collection

The RIS was conducted from 16th September 2013 until 4th October 2013. During the survey, the following problems were observed which prevented proper execution of the survey; 1) geometrically precise road network, which enables proper data collection in the field and data input in the network mutually, could not be obtained by the survey execution in Cote d'Ivoire; 2) lack of resource of surveyors to deal with such complicated road network in a geographical information system (GIS) as well as correspondence between the survey and transport network modeling, and 3) uncertainness of road structure to define the clear separation of required items; and 4) some items were not available in the field.

As a result, node information as well as those of intersections, side friction level, classification and route number could not be obtained properly during the survey.

(4) Definition of Attributes

Hence road condition in terms of the boundaries of road structures, private property and public land varies in accordance with the situation of the designated road as expressed in Figure 2.82. Definitions of attributes regarding sectional road composition are defined as illustrated in Figure 2.83 and Figure 2.84. Definition of "R" and "L" is also shown in Figure 2.85. Definition of roughness of road surface is shown in Figure 2.86. It also should be noted that tabulated total length of roads in the network is different from the actual condition due to two reasons; 1) the network contains so-called double links (see Figure 2.83) which are composed of two links for each direction mainly used for highways to express the division by a median as appropriate for the necessity of transport modeling, and 2) Attribute information of double links, such as width of road (Shoulder_R and Shoulder_L), is put in "R" in each link to keep network consistency. In this report, this kind of information is aggregated to show the result simply.

Figure 2.82 Example of Road Situation

Single Link Double Link

Figure 2.83 Example of Single and Double Link

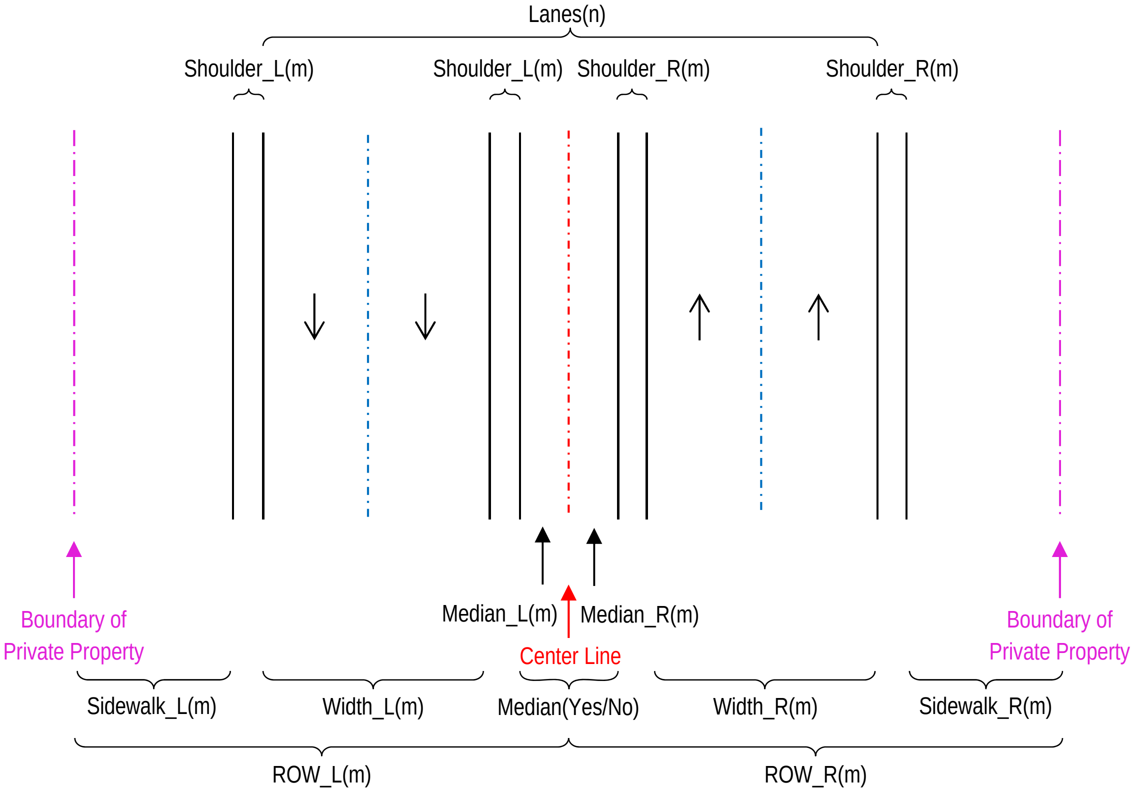


Figure 2.84 Definition of Attributes (Paved Road)

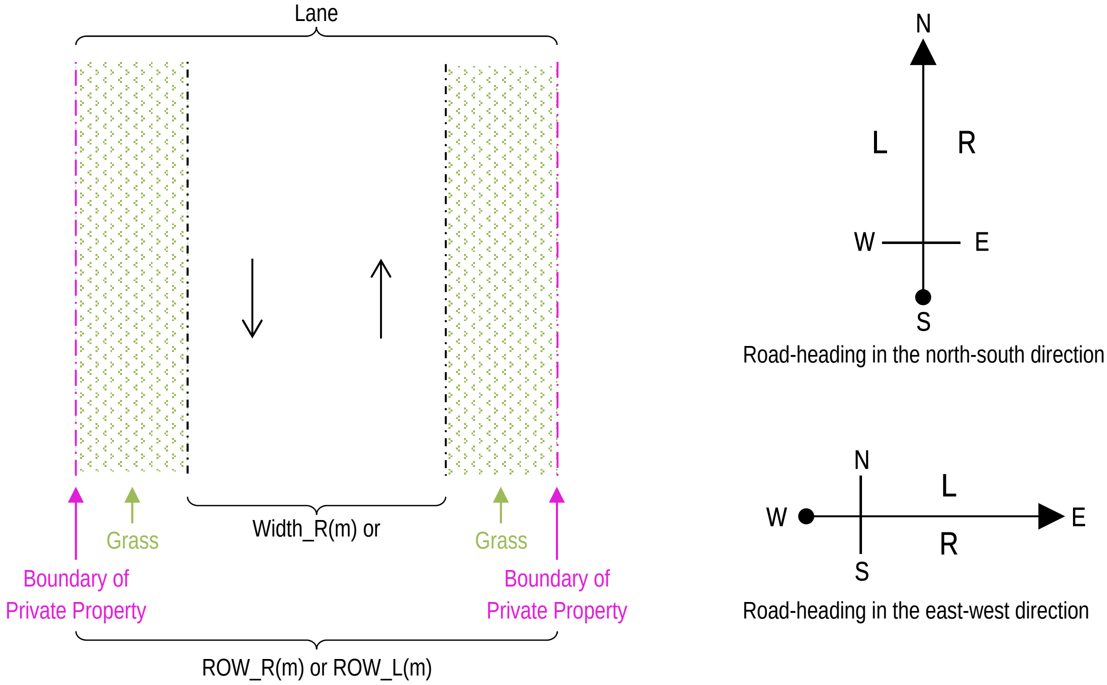
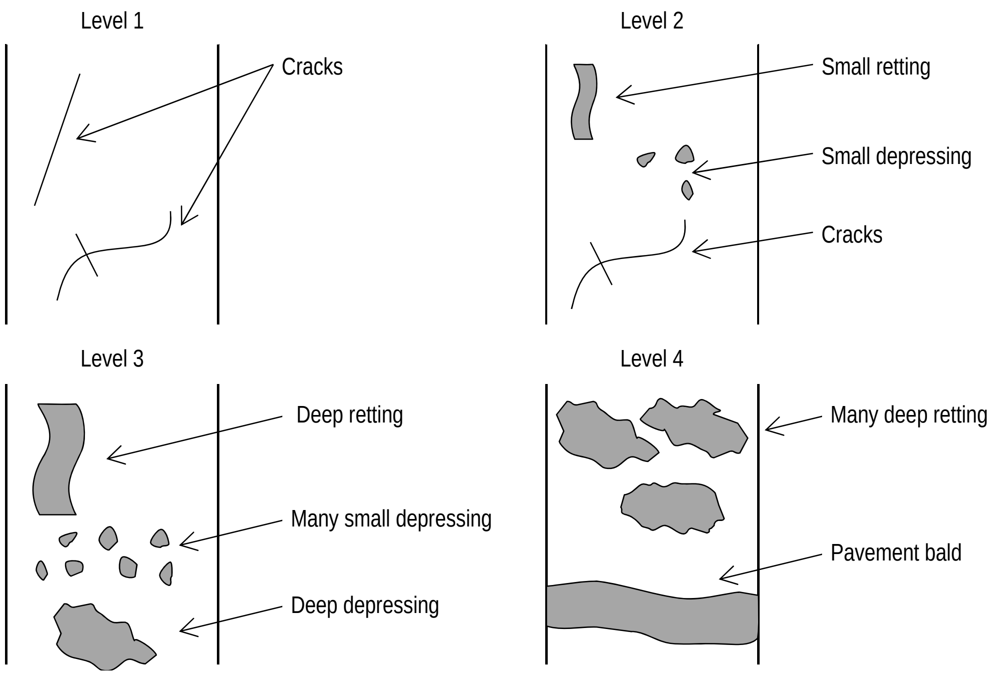


Figure 2.85 Definition of Attributes (Paved Roads) and Direction



* Level 0 means no prominent damage

Figure 2.86 Definition of Roughness

2.12.2 Survey Results and Major Findings

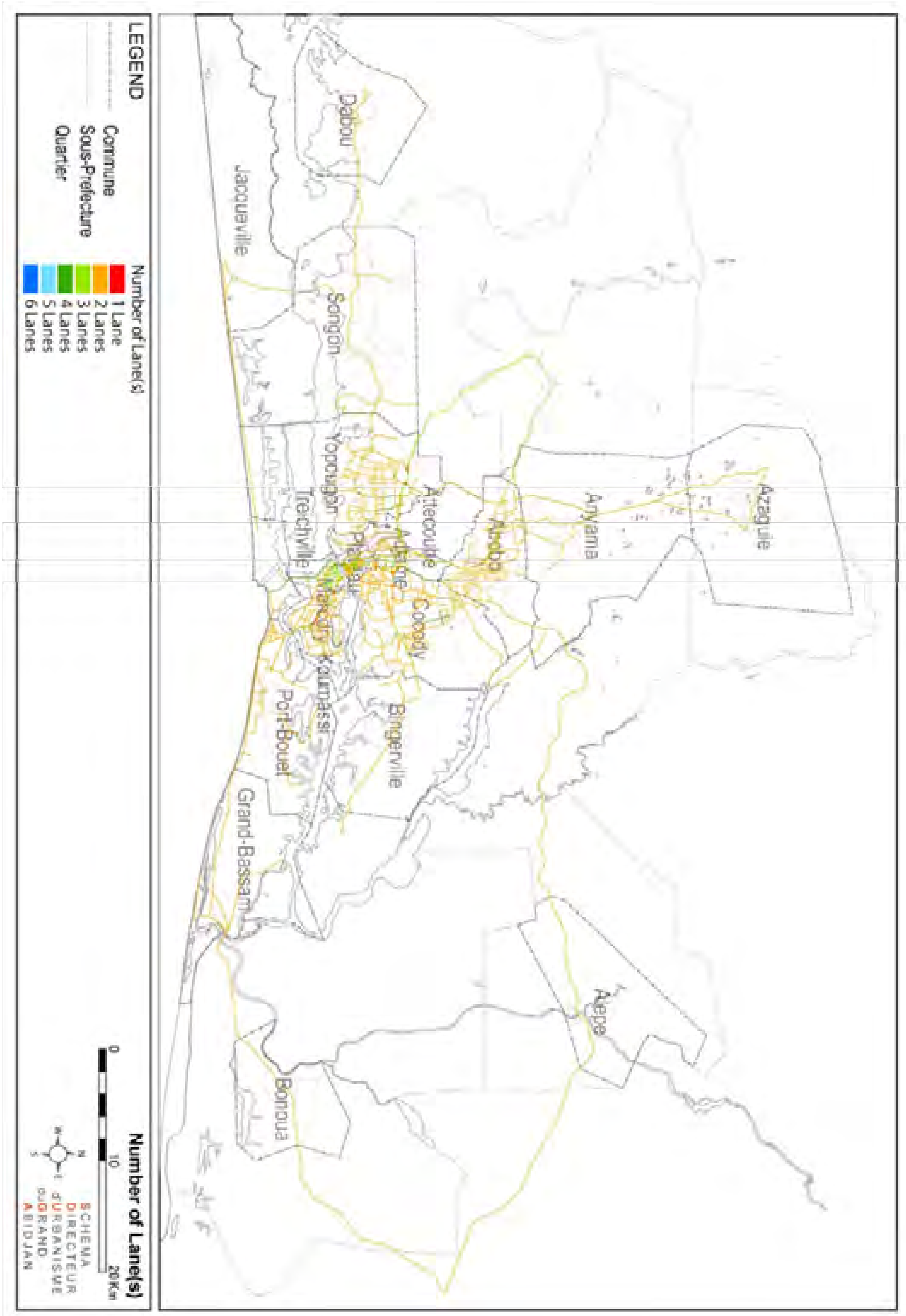
(1) Number of Lanes

Length of the road network categorized by number of lanes is shown in Table 2.35 and Figure 2.87. A high percentage of roads of which the number of lanes is more than three is observed in Treichville followed by Adjame and Plateau, accounting for about 40%, 27% and 22% respectively. Among the 19 communes, about 83% of the roads are composed of 2 lanes. It should be noted that these links include double links of which the total number of lanes is four.

Table 2.35 Number of Lanes by Commune

Commune	Attribute (km)						Percentage (%)					
	1 Lane	2 Lanes	3 Lanes	4 Lanes	≥ 5 Lanes	Total	1 Lane	2 Lanes	3 Lanes	4 Lanes	≥ 5 Lanes	Total
Abobo	3	124	12	0	0	139	2%	89%	8%	0%	0%	100%
Adjame	7	25	15	9	0	56	13%	44%	27%	16%	0%	100%
Alepe	0	1	0	0	0	1	0%	100%	0%	0%	0%	100%
Anyama	0	17	0	0	0	17	0%	100%	0%	0%	0%	100%
Attecoube	3	20	2	0	0	25	11%	80%	8%	1%	0%	100%
Azaguie	0	4	0	0	0	4	0%	100%	0%	0%	0%	100%
Bingerville	0	12	0	0	0	12	0%	98%	2%	0%	0%	100%
Bonoua	0	1	0	0	0	1	0%	100%	0%	0%	0%	100%
Cocody	5	157	10	6	0	177	3%	89%	6%	3%	0%	100%
Dabou	0	3	0	0	0	3	0%	100%	0%	0%	0%	100%
Grand-Bassam	1	4	0	0	0	5	17%	83%	0%	0%	0%	100%
Jacqueville	0	2	0	0	0	2	0%	100%	0%	0%	0%	100%
Koumassi	0	81	1	2	0	84	0%	96%	1%	3%	0%	100%
Marcory	1	37	3	2	1	45	2%	83%	7%	5%	2%	100%
Plateau	3	33	11	4	1	52	5%	64%	22%	7%	1%	100%
Port-Bouet	1	74	0	3	0	78	1%	95%	0%	3%	0%	100%
Songon	0	7	0	0	0	7	0%	100%	0%	0%	0%	100%
Treichville	3	22	22	6	1	53	5%	41%	40%	12%	1%	100%
Yopougon	13	199	5	15	0	232	6%	86%	2%	6%	0%	100%
Total	39	823	81	47	2	992	4%	83%	8%	5%	0%	100%

Source: JICA Study Team



Source: JICA Study Team

Figure 2.87 Number of Lanes

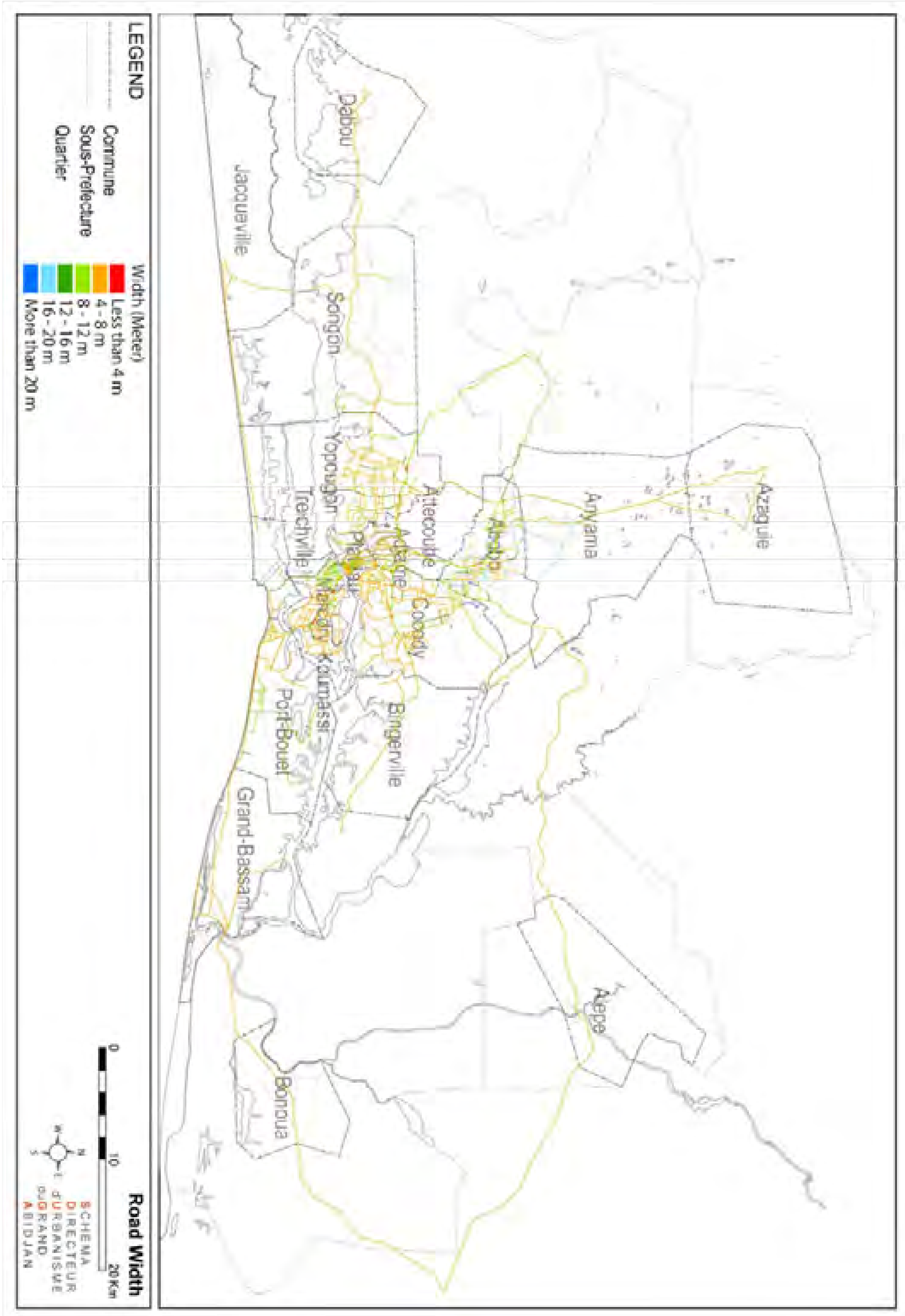
(2) Road Width

Length of road network categorized by road width is shown in Table 2.36 and Figure 2.88. A high percentage of roads with widths of more than 15m are observed in Anyama and Abobo, accounting for about 65% and 21%, respectively. It should be noted that road width consisting of double links cannot be described in this tabulation. In the actual situation, a greater length of roads of which width is more than 15m shall be observed in Plateau, Yopougon and Cocody because it contains the expressway consisting of double links. Among the 19 communes, about 24% of the roads have widths of more than 10m.

Table 2.36 Road Width by Commune

Commune	Length (km)						Percentage (%)					
	≤ 4m	4 - 7m	7 - 10m	10 - 15m	≥ 15m	Total	≤ 4m	4 - 7m	7 - 10m	10 - 15m	≥ 15m	Total
Abobo	2	33	34	40	29	139	2%	24%	25%	29%	21%	100%
Adjame	6	14	12	23	0	56	11%	26%	22%	41%	0%	100%
Alepe	0	0	1	0	0	1	0%	0%	100%	0%	0%	100%
Anyama	0	1	5	0	11	17	0%	6%	29%	0%	65%	100%
Attecoube	3	11	10	2	0	25	11%	42%	38%	9%	0%	100%
Azaguie	0	1	3	0	0	4	0%	14%	86%	0%	0%	100%
Bingerville	0	6	6	0	0	12	0%	48%	50%	2%	0%	100%
Bonoua	0	0	1	0	0	1	0%	0%	75%	25%	0%	100%
Cocody	4	110	44	16	3	177	2%	62%	25%	9%	2%	100%
Dabou	0	2	1	0	0	3	0%	62%	38%	0%	0%	100%
Grand-Bassam	1	1	3	0	0	5	17%	23%	60%	0%	0%	100%
Jacqueville	0	2	0	0	0	2	0%	79%	21%	0%	0%	100%
Koumassi	0	32	49	3	0	84	0%	39%	58%	4%	0%	100%
Marcory	1	8	29	6	1	45	1%	19%	65%	13%	2%	100%
Plateau	2	10	28	10	1	52	4%	20%	54%	20%	1%	100%
Port-Bouet	1	17	38	21	1	78	1%	22%	49%	27%	1%	100%
Songon	0	6	1	0	0	7	0%	84%	16%	0%	0%	100%
Treichville	3	16	6	28	1	53	5%	30%	11%	53%	1%	100%
Yopougon	9	56	137	28	1	232	4%	24%	59%	12%	1%	100%
Total	32	325	409	178	47	992	3%	33%	41%	18%	5%	100%

Source: JICA Study Team



Source: JICA Study Team

Figure 2.88 Road Width

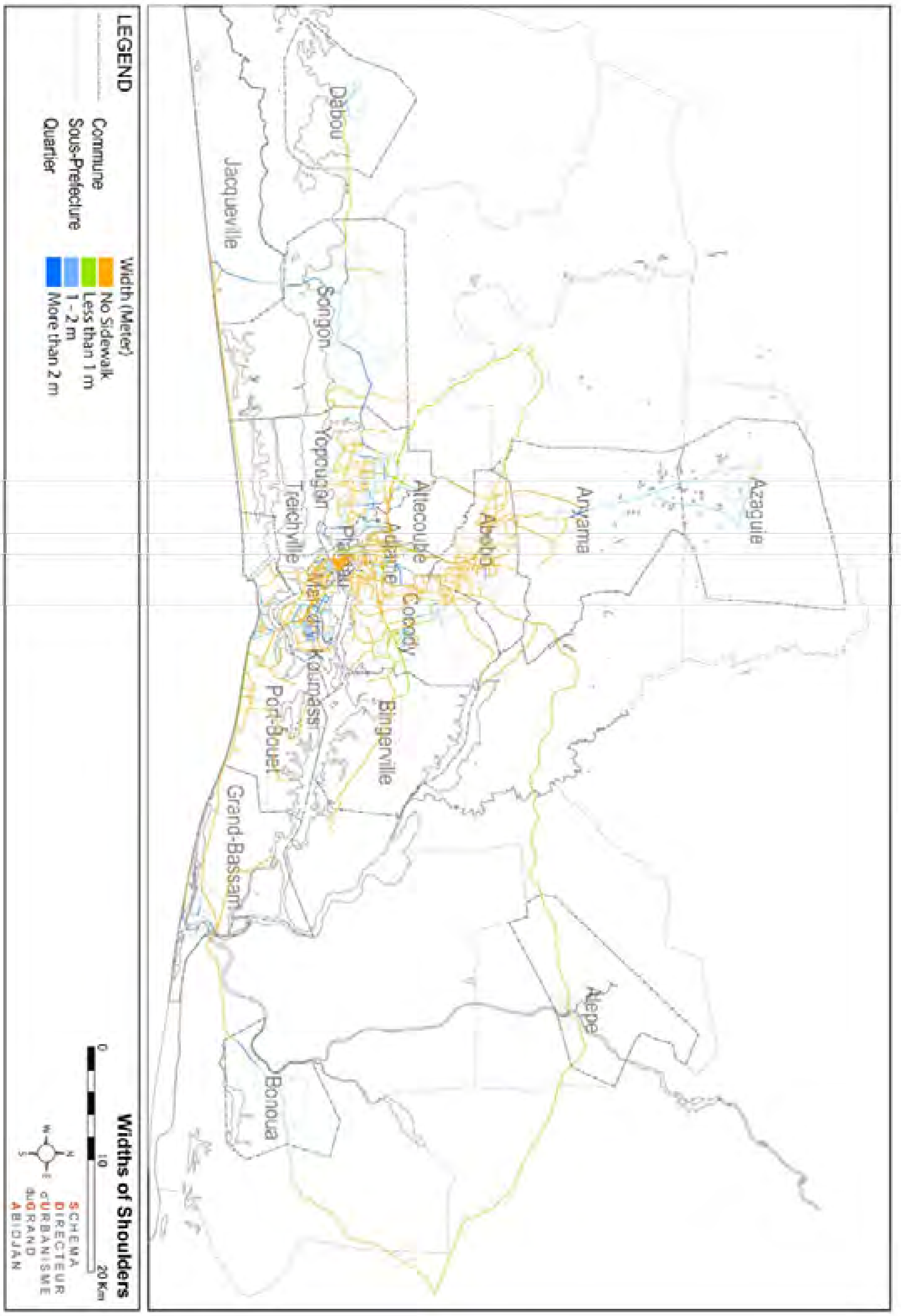
(3) Shoulders

Length of the road network categorized by the widths of the shoulders is shown in Table 2.37 and Figure 2.37. A high percentage of roads with shoulder widths more than two meters are observed in Azaguie, Dabou and Bonoua, accounting for about 88%, 66% and 60%, respectively, these mainly consist of provincial communes which can reserve enough space for the roads. Among the 19 communes, about 6% of roads have shoulders with widths of more than two meters.

Table 2.37 Width of Shoulders by Commune

Commune	Length (km)					Percentage (%)				
	Not Exist	≤ 1m	1 - 2m	≥ 2m	Total	Not Exist	≤ 1m	1 - 2m	≥ 2m	Total
Abobo	131	0	4	4	139	94%	0%	3%	3%	100%
Adjame	51	2	2	0	56	92%	3%	4%	1%	100%
Alepe	1	0	0	0	1	100%	0%	0%	0%	100%
Anyama	15	0	1	1	17	86%	0%	8%	6%	100%
Attecoube	19	0	5	2	25	73%	0%	21%	6%	100%
Azaguie	0	0	3	0	4	3%	10%	88%	0%	100%
Bingerville	12	0	0	0	12	98%	2%	0%	0%	100%
Bonoua	0	0	1	0	1	25%	0%	60%	15%	100%
Cocody	145	12	16	4	177	82%	7%	9%	2%	100%
Dabou	1	0	2	0	3	34%	0%	66%	0%	100%
Grand-Bassam	2	0	2	1	5	42%	0%	42%	16%	100%
Jacqueville	2	0	0	0	2	79%	0%	19%	2%	100%
Koumassi	59	1	6	19	84	70%	1%	7%	22%	100%
Marcory	26	5	9	5	45	59%	10%	19%	12%	100%
Plateau	51	0	0	1	52	97%	0%	1%	2%	100%
Port-Bouet	71	2	5	1	78	91%	2%	6%	1%	100%
Songon	5	0	0	1	7	79%	1%	5%	15%	100%
Treichville	49	1	3	1	53	91%	2%	5%	2%	100%
Yopougon	159	10	39	24	232	69%	4%	17%	10%	100%
Total	798	32	99	63	992	80%	3%	10%	6%	100%

Source: JICA Study Team



Source: JICA Study Team

Figure 2.89 Widths of Shoulders

3.0 Review of Master Plan 2000 and Other Studies

3.1 Road

3.1.1 Master Plan 1985

The Master Plan 1985 is the second master plan for Abidjan after the Master Plan 1969. It defines the major orientations and planning options that have to be respected during the expansion of the city. The aim of this master plan was to rebalance the locations of activities and residential area, develop mass transit, expand port activities on the Banco Plateau and on the Boulay Island, expand the airport facilities, improve the traffic within the city by creating arterial roads and rapid service routes, accelerate the development of Cocody and Plateau Banco and revitalize the eastern area of the city and create a road network crossing the lagoon and connecting Grand-Bassam, Port-Bouet and Bingerville.

The Master Plan 1985 gave a list of priority projects that have to be quickly implemented:

- The construction of an east-west link,
- The extension of the port in Yopougon,
- The Percée Reboul, the 5th bridge crossing the Banco Bay and the twinning of the Houphouët-Boigny Bridge,
- The development of industrial zones in the North of Abobo and in the East of Cocody to restore balance between activities and residential areas as all the industries were concentrated in Treichville and Port Bouet.

Other road projects mentioned in the Master Plan 1985 were:

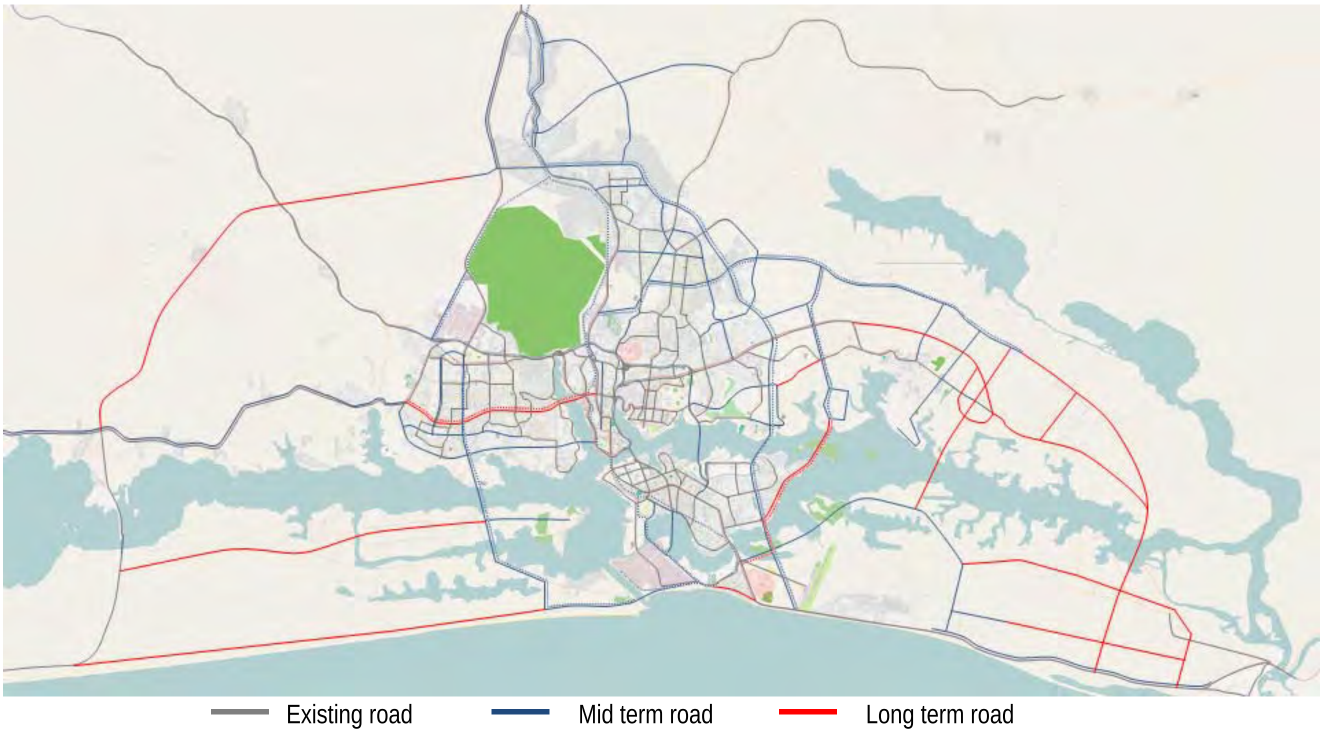
- The voie de dégagement Ouest (West Bypass of Plateau) which was initially design as a road reserved for trucks leaving or going to the port,
- The link between the Charles-de-Gaulle Bridge and the boulevard Valérie-Giscard-d'Estaing,
- The extension and widening of the east-west road between Agban and the route de Bingerville and its widening,
- The primary road network of the Banco Plateau, Koumassi and Abobo,
- The Voie Triomphale,
- The construction of the Cocody-Treichville Bridge,
- The widening to 4 lanes of the boulevard de Marseille,

- The construction of an arterial road at Riviéra and the extension of the east-west Road further north to the route de Bingerville.

During the elaboration of the Master Plan 2000, an evaluation was carried out to determine which projects mentioned in the Master Plan 1985 has been implemented. Only the voie de dégagement Ouest (West Bypass of Plateau), the link connecting the Charles de Gaulle Bridge to the boulevard Valérie-Giscard-d'Estaing, and the extension and widening of the east-west road between Agban and the route de Bingerville had been constructed during this period. All the road priority projects mentioned in the Master Plan 1985 had not been implemented.

3.1.2 Master Plan 2000

In the Master Plan 2000, emphasis was put on the necessity to build new arterial roads with sufficient capacity that would organize urbanization and further enhance the development of Greater Abidjan. The aims of the Plan were to open up some areas, serve remote areas and improve the existing network.



Source : MCLAU

Figure 3.1 Master Plan 2000

The following priority roads were planned for mid and long term:

- The primary road network of Plateau du Banco, Koumassi and Abobo,
- The two bridges of Banco and the Percée Reboul or Reboul Link, the Interchange Aquarium and Chardy,

- The widening to four lanes of the Boulevard de Marseille,
- The extension of Boulevard Latrille (Abobo Baoulé Road),
- The “Voie Triomphale” or Triumphal Road
- The Riviera-Marcory Bridge,
- The Sud Banco Bridge,
- The construction of a rocade de contournement (Y3) (bypass ring road) in the North-East part of Abidjan
- The creation of a voie périphérique (ring road) (Y4) which connects Koumassi, Cocody, Abobo and Yopougon.

3.1.3 Traffic Management

The biggest and foremost issue for the traffic management in Abidjan is the lack of long range planning. The city has been successful to mitigate the local traffic management problems to some extent through such measures as one-way system or geometric improvement of intersections. However, the solution is local and has caused new problem at other locations. There is no long range improvement plan for the entire city including compatible ATC systems and traffic information systems. A more comprehensive and concerted approach is required.

3.2 Public Transport

In order to guide the development of Abidjan, a series of master plans have been prepared for the city with the first presented in 1928. In 1960, the third master plan[11] was prepared for the city with the mandate to transform the city from a colonial capital to a modern national capital. The series of master plans have culminated in the year 2000 master plan. For various reasons not discussed here, the planning proposals of these master plans have not resulted in significant improvement in public transport infrastructure.

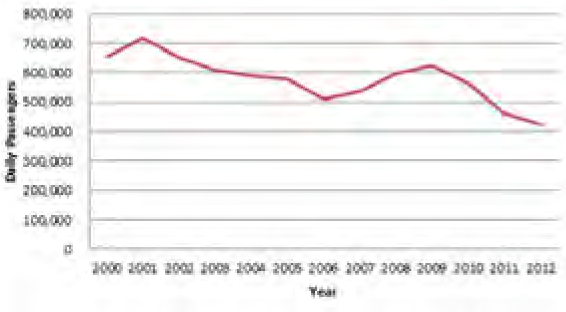
3.2.1 Master Plan 2000

The year 2000 Master plan proposed solutions to the problem of transportation in Abidjan especially with respect to public transport. The proposals were essentially to extend and improve the existing SOTRA bus network and in addition to the SOTRA bus network whilst at the same time commissioning an extensive metro system. There was a failure of implementation of any of the plan proposals.

As a result of any improvement in public transport, SOTRA services deteriorated significantly (see Figure 3.2). After a slight increase in patronage between 2000 and 2002, the patronage of the bus network declined by nearly 40% over the first decade of the new millennium. Meanwhile the population

[11] The second master plan was prepared in 1948. As per the original plan, few of its recommendations had been implemented at the time of the third plan.

of the city continued to grow over this time without any improvement in the performance of the formal public transport system.



Source: SOTRA

Figure 3.2 SOTRA Bus Patronage

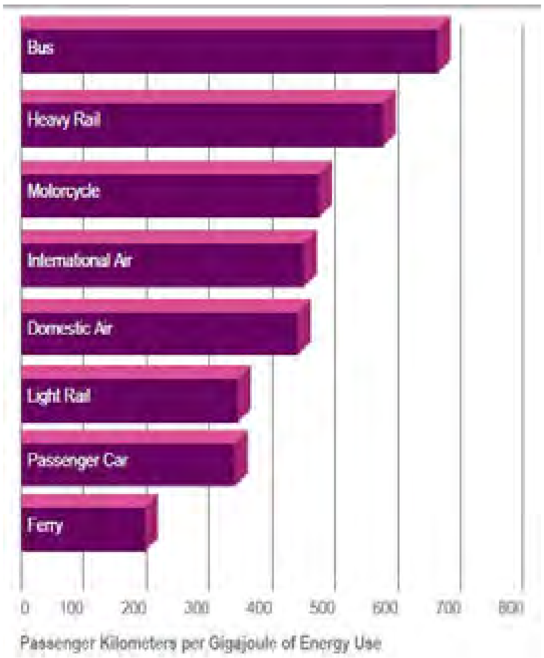
Earlier studies on urban transport conducted in 1991 revealed a total of 2.2 million person trips per day for the inhabitants of Abidjan who at the time were more than 8 years old in the 10 inner communes. Public transit at that time consisted of a healthy share of around 77%. This was dominated by the bus system.

In 1998[12], the modal share of non-walk trips for SOTRA bus was 24% with Gbaka accounting for a further 25% whilst 17% of trips were made by Woro-Woro. By 2013, the modal proportion of bus and Woro-Woro was reversed significantly. Woro-Woro accounted for 44% of person trips in 2013 with SOTRA bus accounting for a mode split of only 12%. This modal shift from the formal sector is likely linked directly to the failure of implementing earlier proposed improvements to public transport.

3.2.2 Public Transport Policies

Public transport policies need to be directed towards the goal of the development of a sustainable energy efficient transport system supporting economic development, population growth and enhanced mobility of Greater Abidjan. The most efficient forms of transport are shown in the adjacent Figure 3.3.[13]

[12] Source: World Bank
[13] The reference to ferry is this diagram is only a simple ferry. It does not refer to the high capacity ferries discussed later in this report.



Source: Engineers Australia, "Energy Efficiency of Transport Modes, revisited September, 2009", by Andre Kaspura

Figure 3.3 Energy Efficient Transport by Mode

At present there are few policies in place to support the goal of access to enhanced mobility for all in Greater Abidjan. The polices that need adoption must be guided to provide a comprehensive and integrated public transport network which is convenient, user friendly and accessible to all income groups to serve all urban centers, both district and neighborhood whilst providing access to local community facilities, employment centers, leisure and tourism sites. To this extent, the Study team proposed the following key initiatives in relation to public transport namely:

- Promotion of High Capacity Public Transport Corridors;
- An enhanced Bus system; and
- A review of the informal public transport sector.

In the promotion of the policies initiatives above, it is necessary to undertake the development and planning of the high capacity transit system that ultimately provides a north south link from Anyama to Grand Bassam, including a link to the International Airport, and an east west link from Songon to Bingerville and possibly additional corridors depending on demand.

It is secondly necessary to establish a comprehensive bus network by rerouting and introducing new routes to provide maximum penetration into residential areas and major employment and retail centers and deliver the integration with high capacity public transport network sometimes as a feeder of that system. It includes the improvement of quality of vehicle, driver and service, including accessibility, safety, punctuality, reliability, frequency of service and comfort.

Thirdly, the implementation of above comprehensive services is likely to reduce the current high reliance on the informal sector such as Gbaka and Woro-Woro necessitating in a complete review of the informal public transport sector.

3.2.3 Water-Based Transport

Regarding the water-based transport, in 1993, studies on the development of river-lagoon transport has been done by an Ivoirian-Belgian company called ARJEK and PARTNERS under the request of the Ivorian government. This study has shown the need to build modern quays on the coastline for a cost of 23 billion FCFA and indicated that they should be completed over ten years (from 1993 to 2003). While some of them have been completed in Grand-Lahou, the rest were not realized due to a lack of funding in 2000. However, this project has been included in the National Development Plan (PND 2012-2015) with a reference to PND Action 4.2.25, and it is planned in the PND Action 133 to put tags on waterways.

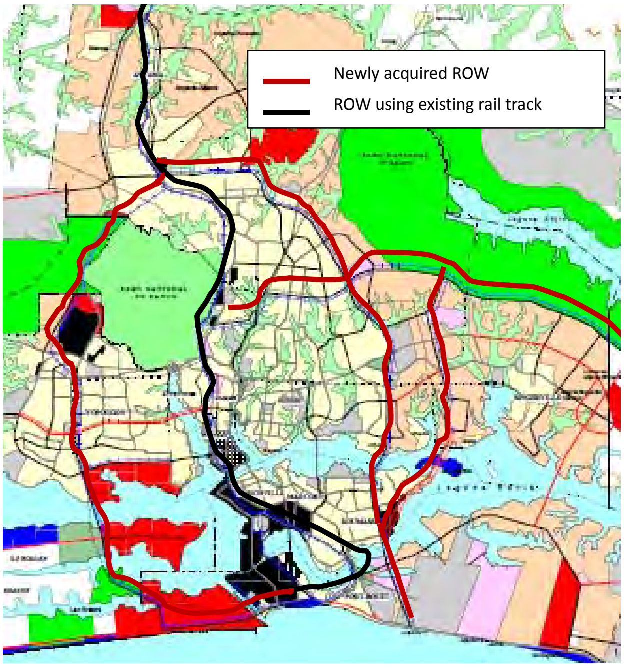
Furthermore, development of more private lagoon transport lines has also been initiated by the Ministry of Transport. In this case, the role of SOTRA will have to be redefined as it is limited to the Abidjan area only. Previously, it was planned to build eight out of fifteen lagoon stations for urban and inter-city water transport in the PND but no funding was found. A study should be redone, analyzing the bathometry, the location of the stations or the type of ships. An environmental impact study of Lagoon transport, in terms of pollution, should also be conducted.

3.3 Rail-based Transportation

3.3.1 Outline of Previous Urban Mass Transit Proposals for the District of Abidjan

(1) Urban mass transit plan by SOFRETU

SOFRETU (Société française d'études et de réalisations de transports urbains) was a French consulting and project development firm which was merged with SOFREIL (a SNCF branch) later and became SYSTRA, a French international engineering consulting group. In the 1970s, SOFRETU had proposed an urban transit network plan, in which the north-south axis transit route and west-east transit axis route are connected at the town of Plateau. Focusing on its network structure, it seems that this plan gave a template for a mass transit route for other parties who have proposed their own urban transit network proposals since then. As for the transit system type, metro was proposed as its concept.



Source: Master Plan of the Greater Abidjan - Long-term Structure Plan

Figure 3.4 Rail Transit Route in Urban Master Plan 2000

(2) Rail Transit Route Proposed in the Master Plan

In the master plan in 2000, published in 1998, urban rail transit routes, i.e. Abidjan urban rail network, were indicated as detailed action plans to be realized over the long and medium terms.

The plan consists of two route segments, a rail route for the North-south axis using mostly the existing rail tracks, and a rail based transit route for the East-west axis, connecting Yopougon and Cocody. The main concept of the proposal was as follows;

- Reducing the north-south traffic load for public transport (SOTRA), utilizing the existing railway track as an urban train service.
- Accelerating urban development in the north-east fringe area for urban area expansion of Abidjan district.
- Alleviating traffic congestion between Yopougon and Cocody.

Regarding what kind of mass transit, no clear definition was made, no physical features such as route length or station location are indicated either.

(3) Tramway Network Plan

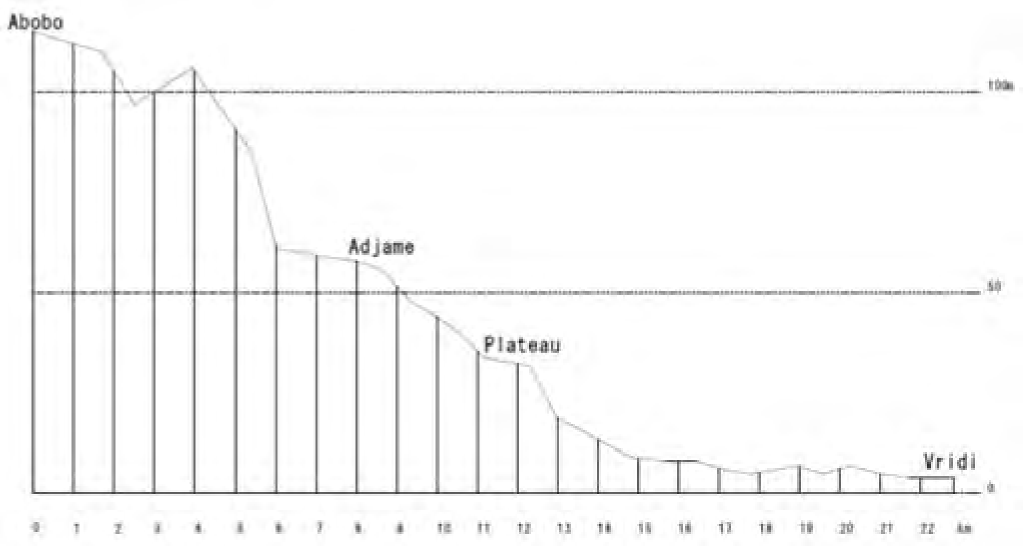
1) Outline

In 2008, upon request of the Ministry of Economic Infrastructure (MIE) who want to implement the development of a light rail or modern tram in Abidjan, a Tunisian consultant SCET was conducting a preliminary feasibility study on a modern tramway in Abidjan through technical collaboration with SYSTRA. In this study a tramway route that connects Abobo-Adjamé-Plateau-Treichville-Vridi along the North-South axis, and another route that links Yopougon and Adjamé along the West-East direction are discussed. In parallel, a "complementary" project to develop an urban train, using existing rail track, was initiated. In 2012, the Ministry of Economic Infrastructures requested French research group EGIS to study how to consolidate both study results and update them. The latest proposed route is shown in Figure 3.5.

Source: EGIS report 2012

Figure 3.5 Proposed Tramway Network

According to EGIS, the first priority route is the North-South line connecting Abobo and Vridi, with the line length of 22.8km and 27 stations. The line from Yopougon to Bingerville via Cocody is concluded as the second phase line in a long term context. Whole sections composing the line are covered by existing roads, including trunk roads and local main roads with certain road widths. This means that ROW is already secured. Figure 3.6 shows a longitudinal geographical profile of the tramway route in rough scaling.



Source: JICA Study Team

Figure 3.6 Sketch Profile of Tramway Vertical Alignment

The continuous down slope from[14] Abobo toward the port is seen and maximum gradient is estimated at around 3% or more.

2) Project description

To materialize this plan the following project items are proposed:

- Installation of tramway track with modification of road surface structure and sub grade,
- Modification / Upgrading of Houphouet Boigny bridge structure with its surroundings,
- Platform ,
- Tram track installation,
- Power line and supporting equipment,
- the restoration of public space adjacent to the tram platform,

[14] This fact indicates the necessity to examine how a continuous slope could affect motor performance of electric powered tram vehicles.

- Preservation of urban facilities (street furniture, protective barriers for the platform, public lighting, planting trees),
- Installation of substations or power stations for power supply equipment,
- Construction of a car depot and maintenance center,
- Installation of operation control and monitoring system,
- Preparation of Park & Ride facilities, and
- Preparation of rolling stock.

(4) Urban Train Plan

1) Outline

Since 1998, when the previous urban master plan in 2000 was compiled, several studies have been conducted on the Urban Train project, using the whole or part of the existing railway track, which at present is used for railway freight services from Vridi (Abidjan) to Ouagadougou-Kaya (Burkina Faso) by SITARAIL. The objective of the project is to create a service for urban rail across the greater Abidjan following a North-South axis. The latest feasibility study has been carried out by Dongsan Korea Consortium.

The current rail line has an advantage of being located on the main axis of the growth of the town (North-South).

The proposed route by Dongsan Korea Consortium is shown in Figure 3.7.

Source: Feasibility Report on Urban Train by Dongsan Korea Consortium

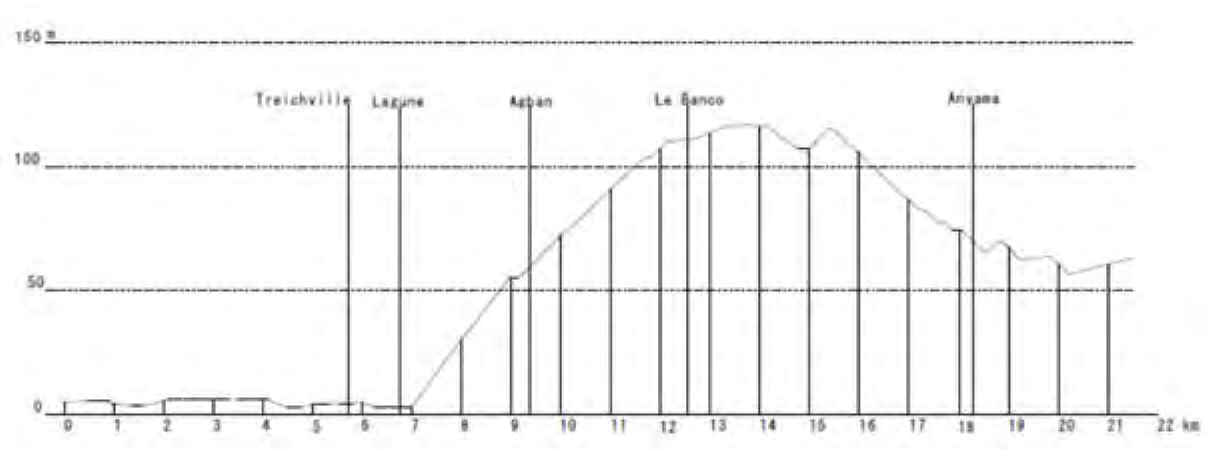
Figure 3.7 Horizontal Alignment of Proposed Route of Urban Train

This plan presumes that the whole urban train route is on the existing railway track used for railway freight and regional passenger transport services by SITARAIL. The first phase section is 25.5km from Abobo Nord to Marcory G d'Estaing with 13 stations. Obviously, there are no issues on ROW except for specific at grade intersections with roads because the entire route follows the existing rail track.

Figure 3.8 shows a sketch profile of the vertical alignment[15] of the train route.

According to the Dongsan report, the maximum gradient is 1.4% at PK 3.073 and the minimum curve radius is 140m.

[15] This fact indicates the necessity to examine how continuous slope could affect the motor performance of the electric powered cars.



Source: JICA Study Team

Figure 3.8 Sketch Profile of Vertical Alignment of Urban Train

2) Project description

To materialize this plan the following project items are proposed:

- Converting existing railway track from single to double, including newly built rail track, with a total length of 38km,
- Electrification of railway operation facilities such as power lines, supporting facilities, electric substations,
- Improvement of bridge structure for Felix Houphouet Boigny bridge and others,
- Upgrading of rail track structure, including drainage infrastructure,
- Improvement of railway crossings, including grade separation of traffic for large intersections or points with heavy traffic,
- Installation of car depot (Abobo area was proposed for its location),
- Improvement of station facilities,
- Upgrading of rail standard and improvement of permanent way, including railway switch facilities,
- Signaling and communication system installation,
- Railway control system installation, including operation control center, and
- Rolling stock.

Major Understanding on Current Direction of Mass Transit Project

Through interviewing related authorities, the following information was obtained regarding the latest activity / status for mass transit projects:

- To define a project as an active project, the fact that a feasibility study or equivalent process has been completed is considered to be the minimum requirement;
- In view of necessary processes, both the tramway proposal and the urban train proposal are considered to be eligible projects to proceed to the next step;

- As the most important criteria for judging project viability, the authority needs accurate demand forecasts. At this moment, no proposal satisfies this requirement, and therefore, they are not eligible for entering the next step of project implementation such as the project bidding stage;
- However, according to the latest information from authorized source, the bidding for urban train project was announced in May 2013 and three companies who expressed interest were shortlisted for project. Only one consortium submitted the technical proposal in October. The Ivorian government has set up an inter-ministerial committee taking charge of project implementation. The proposal submitted from consortium is not accepted yet as it is still being reviewed by the committee; and
- In addition as for the finance arrangement of project, the government has intention to introduce the private oriented financing schemes such as BOT or PPP.

3.3.2 Comparison of Project Indicators between Tramway and Urban Train

In this section, a brief comparison of basic indicators of projects is made based on the data/information available at present.

Table 3.1 Brief Comparison of Basic Indicators in Transit Proposals

Item	Tramway	Urban Train	Remarks
ROW	Depends existing road infrastructure	Uses existing rail track	
Route length	22.8 km	24.8km	1st phase
Number of stations	27	13	
Estimated demand	-	256,000 /day	
Planned speed	21km/h	32km/h	
Time required between origin and destination station	64 minutes	41.6 minutes	
Applied system	Modern tram	Conventional rail transit	
Train frequency in peak hour	Every 3 minutes	Every 10 minutes	At first opening year
Number of trains	56 vehicles	12 train set	At first opening year
Total investment cost	420 billion FCFA	213.7 million Euro	

Source: JICA Study Team

3.3.3 Preliminary Appraisal of a Project

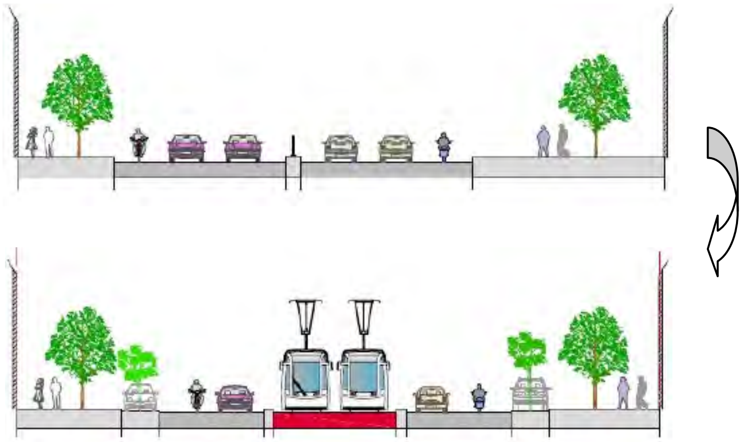
(1) Expected Difficulty on Land Acquisition

Land acquisition necessary for constructing a mass transit system could be a critical issue in the first stage of project implementation because of the opposition of peoples who are living in the area designated to be the construction site. To mitigate this issue, it is desirable to secure ROW (Right of Way) by a reasonable method. Regarding the ROW, both the urban train project and the Tramway project are considered to have considerable advantage, because existing railway space is designated to be the ROW for the urban train project and existing highway space is expected to be the ROW for the tramway project. However, it is considered that the latter is better positioned than the former because there are few locations where there is a possibility of encroachment happening in the existing road area.

(2) Impact on Other Transport Modes

1) Road traffic

If the tramway is introduced at grade in the existing road space, it is inevitable that it will decrease the carriageway for road traffic as shown in Figure 3.9. While in the case of urban trains, the ROW use is limited to the existing railway ROW, therefore, no impact is generated. To minimize this impact on road traffic, it is important to effectively divert car passengers to mass transit use. Particularly, it is a key point to move many passengers of private cars, which carry few passengers in a single car unit, to mass transit use because a bus carries many passengers in one car unit. However, generally it is seen that most mass transit users came from previous bus users. To avoid this situation, it is necessary to prepare effective countermeasures such as feeder transport services, a TDM (Transport Demand Management) scheme, including park & ride scheme and car pool scheme etc. to make mass transit convenient enough for private car users.



Source: JICA Study Tea

Figure 3.9 Tramway's Impact on Road Traffic

2) Railway freight transport

The urban train project assumes co-existence with current freight railway services and use of the same railway track facilities. Several issues are pointed out as follows:

- It is necessary to adjust the train operation schedule to accommodate both the freight trains and passenger trains. According to the urban train study, the number of urban trains is small enough that both passenger and freight train operations can share the tracks, except for peak hour. However, there is large speed difference between passenger trains and freight trains, and this may affect railway safety and make train operation less effective;
- To allow freight trains to run on the same rail track, it is necessary to upgrade freight railway facilities and electrify them as well. As this investment cost might be considerable amount, who will pay the cost becomes a serious issue; and

- Current freight railway services are carried out by SITARAIL under a concession contract with the Cote d'Ivoire Government and Burkina Faso Government. Railway assets are owned by the Government and SITARAIL pays a leasing fee and interest for borrowing funds. If an urban train is operated by a third party other than SITARAIL, several issues are raised regarding sharing the track access charge and the cost of track maintenance etc.

3) Validity of passenger transport services

As shown in the system comparison in Figure 3.10, the urban train project and tramway project show in clear contrast that urban train service is more rapid than the tramway; however, the urban train serves fewer stations than the tramway. In particular, if the horizontal alignment of the urban train is located in less populated areas, how to attract railway passengers is quite a concern. Demand forecasts was done in a later stage of this study, simple analysis on transit service coverage, using passenger catchment areas, was undertaken. (see Figure 3.10)

[Urban Train Plan]

[Tramway Plan]

Source: JICA Study Team

Figure 3.10 Comparison of Catchment Areas of Mass Transit Systems

In this figure, passenger catchment areas are indicated by circular zones with a radius of 1km (maximum access length for train passengers), of which the center is located at each mass transit station.

Obviously, the passenger catchment area of the tramway is larger than that of the urban train. However, the area coverage from Plateau to Port Bouët does not show much difference. It is difficult to determine which system is preferable in service performance if the rapid service of urban trains is taken into account. This subject needs more analysis and discussion, and especially demand forecasts.

4) Investment cost

As shown before in the comparison table, the investment cost of the urban train project is relatively smaller than that of the tramway project. The reason is that the new investment is very small and most of that is for upgrading facilities. However, a railway system change from freight only use to dual use for cargo and urban transport is considered to be rare, therefore, more case data and information is needed. In addition to that, the target railway facilities are currently used for freight train services. It is considered that construction work close to active railway operation is very difficult. Construction work has to be undertaken during the railway operation off time and the extent of the construction site itself has to be very limited. These factors could cause construction time extension and cost escalation. In Japan there are many similar cases in which railway related construction work was carried out near active railway track, but these cases exhibit longer construction time, more than ten years, and huge construction cost. Furthermore, it is considered that construction work could disturb the current freight business to some extent. In such case revenue loss compensation might be claimed from SITARAIL. All of this leads to cost increase. Therefore, it is desirable to conduct further cost analysis in detail.

5) Summary of findings

Hereinafter, an evaluation of both transit proposals is made based on the review and analysis conducted in previous reports and documents. Needless to say, as far as it may concern present traffic mobility and people's preference on urban rail transit, there is no data and thus no crucial perspective. Therefore what is mentioned in this section is only for reference purposes, and should be revised after compiling the present traffic database and subsequent analysis. For this purpose, as a tentative conclusion, the preliminary rating for each proposal is presented by various planning items, picking up major issues expected from each transit proposal. The result is shown in Table 3.2. Based on the table, overall project issues are highlighted and the direction of subsequent study is also suggested.

Table 3.2 Summary of Findings in Preliminary Appraisal

No.	Planning Issues	Urban Train		Tramway		Remarks
		Rating	Explanation	Rating	Explanation	
1	adverse effect to existing freight railway services	▲	expecting considerable impact during construction period, and possibly adverse effect on business result.	○	no impact expected due to different project site	
2	physical impact for road traffic	○	no impact expected due to different project site	▲	If ROW is introduced at grade on road carriageway space, 2to 3 carriageways is reduced.	
3	Project liability from viewpoints of land acquisition.	○	ROW will be spontaneously reserved in existing railway space.	○	ROW will be spontaneously reserved in existing road space.	
4	System linkage with other transport modes, including East-West urban transit line.	-	requires specific countermeasures because transit route is located far side of conventional public transport	○	Relative smooth connection is expected because both transit system have same modality.	
5	Difficulty during construction.	▲	Expecting certain restriction on construction space due to interference with existing train operation.	▲	Considerable construction difficulty is expected because construction has to be done in the existing traffic.	
6	Financial difficulty by investment cost.	○	Relatively small amount is needed, comparing to Tramway project. But different interpretation will be possible, depending on further examination.	▲	Higher investment cost is expected, comparing with Urban Train project.	Rating turns to be marginal by further cost verification.
7	Investment risk	-	Not foreseen due to lack of principal data/information.	-	Not foreseen due to lack of principal data/information.	So far, impossible to draw conclusion due to lack of data, especially demand forecast.
8	Sustainability in terms of operation and maintenance for transit services.	-	Not foreseen due to lack of principal data/information.	-	Not foreseen due to lack of principal data/information.	
9	Linkage with land use plan and town planning	▲	Basically project is undertaken in reference to the railway planning standard different from urban planning.	○	Coordination with urban planning is possible in station location planning and train operation plan.	
10	Project planning maturity	○	Preliminary feasibility study completed.	○	Preliminary feasibility study completed.	

Note : Meaning of symbols: ○(relatively positive), ▲(relatively negative), ー(N/A)
Source: JICA Study Team

On the whole at this moment, it is difficult to clarify which proposal would be better to take to the next step. As the priority planning issues for discussion in the next step, the following are suggested.

Table 3.3 Priority Issues

Priority	Viewpoints to split issues in priority setting	Issue No.
1	Issues in which both proposals have a negative rating. Issues in which both proposals have an N.A rating.	5, 7, 8
2	Issues in which the proposals have different ratings.	1, 2, 4, 6, 9
3	Issues in which both proposals have a positive rating.	3, 10

Source: JICA Study Team|

4.0 Significant Transport Issues

4.1 Road

The District of Abidjan is now covered by almost 1,800 km of roads, of which 850 km are paved (Table 4.1), with major arterial roads such as boulevards, avenues and highways running through most of the communes. Two bridges across Ebrié Lagoon link the northern residential areas of Cocody, Yopougon or Abobo and the southern industrial zone spreading from Treichville to Petit-Bassam.

Table 4.1 State of the Abidjan District Road Network (2011)

Communes	Length (km)	Paved Roads (km)	% of Paved Roads	Unpaved Roads (km)
Port-Bouët	55.2	40.0	72%	15.2
Koumassi	126.8	75.1	59%	51.8
Marcory	103.9	84.3	81%	19.6
Treichville	71.8	64.8	90%	7.1
Plateau	26.8	26.8	100%	0.0
Adjamé	120.0	84.6	71%	35.4
Attécoubé	50.0	30.0	60%	20.0
Yopougon	451.5	163.0	36%	288.5
Abobo	125.4	67.7	54%	57.7
Cocody	134.7	109.9	82%	24.8
Sub-Total	1266.3	745.8		520.4
Bingerville	91.1	15.3	17%	76.0
Anyama	276.4	71.1	26%	205.3
Songon	138.5	22.0	16%	116.5
Total	1772.1	854.6		917.5

Source: District of Abidjan, Directorate of Infrastructures and Equipment, Sub-Directorate of Urban Roads and Sanitation

The road network is characterized by deteriorated road surfaces, missing links and insufficient capacity. Traffic congestion can be seen all over the road network during peak hours and nothing has been done to change this trend. Many road projects have been planned for years but have yet to be implemented, putting further pressure on the existing road network.

The following section gives a list of significant issues that need to be tackled to achieve a quality road network that can strongly contribute to the economic development of Greater Abidjan.

4.1.1 Road Condition

The military crisis has significantly increased the deterioration of roads, as the limited financial resources allocated for road maintenance during this period could not cope with the huge needs in road maintenance and repairs. While in 1985, 77% of the paved road network was below its estimated useful life of 15-20 years, today many road pavements need to be replaced or repaired (see Figure 4.1).

The pavement failures seen all over the road network have a direct impact on traffic flow, as drivers are trying to avoid potholes by reducing their speed and changing direction suddenly. This has resulted in slower travel speed and increased travel time, higher accident rate and worsening of traffic congestion. Thus several roads need urgent repairs to reverse this trend.

Figure 4.1 Potholes and Pavement Failure

4.1.2 Road Classification and Maintenance

The latest official road classification was carried out in 1984 and was officially promulgated by Decree No. 84-851. Under this classification, roads were divided into four categories: roads of national interest, roads of district interest, roads of communal interest and private roads.

The current road classification in Côte d'Ivoire is a jurisdictional system rather than a functional classification, resulting in mixed traffic. Thus, from road-planning and engineering viewpoints, it is necessary to clarify the functional classifications and road hierarchy system for the Greater Abidjan area according to the character of service they are intended to provide, so that travel can be channelized within the network in a logical and efficient manner.

4.1.3 Land Acquisition

Most of the roads mentioned in the Master Plan 2000 had already been planned for several years. Many attempts have been made to start the construction of those roads and each time the people living inside the ROW have been compensated to relocate outside the ROW. However, as the road project has not started due to a lack of financing, people started to live illegally again in the ROW. Thus, if the project is again implemented, compensation will again have to be made. This has an economic impact for the State. For instance, the compensation cost for the Abidjan - Bassam expressway is estimated at 8 billion FCFA[16].

It is thus very important to find a way to make sure that the ROW is maintained. A special division of an existing organization should be in charge of checking that no illegal settlements are installed inside the ROW.

[16] According to Ministry of Economic Infrastructure (http://www.infrastructures.gouv.ci/affichage_det.php?recordID=77)

4.1.4 Road Network Integrating Public Transport

The road network has been mainly developed without any consideration of public transport. Although public transport has been declining in recent years, the main objective of the Master Plan 2030 is to restore the credibility of public transport lost during the last ten years.

In order to integrate public transport into the road network, and in particular a mass-transit system, the first step is to secure sufficient space for both road users and public transport facilities along the targeted roads. The ROW width was estimated based on the type of public transport that was selected.

4.1.5 Fast Urban Development

Around Abidjan, fast urban development can be seen, in particular between Cocody and Bingerville where large residential areas have been built at a very fast pace. To meet the growing demands in habitation, several developers are constructing large residential areas. The transport master plan and thus the road master plan took into account all the latest urban development to make sure that they are consistent with each other.

4.1.6 Topography

The landscape of Abidjan District is punctuated by many valleys, called thalwegs, surrounded by very steep slopes that seem to be very unstable. The thalwegs create natural boundaries to quartiers and are most of the time uninhabited as people are reluctant to live in those areas that are used as illegal landfills and can be flooded instantly during raining days. Planners have used this free space to design roads inside those thalwegs as the lands are unoccupied, like the access roads of the 3rd bridge (in orange in Figure 4.2) built inside the Blingue thalweg (25 meters deep).

Those thalwegs can also be seen as obstacles as bridges are required to cross those valleys. As a result, many quartiers are not linked together. For instance, the thalweg (inside the red dotted lines) seems to cut the road network between Riviera 1 to 6 as seen in Figure 4.2. Specific anti-erosion works have to be carried out on both sides of the crossing to stabilize the ground. Thus, this topographic specificity was taken into account when designing the Master Plan 2030.

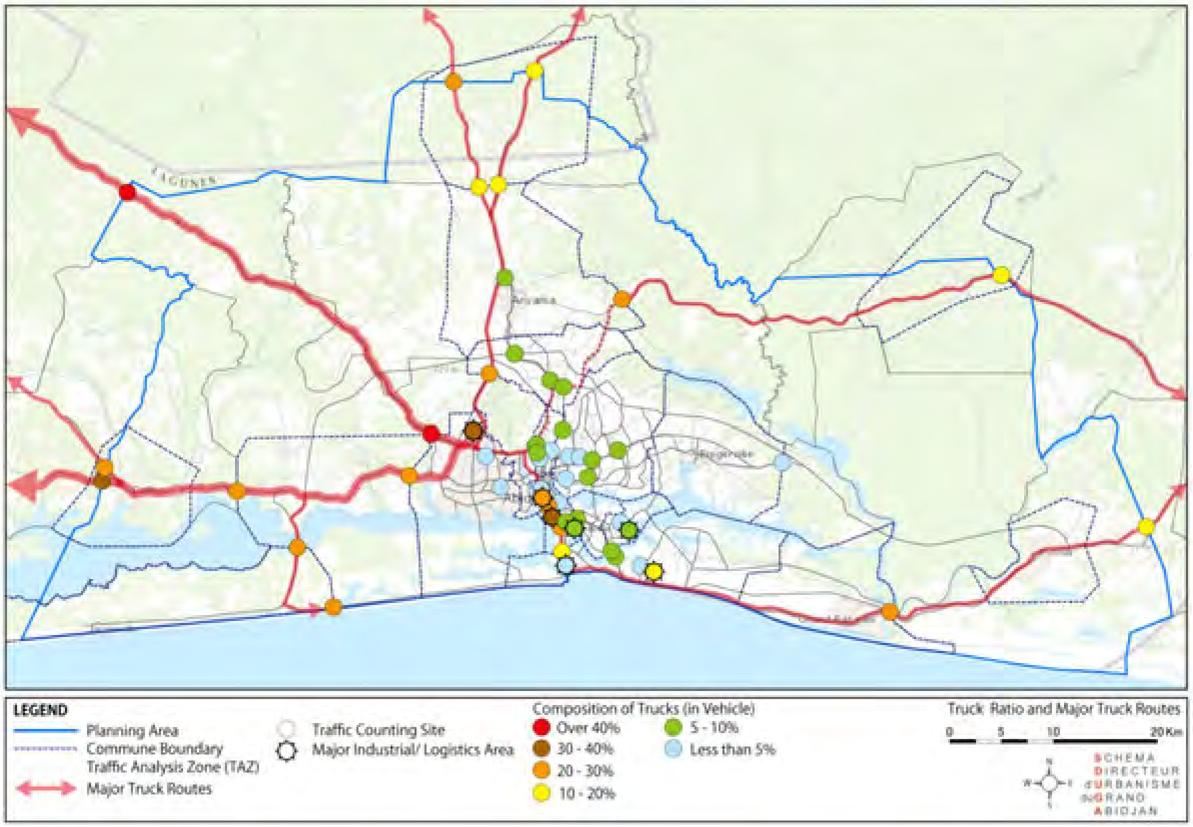
Source: JICA Study Team

Figure 4.2 Thalwegs Segregating the Quartier

4.1.7 Functional Goods Distribution System

Because they are the main roads with a high capacity, many private vehicles take the primary urban roads. Moreover, since the primary urban roads connect the major industrial areas in Abidjan, such as Yopougon, Treichville and Koumassi, via the primary urban roads to Abidjan Port and other major cities in Cote d'Ivoire, it also serves as a freight transportation corridor. Based on the results of the traffic count surveys, the ratios of trucks to all traffic are plotted, and the major truck routes have been identified as shown in Figure 4.3. The access from the northwest and the west can be regarded as the heavy vehicle corridors.

Although freight vehicles (i.e., trucks with more than 3 tonnes or trucks with more than 15 wheels) are banned from entering the central business district (CBD) inside of Plateau except along the expressways around Plateau during the peak hours (i.e., 6:00 - 9:00 a.m. and 4:30 - 8:00 p.m.), these conditions result in high traffic generation. This results in a traffic mix with many slow, heavy vehicles on the existing primary urban roads. Such a burden on the existing primary urban roads should be alleviated by providing alternative roads for both trucks and passenger vehicles.



Source: JICA Study Team

Figure 4.3 Major Truck Routes in Greater Abidjan

4.2 Traffic Control and Management

While there is no clear data regarding the number of vehicles in Abidjan, Table 4.2 presents the number of vehicles by vehicle type based on the number of annual vehicle inspections from SICTA (Société Ivoirienne de Contrôle Technique Automobile et Industriel), a private concessionaire company, which does vehicle inspections. Apart from the decrease in the number of vehicles in 2011, which is considered to be caused by the crisis, annual growth of the number of passenger cars is estimated at nearly 10%. According to former SONATT[17] (Société Nationale des Transports Terrestres), which took charge of vehicle registration in Cote d'Ivoire, there are around 40,000 vehicles (of all types) that are newly registered in Greater Abidjan every year.

Table 4.2 Vehicle Population in Abidjan from 2010 to 2012

Vehicle Type	2010	2011	2012
Light Vehicles (Incl. Passenger Cars and Vans)	127,760	125,843	149,050
Heavy Vehicles (Incl. Buses and Trucks)	20,131	18,649	21,245
Tractors	2,091	3,010	3,049
Semi-Trailers	2,608	3,121	3,549
Meter Taxis	16,047	15,077	18,773
Communal Taxis	14,662	12,848	17,413
Bush Taxis*	69	0	1,012
Total	185,378	180,559	216,103

Note:* Fixed-route taxi going to remote area.
Source: SICTA, based on the data collected at five stations inside Greater Abidjan.

Traffic conditions in Abidjan have already reached an intolerable level and the congestion is serious and widespread. Demand exceeds capacity at many intersections, causing severe congestion for many hours of the day. To alleviate the congestion, traffic management measures have been applied with limited success so far. Traffic management is becoming increasingly important in urban areas where scarce road space is already occupied by vehicles. Measures to enhance the attractiveness of public transport are also a part of traffic management to improve overall efficiency.

4.2.1 Traffic Signal Control

Traffic signals are a basic tool for controlling vehicular and pedestrian movement at intersections. In the history of traffic signals, the Ivorian government considered the development of their road signals after their independence in 1960 and the first traffic signal was installed in Abidjan in 1963. Since then, 230 traffic signals have been installed. Most of the equipment or materials for the existing traffic signals have been supplied from Europe (France, Italy, etc.). Some equipment also came from China.

The maintenance and control of the traffic signals are done by AGEROUTE, which is a government agency that supervises the construction of roads and their maintenance. There is a traffic management department that includes traffic signalization in AGEROUTE. Accordingly, no one other than AGEROUTE can adjust the signal timing of the traffic signals. Signal timing was prepared when these

17 SONATT was dissolved on August 6, 2014, and now a Columbian group, Quipux S.A., which specializes in the development of integrated transportation management systems, has got a public service concession of issuing driving licenses with IC chips for six years.

traffic signals were initially installed. Subsequently, signal timing has not been adjusted except for when inadequate timing is found as a result of disparity of traffic conditions among the approaches. Therefore, as the traffic volume increases, for example, at peak hours, it cannot be controlled by the traffic signals. When there is a need, the police sometimes direct the traffic at peak hours, disregarding the traffic signals.

The government has a project to modernize the control of traffic signals at all intersections in the center of Abidjan District. In addition, they see the need to install another 30 to 40 signals in currently uncontrolled intersections.

The existing traffic signals are not performing at full capacity as they are operated only in the time-of-day mode. No traffic condition data are collected, and signal control is not responsive to the changing traffic conditions. A more efficient control of traffic signals is possible if more vehicle detectors and Area Traffic Control (ATC) systems are installed and traffic condition data are collected. To realize a more effective signal control system, traffic condition data must be collected in real time, which in turn requires a reliable communication system.

4.2.2 Traffic Information Systems

As the number of automobiles has rapidly increased in Abidjan, traffic congestion has become increasingly serious. In light of this situation, it has become important to identify the bottlenecks responsible for traffic congestion using intelligent transportation systems (ITS), and to disperse traffic through the above-mentioned optimal traffic signal control and the provision of traffic information. Traffic conditions on the road sections between intersections should also be monitored as well. In addition to traffic monitoring, an efficient and inexpensive way of compiling data and disseminating traffic information is also necessary for Abidjan.

4.2.3 Traffic Management on Highways

The government has highways that it wants to turn into expressways soon. One is the Abidjan-Yamoussoukro Highway (Autoroute du Nord) and another is the Abidjan-Bassam Highway, which is currently under construction. These highways will have tolls chargeable for drivers who will use the routes. The tolls will be based on the distance traveled by the vehicles. The toll payment will be done by several means. The control and maintenance of the expressways will be done by private companies in the future, but for now, it will be undertaken by AGEROUTE.

Existing highway traffic surveillance facilities are very limited in coverage and function. Traffic condition monitoring now relies on the manual method of patrol cars, which cannot cover the entire highways at short intervals. As a result, detection of an accident takes time and the information is limited as it comes only through reporting from the patrol cars.

Such a situation stems from the fact that there is no comprehensive traffic information system or no effective traffic surveillance. In addition, efficient processing of collected data and timely dissemination of the traffic information to the road users are necessary. Traffic information is useful both for drivers who are already on the road and for those who are planning to travel using the highways. Variable Message Signboards are necessary for the former, while the internet provides pre-trip information. FM broadcasting serves both.

4.2.4 Control of Overloaded Vehicles

There is an overload detection device being built right outside of Abidjan along the route to Yamoussoukro (Autoroute du Nord) that detects overloaded vehicles. The government intends to build two of these systems in fixed locations and have 10 mobile units along the highway.

The construction of the Overload Detection Devices is part of the implementation of the Program of Community Action Infrastructure and Road Transport (PACITR) and the application of Regulation 14/2005/CM/UEMOA adopted by the Council Ministers of UEMOA (Union Économique et Monétaire Ouest-Africaine, West African Economic and Monetary Union), on the harmonization of standards and control procedures template, weight and axle load of heavy vehicles transporting goods. To do this, the UEMOA Commission has therefore decided to support the member states in building and equipping a weigh station on the community network of each of its member states. AGEROUTE is in charge of the implementation of the project.

In Abidjan, an increase of overloaded transport of international freight is foreseen along with development of a future large-scale port and arterial road network. While introduction of the axle-load-measuring device has been implemented in part, it is not being operated in the current situation. Currently, large ruts are being made by overloaded vehicles on the asphalt pavement of the bridges and the arterial roads connecting to the port. The structure of proper large-size freight vehicle management has not been established, and development and enforcement of such regulations are required for road operation and maintenance.

4.2.5 Enforcement of Traffic Regulation

Generally, arterial streets in Abidjan have pavement markings (lane lines, turn arrows, stop lines, pedestrian crossings, etc.). However, most of them are worn out and not functioning well. There are no delineators and therefore road separation is made with concrete guardrails of the New Jersey type, which makes it difficult to change traffic regulation. Moreover, safety is not ensured because they are hard structures made of concrete that cause great damage to the vehicles when accidents occur.

As for the pavement markings and traffic regulation signs built in Abidjan, a French standard (XP P98-501, XP P98-531) is the basis. Some traffic regulation signs still remain, but traffic regulatory signs in the study area are still suffering from the effects of the crisis and are currently not in acceptable condition.

Trucks are not allowed to pass though Plateau during the time periods of 6:00 to 9:00 and 16:30 to 20:00, excluding the highways surrounding Plateau. This regulation is applied for trucks whose weight is more than 3 tons with more than 15 wheels; however, delivery trucks are allowed to pass through Plateau anytime. The current truck ban, which is applied to the roads in Plateau, may also need to be reviewed as to whether other roads or other trucks should be included or more hours should be added to ensure a more efficient use of the existing roads.

4.2.6 Parking Management

Some parking inside buildings is managed by the private sector and public parking is managed by Abidjan Autonomous District (AAD). AAD dispatches enforcers to keep parking organized by leading parking users to maintain proper usage of the parking. Parking in front of private premises such as restaurants, can be utilized legally if the applicant pays tax to AAD, and if road space is not occupied by the car. However, illegal on-street parking outside designated parking areas is reducing the number of available driving lanes, consequently reducing road capacity and increasing travel time and eventually traffic pollution.

Meanwhile, as for the off-street parking facilities, Table 4.3 summarizes the peak hour parking occupancy ratio of the surveyed parking facilities in Plateau. In fact, there are several parking facilities that show low occupancy rates, which might be due to the preferences of the drivers who do not intend to use parking inside the building, especially in the basement and because permission for usage of the parking is required for the security reasons. While many of the parking facilities are free to use, they are underutilized.

Table 4.3 Parking Fees and Occupancy Ratios in a Peak Hour at Major Parking Facilities in Plateau

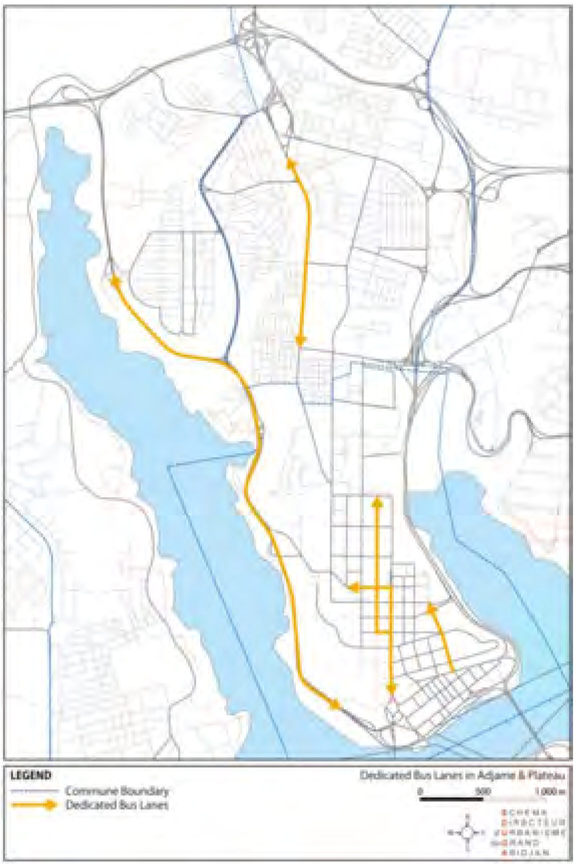
Facility Type	Location of Parking Facility	Parking Fee		Parking Ratio
Governmental Office Building	Cité Administrative TOUR C	Free	No Parking Lots	0.25
	Immeuble POSTEL 2001	Free	No Parking Lots	0.19
	Immeuble SCIAM	Free	No Parking Lots	0.49
	Cité Administrative TOUR D	Free	No Parking Lots	0.39
	Parking Hôtel de ville (district)	Free	No Parking Lots	1.04
Private Office Building	Immeuble JECEDA	Charged	3,000 FCFA for every month	0.04
	Immeuble Pharmacie Long Champ	Free	No Parking Lots	0.47
	Immeuble HARMONIE	Free	No Parking Lots	0.13
	Parking NOUR AL HAYAT	Charged	1,000 FCFA for first hour 500 FCFA for each additional hour 69,000 FCFA for 3 months	1.12
	Immeuble NABIL	Free	No Parking Lots	0.36
Commercial Building	Immeuble Hôtel IBIS	Free	No Parking Lots	0.76
	Parking Amenagé Super Trade Center	Charged	500 FCFA (Fixed price, free of charge if expenditure is more than 5,000 FCFA)	0.99
	Immeuble les HEVEAS	Free	No Parking Lots	0.46
	Immeuble SGBCI	Free	No Parking Lots	0.80

Source: Parking Facility Survey, JICA Study Team

Thus, parking regulations and strategies, especially for on-street parking, also need to be reassessed to guarantee a more efficient use of roads in the CBD. It should also be noted that consideration must be given to ensuring that business and commercial activities along the roads, especially in Plateau, also benefit from any action or decision.

4.2.7 Priority Treatment for Public Transport

In a city like Abidjan where rail-based public transport has limited capacity and the majority of people rely on road-based public transport, buses deserve more favorable treatment to enhance their attractiveness. However, because of their substandard service level and undisciplined traffic behavior, public transport is not considered a good public service that provides people with mobility at an affordable price. Dedicated bus lanes in central Abidjan are shown in Figure 4.4. Though the bus lanes should be given priority, buses are often caught in more severe congestion.



Source: JICA Study Team

Figure 4.4 Dedicated Bus Lanes in Central Abidjan

4.2.8 Traffic Safety

OSER (Office de Sécurité Routière) takes charge of traffic accidents and road safety, in cooperation with police, to enforce traffic violations. The number of traffic accidents, injuries and deaths from 2002 to 2012 is shown in Table 4.4. It shows a 46% increase of the total number of these kinds of phenomena from 2003 to 2012, excluding 2011.

Table 4.4 Number of Traffic Accidents, Injuries and Deaths from 2003 to 2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Deaths	190	166	180	145	119	106	147	132	108	172
Serious Injuries	1,293	1,220	1,496	1,985	1,994	2,090	1,923	2,349	1,682	3,076
Minor Injuries	4,662	4,523	4,905	4,740	4,626	5,075	5,570	4,677	2,397	5,835
Accidents	4,070	3,691	4,171	4,775	4,625	4,961	5,525	5,310	2,901	5,856
Total	10,215	9,600	10,752	11,645	11,364	12,232	13,165	12,468	7,088	14,939

Source: OSER

Among others, as shown in Table 4.5, the number of accidents in which pedestrians are involved has been increasing noticeably. Thus, pedestrian safety is of utmost concern. Pedestrian bridges, especially along busy main arterial roads, are insufficient in number. In order to reduce accidents involving pedestrians, more pedestrian bridges should be provided. In addition, narrow or poorly maintained sidewalks along the arterial roads need to be improved, since sidewalks of good quality will enhance not only pedestrian safety but also the urban amenity and environment. Furthermore, traffic education programs and campaigns, as well as stricter traffic law enforcement, should be promoted to reduce the number of traffic accidents as well as to minimize traffic disturbance (see Table 4.5).

Table 4.5 Traffic Accidents by Vehicle Type in Abidjan from 2003 to 2012

Type of Vehicle	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pedestrian	2,846	2,435	2,893	3,479	3,355	3,542	3,822	3,814	1,828	4,194
Bicycle	5	2	1	2	16	2	7	37	3	11
Motorcycle	88	57	18	86	108	112	179	282	204	386
Private Vehicles	1,309	1,154	1,472	1,508	1,300	1,456	1,500	1,732	951	1,753
Meter Taxi	637	575	699	823	696	728	667	769	414	960
Gbaka	398	367	441	554	639	810	750	696	259	694
Bus (SOTRA/Private Bus)	175	172	172	148	143	170	131	112	56	165
Truck	104	112	101	126	87	81	114	79	65	139
Total	7,565	6,878	7,802	8,732	8,351	8,909	9,179	9,531	5,791	10,314

Source: OSER

4.3 Public Transport

4.3.1 An Overview

Currently, public transport in Abidjan principally operates on only two rights of way, namely that of the road and that of the lagoon. In the future, there is a plan to operate public transport on the existing international rail alignment. Today, public transport currently attracts around nine million boarding each day. In Abidjan, both the formal and informal sector operates on both rights of way.

There are few policies in place currently to support the goal of access to enhanced mobility for all in Greater Abidjan. The polices that need adoption must be guided to provide a comprehensive and integrated public transport network that is convenient, user-friendly and accessible to all income groups to serve all urban centers, both district and neighborhood, whilst providing access to local community facilities, employment centers, leisure sites and tourism sites. To this end, the SDUGA team plans to promote the following key initiatives in relation to public transport:

- Promotion of high-capacity public transport corridors;
- An enhanced bus system; and
- A review of the informal public transport sector.

Today, movement in Abidjan is mainly via public transport as there is low car ownership. Most are used to public transport so this is an opportunity to maintain this mode split even as more people gain access to a car. However, most public transport passenger trips are in the informal sector.

4.3.2 Road-Centric Public Transport

A key issue at present is that the public transport service is provided largely by the informal sector. Bus services are concentrated on routes originating from suburban areas and ending in several city terminals such as Adjamé or the Plateau. The informal sector currently accounts for 85% of public transport trips. This consists of the following principal modes:

- Gbaka;
- Meter taxis;
- Intra-communal taxis (Woro-Woro); and
- Shared, fixed-route, inter-communal taxis (or illegal Woro-Woro).

The informal sector has grown at the expense of the formal sector. Although the population of Abidjan has increased over the last ten years, as described in Part 1 of this report, the number of SOTRA bus passengers has declined from a high of over 700,000 per day in 2001 to a little over 400,000 by 2012, as seen in Figure 1.15. The informal sector has effectively taken the role that is the domain of the formal bus sector. There are several likely reasons for this:

- Lack of proper infrastructure (i.e., bus-exclusive lanes), which would keep the bus operation from traffic congestion;
- Decrease in size of the bus fleet, due in part to the above-mentioned financial problem, causing an overcrowding situation on buses and impairing the quality of service, such as frequency and coverage;
- Flexibility of the informal sector; and
- Increase in car ownership.

A reversal of this situation requires a change in the direction of road-centric public transport, as discussed in further detail in Chapter 5 of Part 6.

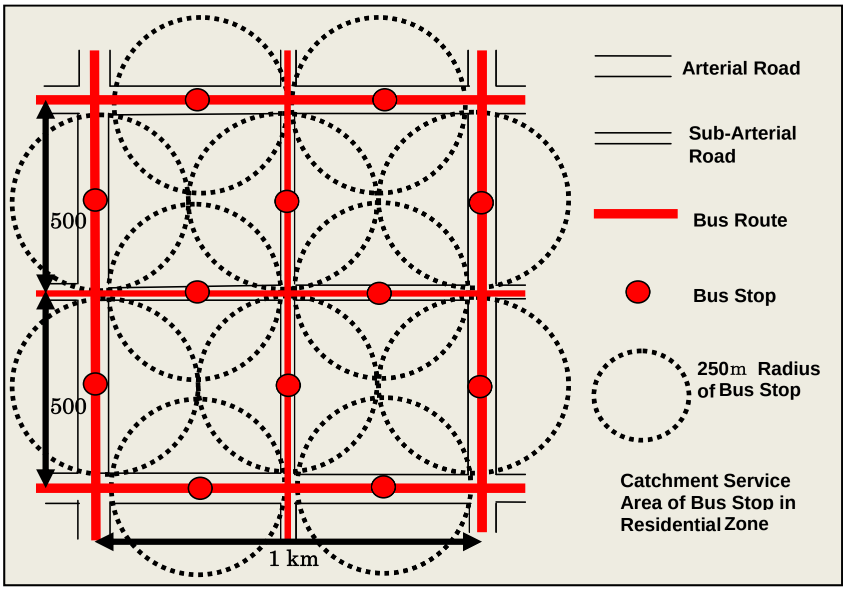
4.3.3 Consideration of Bus Route Structure

Bus routes are categorized into four types from a planning point of view, namely, line-haul bus services on high-capacity corridors, circulator bus services within major centers such as the CBD, circumferential routes and suburban feeder bus services. The circumferential routes[18] would provide linkages between major activity hubs without the need for coming into the center to access an adjacent hub. The viability of bus route restructuring is dependent on future travel demand.

If the demand warrants, the line haul routes will become the prerogative of the formal public transport structure. The role of the informal sector such as Gbaka, Intra Communal Taxi or Woro-Woro can then focus on circulator and feeder routes and possibly the need or otherwise for circumferential routes. Whilst it is common to have a circular route in a CBD, in Abidjan consideration should also be given to the need of such routes within the individual communes.

[18] Alternatively, one may consider three levels of public transport, namely, a primary, secondary and tertiary level, with both the circulator and feeder services set into the latter category.

In fact, a majority of public transport users residing in suburban areas would desire the improvement of feeder bus services in terms of accessibility, frequency and punctuality. This is the most vital point to strengthen the intermodal system of the overall public transport network. Ideally, all the residential areas should be served and covered by feeder public transport within about 250 meters from the nearest bus stop. Consequently, as shown in Figure 4.5, the interval of parallel bus routes should be about 500 meters at maximum, and intervals of bus stops should also be 500 meters at maximum. For this, even the informal sector, such as Gbaka could take this role to develop into "formal" minibus services.



Source: JICA Study Team

Figure 4.5 Conceptual Structure of Bus Service Network

Such internal communal routes would change the role of the currently dominant informal sector. For example, a circular route feeding the central Plateau could possibly originate from the existing inter-modal bus and ferry SOTRA terminal at the base of the Plateau.

4.3.4 Provision of More High-Capacity Public Transport Services

As observed in many metropolitan areas, road traffic demand overwhelmingly exceeds the capacity of the road network, causing chronic traffic congestion, especially in and around the Central Business District, which in Abidjan is in effect the commune of the Plateau. In terms of urban transportation, priority must be given to the mobility of people not cars. In that context, public transportation should be given priority over private vehicles to secure smoother travel for those who use public transportation. The capacity of a car is five to six people, whereas the capacity of a bus is 50 or more people. The road system is a limited resource. Such a resource one must use efficiently.

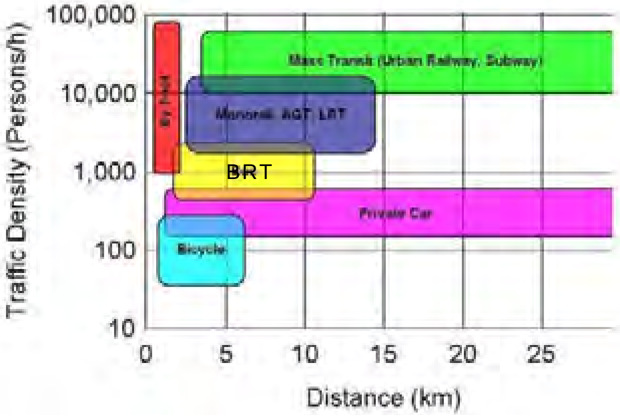
Currently SOTRA has identified five potential line haul routes or high-capacity routes, as follows:

- Western Route (Yopougon to Adjamé);
- Northern Route (Anyama to Adjamé);
- Eastern Route (Bingerville to Southern Plateau Station);
- Southern Route (Grand-Bassam to Southern Plateau Station); and

- Central Route (Adjamé to Southern Plateau Station).

These priority corridors identified by SOTRA are all, in essence, part of the previously identified north-south and east-west high-capacity public transport corridors. The possibility of applying the Bus with High Level of Service (BHLS) system to more arterial roads is examined with regard to forming a continuous network for buses. Furthermore, the introduction of BHLS and new transit malls where many bus routes meet on these bus priority lanes may be developed in conjunction with land use.

After investigating people's travel demand and its forecast, land use plans, and development directions in Greater Abidjan, a new rail-based mass transit system should likely be a recommendation[19] of this study for the high-capacity public transport corridors. Whether to develop the new mass transit system as rail- or bus-based transportation, such as BRT, is dependent on the demand forecast and the service distances on the corresponding transportation corridors, as illustrated in Figure 4.6. However, it should be noted that future passenger demand also varies depending on the attractiveness and convenience of the new mass transit system, including its accessibility and linkage with other transportation modes.



Source: Amano, et al. (1990), Zusetsu Tetsudo Kougaku, Maruzen

Figure 4.6 Urban Public Transportation Systems by Passenger Density

4.3.5 Integration of the Informal Sector

The informal services are currently an integral part of the transportation system of Abidjan. It is possible for all of these services to be re-engineered to support the line haul high-capacity corridors as feeders. The locations with a high density of feeders linking to line haul systems become opportunity locations for Transit Oriented Development (TOD) Centers. The current operation of the informal services is such that they provide a convenient but chaotic service.

The development of a feeder service to high-capacity public transport corridors could incorporate the use of the existing Gbaka fleet whilst the development of the circular routes, especially within communes, is also a likely use of the Gbaka fleet. The missing element in this system is the future role of the Woro-Woro, which currently provides an important local role. The integration of the Woro-Woro to an efficient public transport system needs further consideration in consultation with the direction of the future land use plan.

[19] As is discussed in Chapter 7, the demand on certain corridors confirms the need of urban rail transport.

4.3.6 Rail-Centric Public Transport

(1) An African Perspective

For the last several decades, the African railways have been operated under state ownership, with favorable conditions provided by the governments. However, while most national economies and national railways have been liberalized considerably, today, most railways in Africa, excluding that of South Africa and dedicated mineral lines, are not essential to the functioning of the state economy due to the strong inter-modal competition with road transport.

Many attempts to introduce commercialism into publicly owned railways have failed. Most countries in Central, East and West Africa have moved all or part of the way to a system of concessions. Concessions in general have improved the operation performance and in most cases increased the carried volume. This is a result of the railway operation being more efficient.

(2) Existing Passenger Transport

The existing railway system provides inter-regional freight and passenger railway services, which connects between Cote d'Ivoire and Burkina Faso. Its route length is 1,155 km from Abidjan of Cote d'Ivoire to Ouagadougou of Burkina Faso and it is a non-electrified railway system with a single track in meter gauge. This service currently attracts around 100,000 passengers per year. This is or on average less than 500 passengers per day and the number of passengers has been in decline since 2008.

To gain a competitive position in the long distance transport market, railway should upgrade its facilities and equipment to enable high-speed and frequent train operation. This direction is desirable, but this obviously requires a huge investment cost. Within the framework of this project, the important feature of the existing rail service is that it provides a potential alignment for urban rail through the center of Abidjan.

(3) Urban Railway System Development

As mentioned in the previous urban master plan in 2000, there are several urban transit proposals and they become medium- to long-term transport issues. In the rail-based mass transit system, there are several system types existing, from the metro-type train to a medium-capacity tramway system. The selection of the rail-based transit system impacts the overall urban transport performance. This becomes an important issue from the viewpoints of transport demand and economic and financial requirements for system introduction.

In general, the following items are the issues[20] to develop rail-based mass transit:

- Transport demand forecast;
- Station location, including modal interchange points;
- Operational control (private or public ownership); and
- Selection of the appropriate technology (capacity, service characteristics).

[20] Consideration at this level of detail is undertaken in a feasibility study.

The existing international and freight rail corridor through the center of the city provides an excellent opportunity for the introduction of urban rail.

4.3.7 Lagoon-Centered Public Transport

At present, there is an under-utilization of the water system in Abidjan as a provision of public transport. Of the public transport passengers carried daily by SOTRA, less than 5% use the waterways of Abidjan. As in the case of SOTRA buses, the SOTRA water buses have seen a decline in passengers in recent times. In 2012, SOTRA water buses attracted only 18,000 passengers. In contrast, in 2009, SOTRA attracted 36,000 passengers with a market share of 60%[21]. The remainder of lagoon transport was on the Pinasses, the informal sector. This informal sector is understood to have a poor safety record.

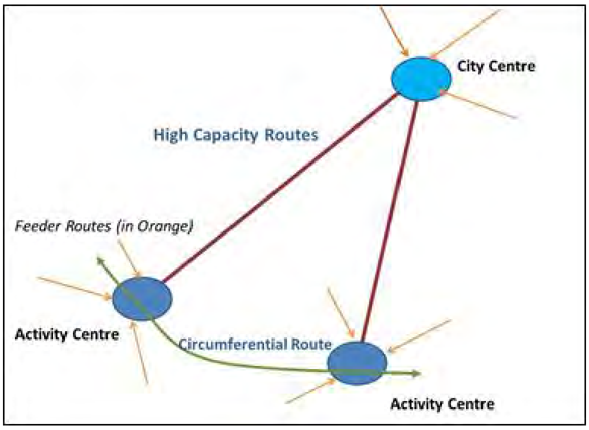
With full public transport integration, local services in the communes west of Plateau could feed to the waterways and link to fast efficient water-based public transport. The waterfront would then see improvement of significant renewal. These water terminal stations then have the potential for urban renewal and transit-orientated development. As is discussed in later sections, SDUGA proposes a major upgrade of the existing lagoon transport service with the main east-west axis operating from Bingerville to Songon.

4.3.8 Integration of Public Transportation

The integration of public transportation should focus on the following two aspects.

(1) Integration of Major Transportation Modes

High-capacity land corridors attract the appropriate technology whether it is bus or rail. These high-capacity corridors, in conjunction with lagoon transport, link activity centers, as seen in Figure 4.7. Access to these high-capacity corridors is expected by bus or the informal sector. A reorganization of the bus route structure is required to provide feeder bus services to provide convenience to potential users of the high-capacity corridors.



Source: JICA Study Team

Figure 4.7 Connectivity of Major Activity Centers

[21] Source: Ministry of Transport

In addition, the introduction of a common fare system would be convenient to public transportation passengers because they could utilize one ticket for several modes. It would also allow free, or at least discounted, transfers between different modes of public transportation. Moreover, it would be another incentive for current private vehicle users to shift to public transportation.

(2) Integration of Public Transportation and Land Use

For an effective integration of land use and transport, it is necessary that the trunk routes or high-capacity public transport routes focus on the principal centers of activity in Abidjan. At these points of integration and transfer, a common ticketing system that is usable on both feeders and the trunk route public transport system would be helpful.

This would likely create a radial route of high-capacity public transport corridors. In addition to this, it is likely that there is a need for future circumferential routes that link development centers or hubs. The necessity and time of the implementation of such routes would need to be based on the analysis of future demand.

4.4 Freight Transport

4.4.1 Road Freight Transport

(1) Current Situation of Road Freight Transport Sector

Road freight transport is the main means of cargo transport inside Greater Abidjan. Food processing, export products or manufactured products, all are transported by road; only a small portion is carried out by rail. Thus the major role of road infrastructure in the economic development of the country cannot be denied. The State of Cote d'Ivoire has quickly understood the importance of this sector in its economic development and has put effort into developing and modernizing road transport, and the building of many roads. However, during the last 15 years, the socio-military crisis has disrupted the road freight transport industry, which is now characterized by the following:

- Informal and disordered operation of road freight transport by a multitude of private companies;
- Lack of control by the public authorities;
- Lack of road freight transport statistics; and
- Increase of racketeering and corruption.

As a result, road freight transport has become a liability to the Ivorian economy, causing significant shortfalls for the state and carriers.

(2) Road Freight Transport Issues

1) Lack in Freight Transport Management

Currently, both public authorities and freight transport stakeholders do not have at their disposal a system to properly manage freight transport operation services. This situation has resulted in the increase of corruption and racketeering due to the opacity of the system. Procedures for transactions are complicated, reducing the efficiency of the transport operation services and increasing, at the same time, its cost.

In order to address this issue, the Ministry of Transport is trying to implement a new data system that is expected to achieve rational management of freight transport.

2) Deteriorated Road Conditions

Road deterioration due to lack of maintenance has become a growing issue in Cote d'Ivoire. The country has been spending much less than is necessary to adequately maintain the road network, and road assets are deteriorating at an alarming rate. As roads facilitate the movement of goods, the deterioration has been a key factor in the loss of economic development and employment opportunities and in the increase of transport costs as damaged roads impose higher costs on transporters as operating costs are higher.

3) High Prices in Freight Transport

As is often the case in other African countries, road transport in Cote d'Ivoire is characterized by high prices that affect the country's competitiveness and economic growth, as trade is highly sensitive to transport costs. Those high prices are due to several factors: low trucking industry in Côte d'Ivoire and Africa as a whole, poor infrastructure, low levels of competition between service providers, high fuel prices, but also extortion and other annoyances.

4) Overloading

Although axle-loading regulations exist in Côte d'Ivoire (Regulation No.14 / 2005 / CM / UEMOA, which harmonizes the standards and control procedures, and the weight of the axle load of heavy transport vehicles' goods in the member states of the UEMOA), their enforcement has long been impossible because of the lack of axle-weighing equipment.

This has resulted in many overloaded trucks on the road, damaging the road pavement and substantially increasing air and noise pollution.

5) Multitude of Actors

The road freight transport market in Cote d'Ivoire is known for its lack of transparency and the multitude of actors involved. Carriers have to pass through intermediaries, which results in higher operating costs. The current regulatory framework needs to be improved so that supply and demand can be linked via an effective organization and monopolies can be regulated.

4.4.2 Railway Freight Transport

(1) Current Situation of African Railway Sector

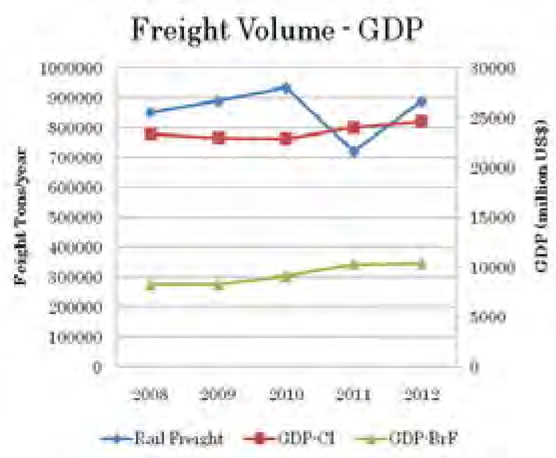
For the last several decades, the African railways have been operated on a state ownership basis with favorable conditions provided by governments. However, while most national economies and national railways have been liberalized considerably, today, almost all railways, excluding those of South Africa and dedicated mineral lines, are not essential to the functioning of the state economy, due to the strong intermodal competition with road transport.

After many attempts to introduce commercialism into the failing publicly owned railways, most countries in Central, East and West Africa have left all or part of the railways to a concession system. Concessions have improved operation performance, and in most cases they have increased transport volume and railway operation efficiency.

(2) Freight Transport Issues

Before the railway concession by SITARAIL[22], railway freight volumes were around 250 thousand tons per year. The railway freight volumes transported by SITARAIL had shown a steady growth trend since 1995 and reached their highest volume, i.e., 1 million tons, in 2001. However, this favorable situation was interrupted in 2002 due to the crisis in Cote d'Ivoire (CI) at that time. As a result, railway cargo volumes have dropped drastically to almost 200 thousand tons. During this period of turmoil, SITARAIL suffered damage to its railway assets, such as track and equipment.

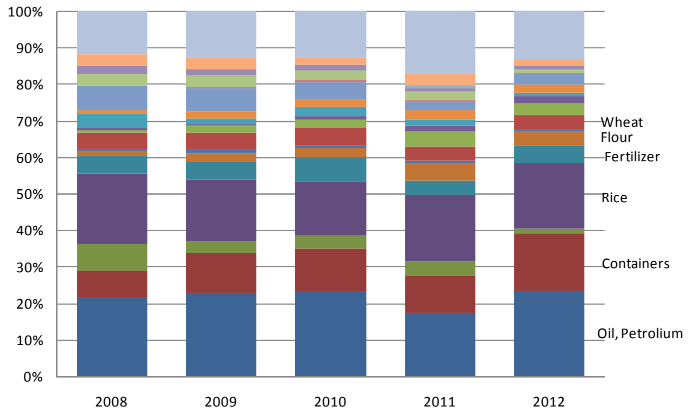
After 2004, railway freight volumes recovered at a swift pace to around 900 thousand tons. In Figure 4.8, the GDP (Gross Domestic Product) of Cote d'Ivoire and Burkina Faso are displayed along with the railway freight volumes. The GDP of CI seems to affect the railway freight volume slightly with a one- to two-year time lag; however, no clear evidence is observed. Freight volumes by cargo type are shown in Figure 4.9. Primary goods types are oil and petroleum, followed by containers and rice. These three items cover around 60% of the total freight volumes, including both domestic and international freight. However, most of them are considered to be international transit cargos to neighboring inland countries, i.e., Burkina Faso and Mali, due to the locational advantage of Abidjan's port in the western Africa region.



Source: SITARAIL

Figure 4.8 Railway Freight Volume and GDP

[22] SITARAIL was established in 1995 as a railway operation concessionaire entrusted by the contract agreement with the Governments of Cote d'Ivoire and Burkina Faso, one of the group companies belonging to Bollore Logistics, who is a major shareholder of SITARAIL. As a corporate profile, its human resources consist of 1300 permanent staff and it works in close collaboration with about 250 subcontractors, and its highest transport performance was achieved in 2001, i.e., 1.2 million tons of cargo and 250 thousand passengers were transported.



Source: SITARAIL

Figure 4.9 Trend of Goods Compositions by Railway Freight

As a background, there are several other internal factors, such as transport capacity constraints due to poor track conditions and a shortage of rolling stock, especially locomotives. In this regard, it is urgent for SITARAIL to improve its railway facilities significantly.

A weak aspect of railway freight transport is that it can only provide transport between stations, but cannot transport between the railhead and ultimate origin/destination. To overcome this situation, it is necessary for the freight railway to focus on specific freight markets in which the railway can provide freight services in a front-end type, such as petroleum and containers.

(3) Issues Related to Interaction with Urban Train Project

The urban train project assumes coexistence with current freight railway services and use of the same railway track facilities. Thus, several issues are pointed out as follows:

- It is necessary to adjust the train operation schedule to accommodate both freight trains and passenger trains. According to the urban train study, the number of urban trains is small enough that both passenger and freight train operations can share the tracks, except during peak hours. However, there is a large speed difference between passenger trains and freight trains, and this may affect railway safety and make train operation less effective.
- To allow freight trains to run on the same rail track, it is necessary to upgrade freight railway facilities and electrify them as well. As this investment cost might be a considerable amount, who will pay the cost becomes a serious issue.
- Current freight railway services are provided by SITARAIL under a concession contract with the Cote d'Ivoire Government and Burkina Faso Government. Railway assets are owned by the Government, and SITARAIL pays a leasing fee and interest for borrowing funds. If an urban train is operated by a third party other than SITARAIL, several issues are raised regarding sharing the track access charge and the cost of track maintenance, etc.

4.5 Analysis of the Transport Sector in Greater Abidjan

Based on the discussion of the problems and issues faced by each sub-sector of urban transport in Greater Abidjan, a SWOT analysis was done. The SWOT analysis model was conducted to determine how the Study area positioned its transport sector. The SWOT analysis model is expected to provide policymakers the opportunity to maintain, build and leverage its strengths, prioritize and optimize its opportunities, remedy its weaknesses and counter its threats in order to achieve a more robust urban transportation network. The result of the analysis is shown in Figure 4.10.

	Helpful In Achieving Progress	Harmful In Achieving Progress
Internal in Origin	Strengths • Increase of mobility brought about by upgrade of roads and upgraded bus fleet and facility • Expected revenue from parking fees and highway tolls due to growing parking and traffic demand • Informal sector of Gbaka and Woro-Woro ensures maximum flexibility in service • Relatively large mode share of public transportation • Potential for capacity expansion of the existing bus system (New buses will likely immediately increase bus ridership.) • Relatively longer acceptable walk distance for a tropical region • Improvement of intermodal facilities such as in Adjamé • Existing hard/soft technology in conventional railway • Existing railway line on the major travel axis of the metropolitan area • High-density sprawl areas have strong need of high-capacity public transport systems.	Weaknesses • Poor road infrastructure in many parts of Greater Abidjan • Lack of a functional hierarchy of the roads resulting in mixed traffic • Traffic concentration into Plateau and congestion on radial roads and bridges • Decreasing road capacity in Plateau, often caused by traffic disorder and roadside parking due to insufficient parking space • Public and private vehicle drivers not observing traffic rules. Lack of traffic monitoring/enforcement systems. • Insufficient network coverage of conventional bus services • Lack of intermodal/transfer facilities and services • Low level of bus services such as overloading, slow speed and insecurity. Even "Express" bus is not providing express service. • Non-existence of high-capacity routes such as rail or BRT • No priority given to public transportation • Decreasing number of bus and rail passengers (Bus passengers have declined by 40% over the last ten years)
External in Origin	Opportunities • Low proportion of car transport (Hence easier to maintain high public transport mode) • Relatively low popularity of 2-wheel vehicles, comparing with Asian region • Development of new public water transport to enhance east-west connectivity • Increase in social housing to the east of the city along major road (add better PT route) • Creation of new industrial centers to the west of the city and elsewhere • Linkage with Abidjan Port and its potential development	Threats • Increasing number of automobiles and private vehicle trips • Many work trips must pass through Plateau to travel from low income residential areas in the north to workplaces in the south/west • Urban sprawl will not produce high ridership corridors needed for either rail or bus mass transit • Urban development structure depends on use of private vehicles • Impediments in bureaucracy, corruption and gap between the rich and the poor • Lack of stable electric power supply

Source: JICA Study Team

Figure 4.10 SWOT Analysis of Transport Sector in Greater Abidjan

Japan International Cooperation Agency (JICA)
Ministry of Construction, Housing, Sanitation and Urban Development (MCLAU)

The Project for the Development of the Urban Master Plan in Greater Abidjan in the Republic of Côte d'Ivoire (SDUGA)

Final Report

March 2015

Volume III
Urban Transport Master Plan for Greater Abidjan

Part 6
Urban Transport Master Plan for Greater Abidjan

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1.0 Planning Objectives and Strategies

1.1 Goals of Transportation System Development

Based on the vision and planning objectives for development of Greater Abidjan, as well as the planning issues associated with the urban transportation sector, the following three main goals of transportation system enhancement in Abidjan have been identified:

- Efficiency,
- Equity, and
- Better Environment.

Each of the above goals is explained below.

1.1.1 Efficiency

An efficient transportation system should be developed to strengthen urban functions, to enhance people's quality of life, to facilitate economic activities, and to sustain stable economic growth in Abidjan. It is of great significance to achieve efficiency by decreasing negative externalities such as economic loss of travel time caused by increasing traffic. Efficiency in transportation is achievable by balancing the growing travel demand and the transportation infrastructure supply or innate capacity.

There are three ways to balance the demand and the supply: 1) by increasing and recovering the infrastructure capacity to meet the demand; 2) by optimizing utilization of the existing transport infrastructure through efficient transportation control measures (TCMs); and 3) by decreasing excessive vehicular traffic demand through transportation demand management (TDM) and diverting private vehicle users to public transport.

1.1.2 Equity

Equity means that a certain minimum level of mobility should be assured and provided for all members of society. Not only automobiles but also all modes of transport should have a right to share the public space and travel around the city freely and safely.

On the other hand, some low-income people cannot afford to pay expensive transportation costs. Some socially vulnerable people, including the aged and the handicapped, have difficulties in their mobility. An affordable and sufficient level of transportation services should be provided for those people, especially by improvement of the public transport system.

1.1.3 Better Environment

As implied in the vision for Greater Abidjan, for "providing quality living environments," air pollution and noise caused by automobiles should be minimized by promoting public transport use and controlling the traffic demand. At the same time, air pollution and noises should be reduced by applying stricter vehicle emissions standards. The above-mentioned TCMs were originally designed to reduce air pollutant emissions.[1]

In addition, traffic safety should be enhanced and the number of accident victims should be minimized through the enforcement of laws and regulations, intensive public campaigns, and training and education of drivers as well as the general public. Improvement of traffic facilities through engineering design would also contribute to the reduction of traffic accidents.

1.2 Urban Transportation Objectives

In order to achieve the above-mentioned three main goals of transportation system development in Abidjan, four major urban transportation objectives have been listed, as described below, along with more specific policies.

1.2.1 Enhancement of Road Network Capacity that Supports Economic Activities

- To structure a hierarchical road network to support multi-core, integrated urban sub-centers and to meet the growing future travel demand
- To increase road capacity through development and improvement of the road network
- To make the most of the existing capacity through efficient TCMs and avoid excessive traffic concentration through TDM
- To structure a functional goods distribution system

1.2.2 Promotion of Public Transport Use

- To improve the route structure and the level of service of existing bus transport
- To introduce new mass transit systems, preferably rail-based
- To facilitate more effective dedicated bus lanes as a base for BHLS (bus with high level of service) leading to the introduction of BRT (bus rapid transit) and organize intercity bus terminals
- To keep the affordable public transport fare under supervision of one managerial body

[1] 1990 Clean Air Act Amendments (Section 176(c)). Public Law 101-549. The United States of America.

1.2.3 Intermodal Development/Transit-Oriented Development

- To enhance intermodality through development and improvement of transfer facilities
- To apply functional transit-oriented development for major public transport corridors with a balanced urban spatial structure

1.2.4 Realization of an Environmentally Sound Transportation System

- To apply TCMs to reduce air pollution
- To enhance traffic safety and the environment through law enforcement and public campaigns as well as through user-friendly transportation facilities for all travel modes

1.3 Strategic Transport Network Structure

1.3.1 Introduction

Since the elaboration of the last master plan, the mobility situation in the economic capital of Cote d'Ivoire has drastically changed. During the socio-military crisis, the population grew rapidly in the outskirts of Abidjan, such as Abobo and Yopougon, and due to the degradation of the public transport services, many people have turned away from public transport and have started using the more convenient Woro-Woro and Gbaka, increasing at the same time the number of vehicles on the roads and the related traffic congestion. The new Strategic Transport Network Structure aims to reverse this trend by developing public transport and mass transit corridors along the north-south and east-west axes but also by building new road infrastructure to help relieve the existing road network.

Currently, the major residential areas are the communes of Yopougon, Cocody and Abobo, which have been experiencing urban sprawl over the past 15 years due to massive migration from suburban, rural and remote areas. The population of Greater Abidjan rose from 3.4 million in 1998 to an estimated 5.4 million in 2013, and is expected to reach 8.4 million by the year 2030. The Master Plan 2000 had foreseen such massive expansion of the city, projecting many new road infrastructures in the Abidjan District. However, almost none of those infrastructures have been built since then and the transport and road network will require upgrading and expansion in order to provide sufficient transport infrastructure for a sustainable economic development of Greater Abidjan (Figure 1.1).

Urban Sprawl
Future Areas Where Road Network Needs to Be Developed
Urban Areas with Insufficient Arterial Roads

Source: JICA Study Team

Figure 1.1 Urban Expansion in Greater Abidjan

The new strategic transport network structure will not only have to take into account the existing situation of land use and the current transportation needs of Abidjan, but also evaluate the future transportation demands in line with the forecast urban development.

As well as tackling a number of other issues, the new strategic transport structure proposes a number of measures - primarily with a focus on public transport and on developing the road network. Proposed measures include 1) construction of a radial-concentric road network with the construction of a ring road to which the major interurban roads will be connected and 2) building an integrated public transport system. The latter includes the construction of a north-south and east-west high-capacity transport system in addition to a BRT or BHLS system that will extend the public transport network to the outer communes of Greater Abidjan.

1.3.2 Radial-Concentric Road Network

The Ebrie Lagoon and the Banco Forest have been two major natural obstacles for the development of the road network in Greater Abidjan, preventing it from having one or more ring roads to divert transit traffic, as it is nowadays the case in most major cities. All the major roads connecting Abidjan to the rest of the country converge at Plateau and Adjamé, the city center, concentrating all the traffic at one location. In addition, the only north-south access to the industrial area surrounding the port is the two bridges crossing the lagoon, which forces all the heavy vehicle traffic generated by the port to transit inside the city center.

The road network structure will have to be expanded in order to provide alternatives for drivers and relieve the roads surrounding the Plateau and Adjamé. The first step will be the construction of the outer ring road Y4 that will connect all the major radial roads. The primary road network will thus change from the current concentric road network, to a new radial-concentric road network that will allow transit traffic to avoid the city center and provide fast and reliable connection between the suburban activity areas (Figure 1.2).

Source: JICA Study Team

Figure 1.2 Sketch of the Future Road Network

1.3.3 Integrated Transport Network Structure

The Urban Master Plan has set the following vision for Greater Abidjan as described in Volume 2 – Part 2:

- The efficient and effective operation of Abidjan Port
- A solid base for industrial growth
- Rejuvenating tourism potential
- Increasing agricultural productivity
- Recapturing its position as the preeminent financial and business center in West Africa
- A modern transport infrastructure that also promotes public transport use
- Improvement of quality of life for its citizens

Greater Abidjan Vision

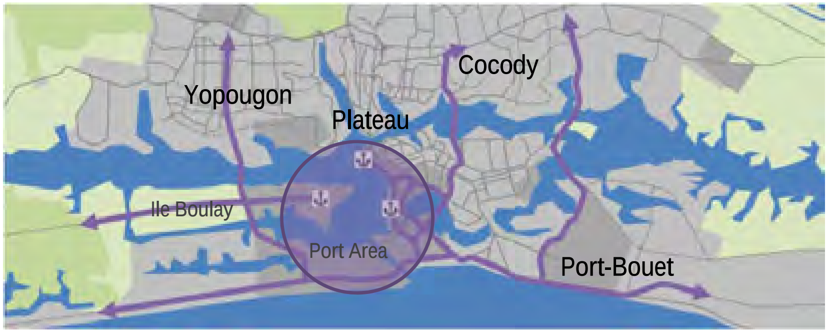
Establish a balanced economic growth area providing quality living environments and easily accessed clean industry employment areas, with conserved and enhanced agricultural and natural landscapes that also provide the ideal setting for tourists.

In order to develop a transport master plan consistent with the vision of the urban master plan, the Strategic Transport Network Structure has been defined with the following goals.

(1) Development of Infrastructures to Support the Port of Abidjan

The Autonomous Port of Abidjan has been the natural transshipment hub port of the West Africa region. However, in recent years, it has lost market shares to surrounding ports, such as Dakar, Tokorad, Tema and Lome, due not only to the socio-military crisis but also to the delay in the development of the Port. The expansion of the Port of Abidjan to Ile Boulay has long been planned but the lack of appropriate infrastructure to cross the lagoon has been the main obstacle to its development. This expansion is crucial for the Port of Abidjan to keep competing for the subcontinent transshipment market as the existing terminal in Treichville does not have the sufficient depth required to berth the latest generation of container ships.

The development of the transport and road network should concentrate on providing, in the near future, adequate transport infrastructure to allow the port to continue its growth. New links will have to be built around the existing port in Treichville, such as the Vridi Bridge or the Vridi Bypass to provide alternative access and relieve the only road running through this area. Furthermore, the 4th bridge connecting Yopougon and Ile Boulay or the dedicated truck route connecting the island with Songon, should also be targeted as short-term projects (Figure 1.3).



Source: JICA Study Team

Figure 1.3 New Infrastructures to Support the Port Development

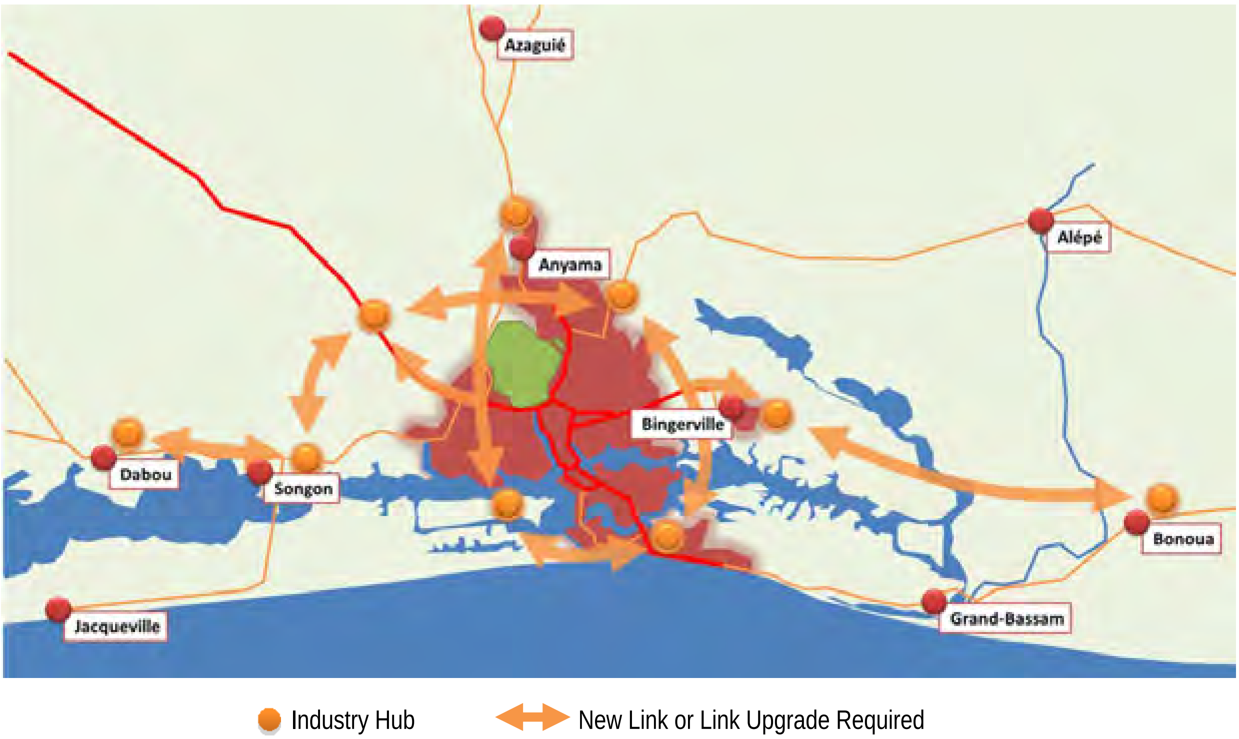
Port expansion will also require the construction of a new freight railway connecting the Ile Boulay to the existing freight railway and the construction of a new logistic center near Anyama for transshipment.

(2) Efficient Cargo Transport for Industrial Growth

The Greater Abidjan economy and freight transportation are closely related as an improvement in cargo transport can be expected to have important economic effects. Lower costs and more reliable freight movement have a positive effect on all the industrial activities, as factories do not have to stay in the center of the city where available lands are limited and can get supplies from a wider area with potential gains in terms of cost.

The industrial sector is currently mainly located in the Vridi area, although there is a well-established industrial park in the northern part of Yopougon. Trucks have to transit through the congested city center, increasing the costs of goods carriage and consequently decreasing productivity. This situation is expected to worsen as vehicle traffic grows and congestion increases. The urban master plan is proposing to implement industrial logistics outside the urban limit. In order to do so, the road network will have to be developed so as to connect all those new industrial areas with an efficient and reliable freight transportation system.

The Y4 ring road's main function will be to create a link between those industrial areas. It is expected to become the backbone of the transport and road network, allowing trucks to avoid the city center and generating at the same time improvements in economic productivity. Other projects such as a direct link between Ile Boulay and the Autoroute du Nord or the creation of a new connection between Bingerville and Bonoua are all part of this strategic structure to help increase efficiency in transport (Figure 1.4).



Source: JICA Study Team

Figure 1.4 Fast Link between the Activity Hubs

(3) Increase Touristic Potential with Convenient Access

The Atlantic Coast and Ebrie, Adjin and Potou Lagoons are targeted as major tourist zones with resort style hotels and facilities for domestic and international tourists. Jacqueville will be the main tourist destination in the west and Grand Bassam the “Tourist Gateway” to the eastern coast.

In order to attract tourism in those areas, the transport network has to be upgraded to provide convenient access. Roads will have to be upgraded or built to connect those future tourist hotspots and new transport means should be implemented that are more comfortable than the existing ones (Figure 1.5). The extension of the north-south urban train up to Grand-Bassam should provide the type of fast and reliable transport that tourists are looking for.

In addition, logistic infrastructure and heavy trucks should be kept away from those touristic zones by defining a proper truck route system that will avoid those areas in order to preserve the natural beauty of those places.

Source: JICA Study Team

Figure 1.5 Convenient Access to Touristic Areas

(4) Reliable Access for Agricultural Activity

From 2020 to 2030, the outer communes of Azaguie, Alepe and N'Djem are expected to see the development of major food processing plants in parallel to the increase in agriculture production. In order to support such growth, logistic support should be implemented, and reliable and safe roads should be provided (Figure 1.6). The roads connecting Azaguie and Alepe will have to be reinforced and widened as some sections of the road have been damaged and trucks can no longer use those sections.

The growth of agricultural activity will also have an impact on the population size of the outer communes and appropriate public transport will have to be implemented. Bonoua and Dabou will be linked to the Abidjan District with BRT lines, providing fast and reliable access to allow commuters to easily travel between the city center and the peripheral areas.

In order to protect agricultural activity, urban sprawl will have to be controlled as it is land-consuming. The road network will have to be developed as a way to limit the urban development, such as the Bingerville Bypass that will be blocking urban development from expanding towards the north.

Source: JICA Study Team

Figure 1.6 Reliable Link for Food Processing

(5) Modern Transport Reflecting the Preeminent Financial and Business Position in West Africa

The high level of mobility that guarantees smooth and efficient transportation of people is one of the key issues for a developing economy. Thus a good transport system is an important indicator of the competitiveness of a city and failure to achieve this reflects an unsustainable use of the transport infrastructure.

For Greater Abidjan to keep its leadership role in Western Africa, a modern transport system is needed that does not only rely on roads but also on other more sustainable means of transport. Two mass transit corridors have been considered in the urban transport master plan.

(6) Transport Infrastructure to Promote Public Transport Use

The traffic surveys have shown that the main transport corridors are the east-west and the north-south axes. As the SDUGA goal is to achieve sustainable development, public transport should be promoted. Currently, public transport is limited to SOTRA buses, which are mostly using the same congested roads as private cars. Thus, public transport is providing a slow and unreliable service that is completely overmatched by other private transport.

The trend will have to be reversed and adequate transport infrastructure will have to be built to promote the use of public transport. A well-designed transport system that is comfortable and more convenient to the public, and that is faster and cheaper than private cars can help reduce traffic congestion and accelerate economic growth.

In order to achieve that goal, adequate means of transport with sufficient capacity to accommodate the traffic demand should be considered along the two main transport corridors (Figure 1.7). Urban train is one of the options for those two east-west and north-south corridors.

Source: JICA Study Team

Figure 1.7 Main Travel Corridors

(7) Improvement of Quality of Life for its Citizens

The goal of the SDUGA is to improve the community's well-being from a social, economic and environmental standpoint. Currently in Abidjan, traffic congestion, road accidents and packed buses are increasing the burden on commuters and negatively impact the daily life of those living in Greater Abidjan. Commuters have to wait a long time at bus stops and buses are frequently jam-packed with passengers.

Furthermore, trucks are forced to transit the city center, creating traffic congestion, increasing the risk of accidents, deteriorating the quality of air and generating noise.

The improvement of quality of life can thus be achieved by tackling those major problems, by providing a fast and reliable transportation network relying on an oriented public transport system. Such a system offers a clean, environmentally friendly and safe mobility solution, guaranteeing a high quality of life.

Truck routes will have to be provided to divert heavy vehicle traffic from the city center and residential areas.

As a result of this analysis, the following strategic transport network structure is proposed (Figure 1.8), based on the construction of new roads to connect major activities (industrial, touristic, food processing) areas and the implementation of a mass-rapid transit system that would provide a stress-free and reliable public transport system.

Source: JICA Study Team

Figure 1.8 Strategic Transport Structure

2.0 Transport Demand Forecast

2.1 The Transport Model

The objective of this chapter is to discuss the transport model, its development, calibration and application, as used to define trip activity, modal characteristics and origin-destination patterns. The model initially synthesizes representative travel patterns as quantified by 5.38 million people residing in 1.26 million households within the study area[2]. Also presented in this chapter are representative findings of demand forecasting procedures, which extend over the adopted planning horizon to the year 2030. While the application of these forecasts in the screening, evaluation and fine-tuning of the proposed transport master plan, referenced in subsequent sections, is summarized in this chapter, more detailed and sector-focused quantification is documented in other chapters, particularly the following: Chapter 3, Road Development Plan; Chapter 5, Public Transport Development Plan; and Chapter 6, Freight Transport Development Plan.

2.1.1 Background

SDUGA successfully completed a series of eleven comprehensive transport surveys during the middle of 2013[3]. In a technical sense, the main purposes of the surveys are to:

(a) Assist in the development and calibration of a computerized transport demand model;
(b) Document current transport demand among the various transport modes and facilities existing in Abidjan;
(c) Establish quantitative as well as qualitative interactions among transport, planning, economic, social and environmental sectors associated with this study; and,
(d) Provide input to the GIS database for Greater Abidjan. This is in terms of the initial objective, that is, necessity for development and calibration of the transport model.

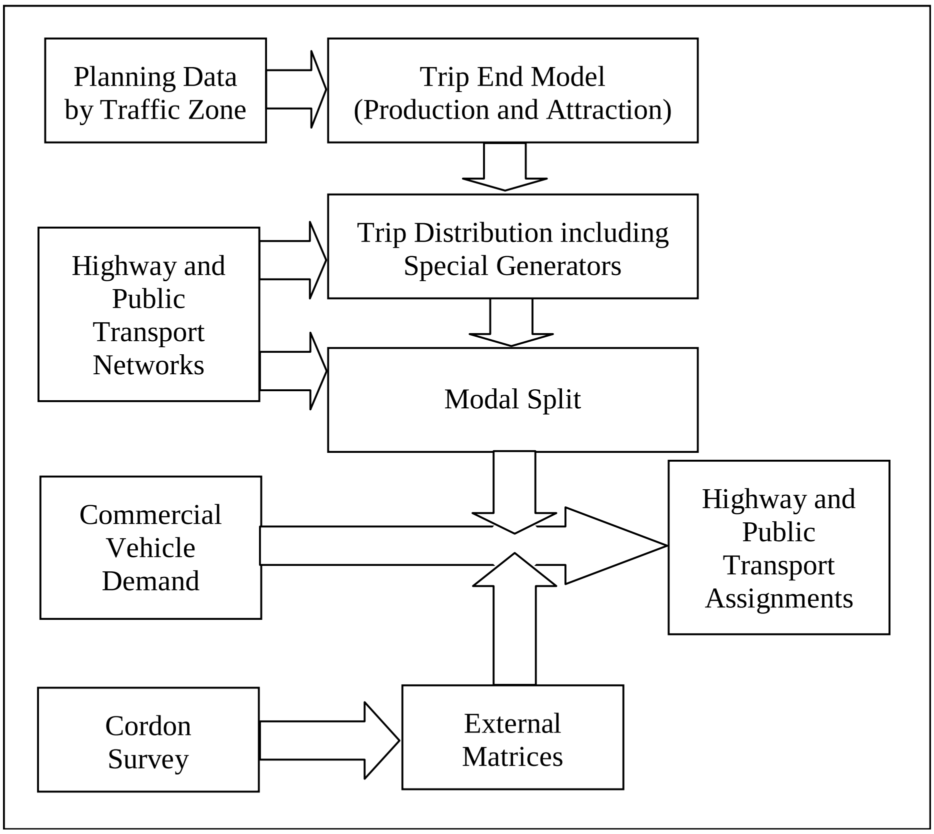
The Household Interview Survey is seen as the "backbone" of model development. It consisted of interviews involving some 20,000 households within the study area. Each member of the household was asked a series of questions relating to household characteristics, personal characteristics and trip characteristics. In addition, subsidiary surveys were conducted with additional, focused questions relating to trip preferences, environmental concerns and opinions on transportation problems, possible solutions and policies. This collection of data forms the transport-modeling database.

[2] All numerical statistics reported in this chapter and subsequent chapters of the report refer to statics relevant to the Study Area not the Planning Area. The study area is slightly broader than the Planning Area.
[3] For full detailing of survey approaches, methodologies, and findings, please refer *to a series of Working Papers prepared by SDUGA team*

As stated, this chapter presents the transport model, its development, calibration and application, as used to define trip activity, modal characteristics and origin-destination patterns. Considerable challenges were overcome in the development of a complete four-step SDUGA model within a limited time period. Overall, this model provides a good technical tool for the evaluation of strategic network infrastructure projects or major transport policy issues in the Greater Abidjan study area.

2.1.2 Model Structure

The framework of the SDUGA transport model is shown in Figure 2.1. It follows the conventional four-stage approach that has been well tried and found to be effective in many cities of the world.



Source: JICA Study Team

Figure 2.1 SDUGA Transport Model Framework

The four-stage approach consists of a series of nested and cascading sub-models:

- Trip End Models - Estimating the "amount" of travel and where it begins and finishes;
- Trip Distribution - Linking the trip ends together to form trips between the origins and destinations;
- Modal Split - Accessing the modal shares of the available travel modes; and,
- Assignment - Usage of each segment of the highway and public transport networks.

The main thrust of the model is targeted at the representation of the travel demand of the residents of Greater Abidjan, and their usage of private and public transport. Goods vehicles and travel that crosses the boundary of the study area (external travel) are "added-in" prior to the traffic assignment. The external travel is derived in the base year from the cordon roadside interview stations that were located adjacent to the study area boundary.

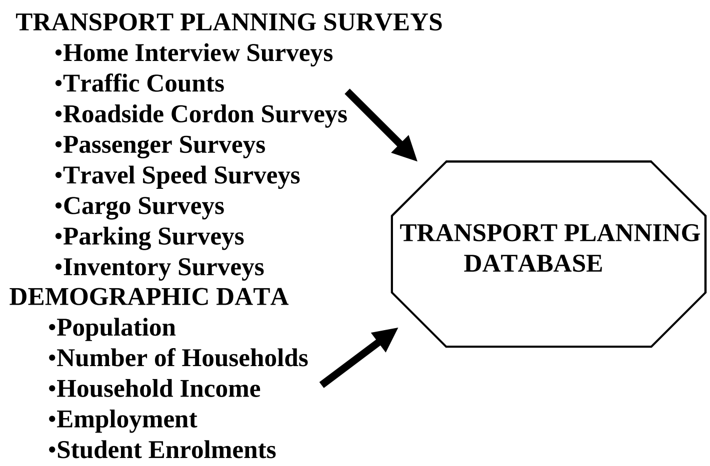
2.1.3 Model Approach

The development of the transport model required the assembly of data describing the transport supply (i.e., networks) and transport demand (population, employment, enrollment, etc., their spatial location, and the pattern of movements). This had to be assembled in a coordinated manner with the data cross-checked against other sources. There were limited sources of data, which have been assembled over the years by different authorities and organizations. These were reviewed and corroborated to form, in conjunction with SDUGA surveys, the database for model development (Figure 2.2).

The starting points for the model development were:

- Collection of socioeconomic and network data;
- Conduct of major surveys as discussed earlier; and
- Compilation of data for corroborative purposes from other sources.

In building the model, travel characteristics were taken from the SDUGA database, primarily from the Household Interview Survey and the Roadside Interview Survey data. However, one of the main final checks on the model was the comparison with the observed screen line crossings of actual traffic flows. Considerable emphasis in calibration was placed on matching the observed and modeled screen line crossings as this illustrates the replication of the current traffic volumes and travel characteristics.



Source: JICA Study Team

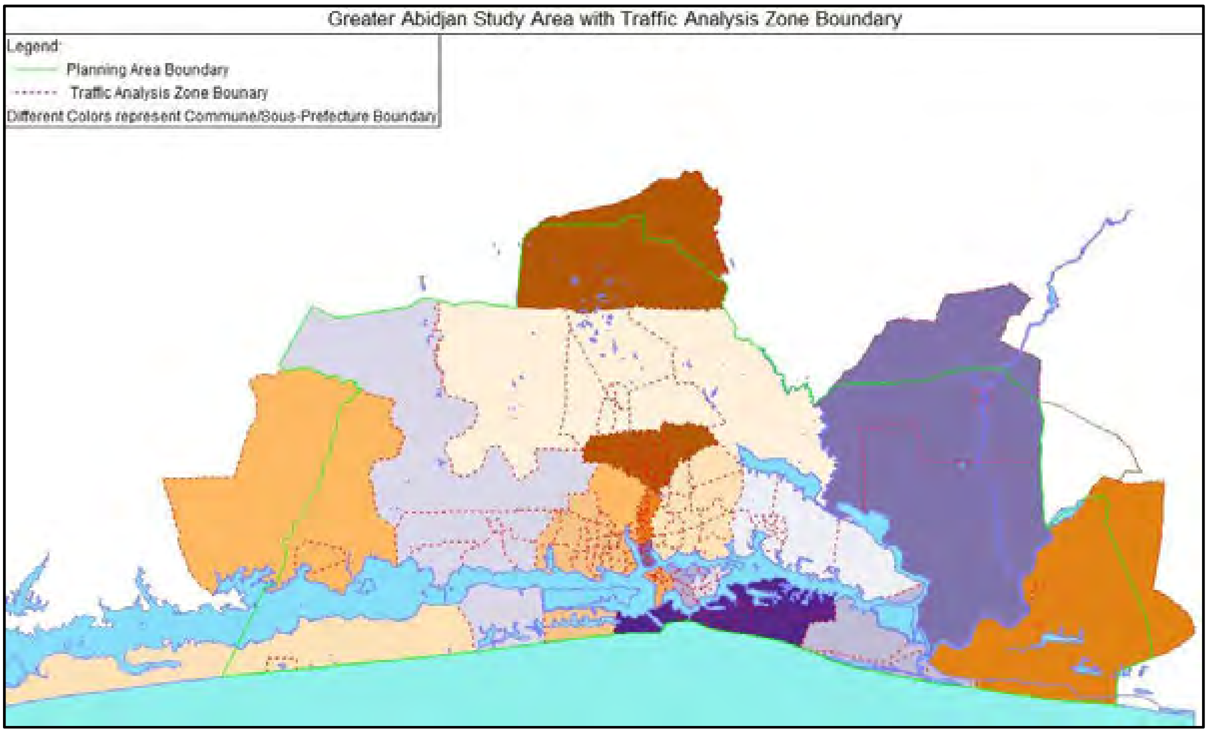
Figure 2.2 Transport Model Database

2.2 Network Development

2.2.1 Development of Traffic Zones

The model study area for the transport model extends beyond the Abidjan Autonomous District (AAD) to include parts or all of the communes of Grand Bassam, Jacqueville and the Sous-Prefectures of Alepe, Oghlawapo, Azaguie, Bonoua and Dabou. In essence there are 173 traffic analysis zones (TAZs), 168 internal TAZs and 5 external stations. Additional zone numbers are reserved for future development.

The detailed breakdown of the TAZ system is presented in Figure 2.3, showing the study area and the planning area boundary.



Source: JICA Study Team

Figure 2.3 Internal Traffic Zone System for the Study Area

2.2.2 Road Network Content

This section presents details regarding development of the master network within the overall framework of the SDUGA transport modeling process[4]. It is noted that the analyses focus on the unique needs of SDUGA and should not be interpreted as having broader implications.

Several surveys and data-collection efforts, augmented by ongoing technical liaison with local experts, provided input to the formulation of the highway network:

- The road inventory survey data included surface type and condition, type of traffic operation, parking practices, road cross-section, side friction and interchange and intersection types;
- Field inspections by members of the Study team; and
- Future network strategy developed in conjunction with the urban planning team.

The simulated road system must include all roads required to achieve modeling of inter-zonal trip demand. The level of detail to which the zone structure and highway network are built must be in balance; thus, not all existing roads need to be included since zonal stratification extends to a 173-zone level of detail. The road network is a computerized simulation of highways located within the SDUGA study area and consists of numerous links (road segments) and nodes (intersection points), with each link being embedded with a unique set of indexes describing its operating capabilities. Parameters for each link include:

- Link distance defining the length of a link in kilometers;
- Link type describing the road class;
- Number of traffic lanes in the case of a road link;
- Road capacity measured in passenger car units (PCU); and
- Future road reference code including the opening year of any new road project.

The network in 2013 contains approximately 9,000 links extending over roughly 3,000 link kilometers. The average free-flow speed varies depending on the facility type, as presented in Table 2.1.

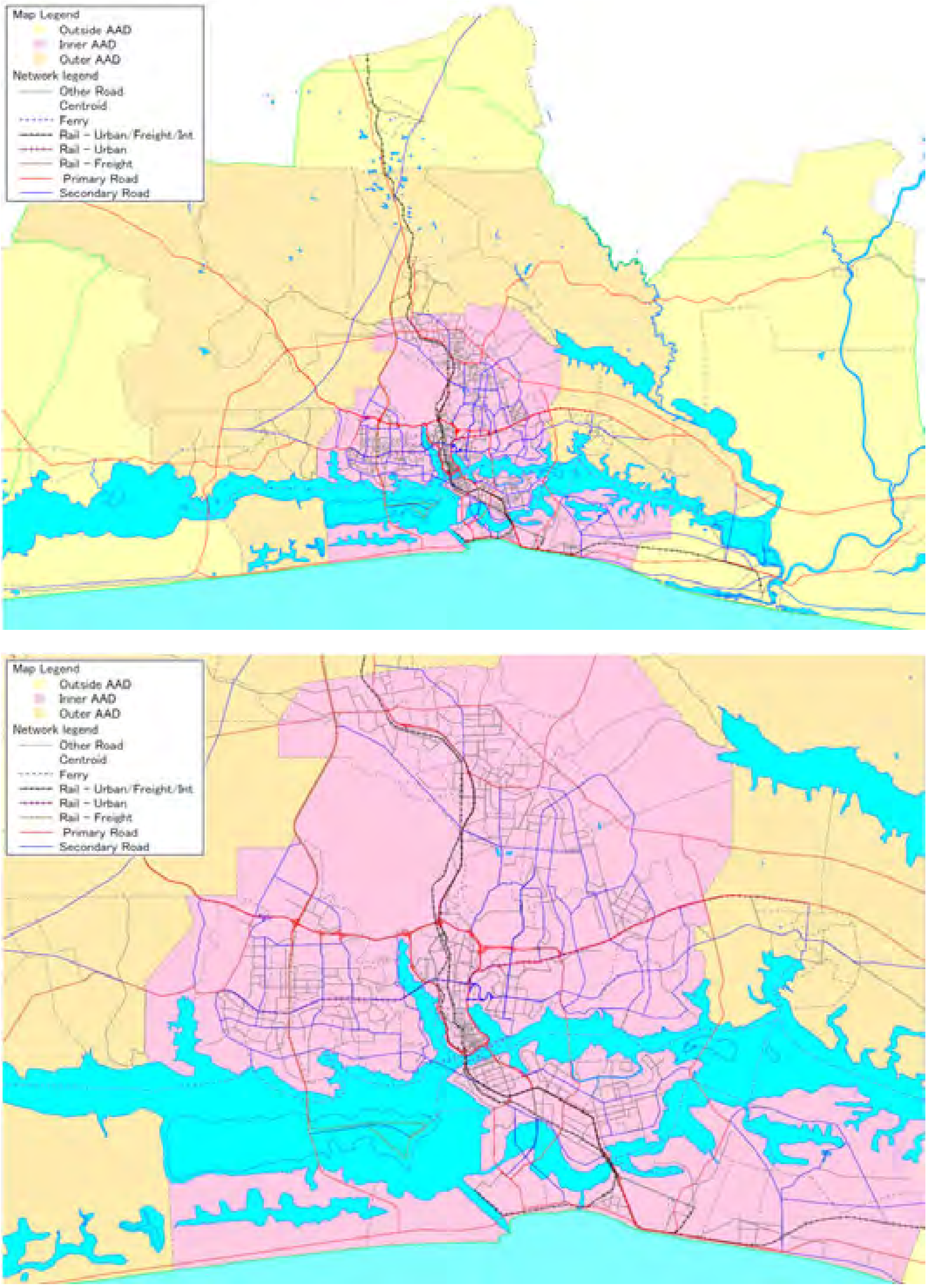
[4] The master network includes the existing network in 2013 as well as all projects currently planned until 2030. As a master network, it also includes the alignments of transit links, such as rail operating on an exclusive right of way.

Table 2.1 State of the Abidjan District Road Network (2013)

Link Type		Number of Links	Total Link Distance (km)	Free Flow Speed (km/h)	Capacity per Hour in PCU
Primary Road	One Way 2 Lanes	903	876	65	2,200
	One Way 3 Lanes	333	169	90	3,000
	One Way 4 Lanes	73	15	90	3,700
Secondary Road	One Way 2 Lanes	1596	720	80	1,700
	One Way 3 Lanes	208	36	80	2,800
Other Road	One Way 2 Lanes	519	67	50	1,700
	One Way 3 Lanes	119	14	50	2,800
	Two Way 2 Lanes	5,226	963	30	680
	Two Way 4 Lanes	502	58	50	2,190
Total		9,479	2,917		

Source: JICA Study Team and Highway Capacity Manual of the USA

The extension of the network is shown in Figure 2.4 for the central study area, as outside of this central area there is only limited network infrastructure. This network diagram shows the future network configuration for both roads and transit as well.



Source: JICA Study Team

Figure 2.4 Central Study Area

2.2.3 Public Transport Network Content

The model uses networks and line files to represent the underlying network structure and the routes that operate across the network. The network file is the same link file as for the road network, with the addition of public transport operating on dedicated rights of way such as rail and ferry.

The starting point of the public transport network development was the bus route information supplied to the JICA Study Team by SOTRA. The informal sector routes of Gbaka were reversely estimated from a review of modal travel from the HIS.

It is assumed that public transport travelers may walk some way along existing road links before finding an appropriate service. Rather than explicitly code a comprehensive walk network that parallels the highway network, the modeling software calculates such a walk network internally. The link description for the network, including future link designations, is shown in Table 2.2.

The modeling software requires public transport routes or lines (as they are known in the terminology of the modeling software) to be classified by two attributes, which are "mode" and "company." "Company" is a report summary classification, whilst "mode" is a behavioral classification. For the base year, the mode and company codes are the same. In addition, every route is allocated a fare table, which defines how the fare is calculated for each route. In the case of this study, an individual fare table was obtained for each route, in particular for road-based public transport. The mode codes are presented in Table 2.3 for both the base and future years for the transport model. On completion of the urban rail system, feeder minibuses are planned to be operated to replace existing informal modes of transport, that is, Gbaka and Woro-Woro with the formal transport sector.

Table 2.2 Link Types in the Master Network

Link Number	Number of Links
1	Centroid Connector
2	Walk Link
5	Primary Road, One Lane per Direction
6	Primary Road, Two Lanes per Direction
7	Primary Road, Three Lanes per Direction
8	Primary Road, Four Lanes per Direction
9	Primary Road, Five Lanes per Direction
10-14	Access Roads
15	Two-Way (One Lane per Direction)
16	Two-Way (Two Lanes per Direction)
17	Two-Way (Three Lanes per Direction)
18	Future Two-Way (Two Lanes per Direction)
19	Future Two-Way (Three Lanes per Direction)
21	SOTRA Water Bus, Existing
22	Future High-Speed Ferry
23	North-South Passenger and Freight Rail
24	East-West Passenger
25	Freight Rail
26	Secondary Road, Two Lanes
27	Secondary Road, Three Lanes
28	Secondary Road, Four Lanes

Source: JICA Study Team

Table 2.3 Mode Definitions

Mode Number	Mode Description
2	Ordinary SOTRA Bus
3	Express SOTRA Bus
4	SOTRA Lagoon Ferry
5	Feeder Minibus
6	Gbaka
7	Urban Rail (Blue Line)
9	High-Speed Ferry
10	Bus Rapid Transit
11	BHLS (Bus with High Level of Service)
12, 13	Woro-Woro/ Fixed Route Taxi
15	Urban Rail (Red Line)

Source: JICA Study Team

2.3 Trip Generation Module

2.3.1 Overview

The first step in the module is to categorize households in each TAZ into various socioeconomic bins or groupings. Often this is done using vehicle ownership categories that are also a pseudo-measure of household income and economic activity within a household. However, in the case of this study area, more than 80% of households did not have access to a private car. For this reason, those households without access to a car were divided into two classes. The zonal household income[5] is used as the measure to determine this distribution.

The households within the zone were split into four classes of economic activity. A trip-generation rate is then linked to each socioeconomic grouping to estimate trip production. The trips attracted to a zone are estimated using zonal attributes such as employment and student enrolments.

2.3.2 Household Distribution Model

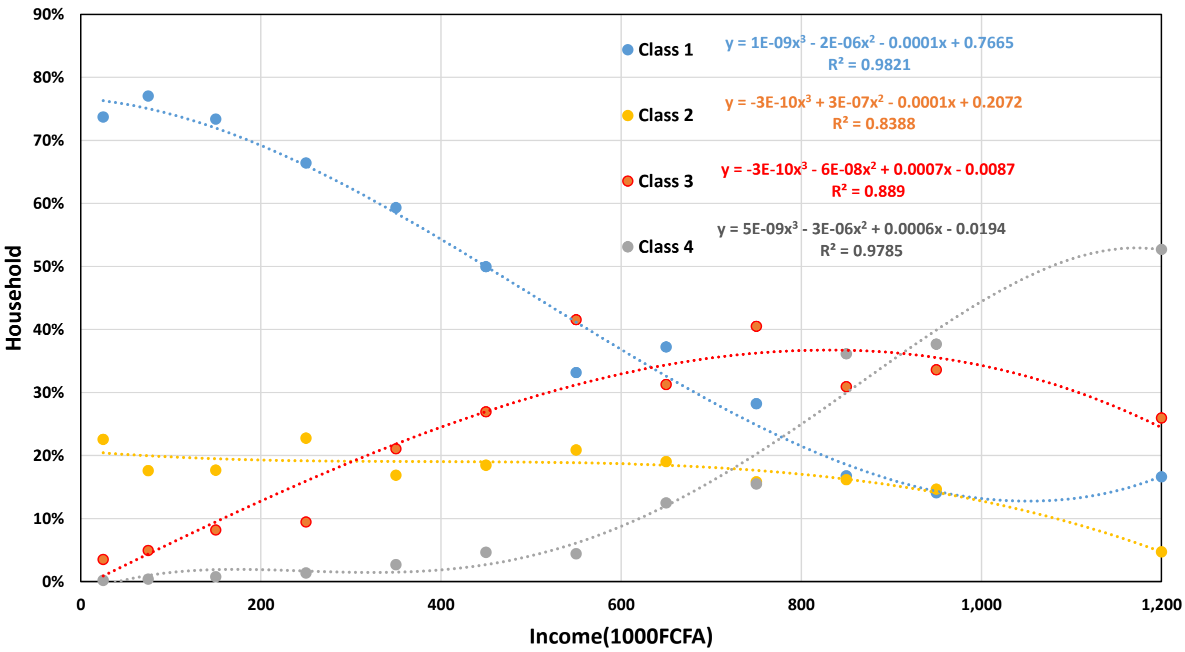
The household economic activity model uses five levels of economic activity, namely:

- Class 1 - No Vehicle Available (Rented Accommodation) - Low;
- Class 2 - No Vehicle Available (Non-Rented Accommodation) - Low-Medium;
- Class 3 - One Vehicle Available - Medium; and
- Class 4 - Multiple Vehicles Available - High.

[5] Zonal household income is initially derived from the HIS and other published documents. The future household income is linked to growth in the regional GDP of Abidjan.

These levels of economic activity were verified against a household expenditure item, namely, the household monthly electricity. For example, in the case of economic activity Class 1 and 2 combined, the average monthly expenditure on electricity is 5,190 and 8,490 FCFA per month, respectively. At the other end of the scale for Class 3 and Class 4, the average monthly expenditure on electricity and telephone is 13,630 and 28,260 FCFA per month, respectively. These household expenditure items verified the breakdown of the households into classes of economic activity.

From the analysis of the SDUGA home interview survey, income-class-based curves were developed with the input variable being the average monthly household income. These curves are shown in Figure 2.5.



Source: Estimated from Household Interview Survey, JICA Study Team

Figure 2.5 Distribution of Households by Economic Activity Class

The economic distribution curves presented in the aforementioned figure take the form of polynomial best-fit curves of the order of three. In an initial review of the data, different types of curves were fitted to the data, such as logarithmic, power, exponential as well as higher-order polynomial curves. The polynomial curve provided a good fit for the curves. The curves take the following form:

$$y = ax^3 + bx^2 + cx + d \qquad \text{…….. Equation 3.1}$$

where:

y is the percentage of households in a given grouping;

x is the zonal average of household income; and

a, b, c and d are calibration constants.

The correlation coefficient results from the Economic Activity Class analysis range from 0.85 to 0.96.

2.3.3 Trip Production Model

The trip generation model is developed based on households as a unit. Trips are a function of household characteristics. For example, a non-working person from a household with low economic activity will behave completely differently from a similar person from a high economic activity class. In both trip production and trip attraction models, the model is disaggregated into four trip purpose categories:

- Home-Based Work (HBW);
- Home-Based Education (HBE);
- Home-Based Other (HBO) and
- Non-Home-Based (NHB).

The definition of a Home-Based Trip is that the production part is always at the home end. Thus, a trip from home to work and then the reverse trip from work to home have two productions in the home TAZ and two attractions in the work TAZ. In contrast, a Non-Home Based Trip, for example from work to shopping and then back to work, has one production and one attraction in each of the work and school TAZs. This is often referred to as a trip in production-attraction format. The trip production rates are depicted in Table 2.4.

Table 2.4 Trip Production Rate

Economic Activity Class	Trip Purpose			
	HBW	HBE	HBO	NHB
Class 1	2.56	2.56	3.93	1.71
Class 2	2.86	3.24	5.79	1.59
Class 3	2.43	3.51	4.70	2.44
Class 4	2.90	3.09	7.47	1.72

Source: Estimated from Household Interview Survey and Activity Diary Survey, JICA Study Team

2.3.4 Trip Attraction Model

The trip attraction model employs a linear regression analysis to calibrate the coefficients. The format of the equation for attractions is as follows:

$$A_j = b_1x_1 + b_2x_2 + b_3x_3 \quad \text{……..Equation 3.2}$$

where A_j = Trip attractions in zone j
x_1, x_2, x_3 = Socioeconomic variables, namely primary, secondary and tertiary employment and student enrolments
b_1, b_2, b_3 = Constants and co-efficient determined by calibration, reported in Table 3.5.

The correlation coefficient of these equations is also presented in Table 2.5, namely R^2.

Table 2.5 Trip Attraction Equation Coefficients

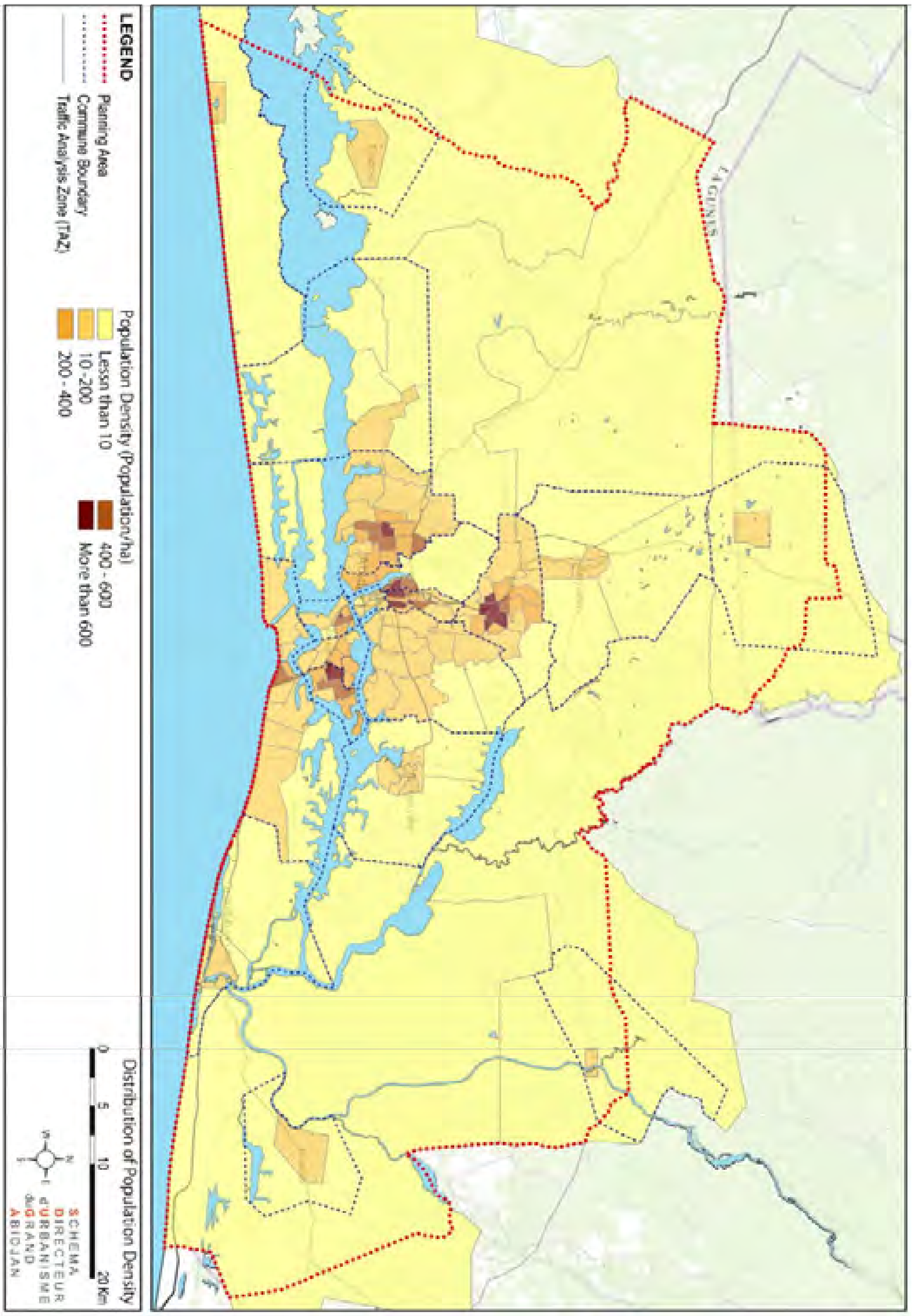
Economic Activity Class	Primary Employment	Secondary Employment	Tertiary Employment	Student Enrollments	R^2
Purpose: HBW					
Class 1	0.787	1.138	0.833	0.000	0.92
Class 2	1.127	0.230	0.428	0.000	0.79
Class 3	0.408	0.022	0.352	0.000	0.78
Class 4	0.003	0.000	0.144	0.000	0.53
Purpose: HBE					
Class 1	0.000	0.000	0.000	1.271	0.81
Class 2	0.000	0.000	0.000	0.450	0.75
Class 3	0.000	0.000	0.000	0.265	0.81
Class 4	0.000	0.000	0.000	0.059	0.36
Purpose: HBO					
Class 1	0.221	1.831	1.287	0.000	0.88
Class 2	2.511	0.595	0.687	0.000	0.77
Class 3	0.781	0.055	0.724	0.000	0.72
Class 4	0.163	0.000	0.409	0.000	0.52
Purpose: NHB					
Class 1	0.000	0.637	0.816	0.000	0.81
Class 2	2.145	0.059	0.274	0.000	0.71
Class 3	0.000	0.037	0.446	0.000	0.67
Class 4	0.428	0.000	0.082	0.000	0.62

Source: JICA Study Team

In application, the control total for each trip purpose is taken from the "production model". It should be noted that the trip ends from the NHB attraction model are used to replace those from the trip production model as, by definition, they do not occur at home.

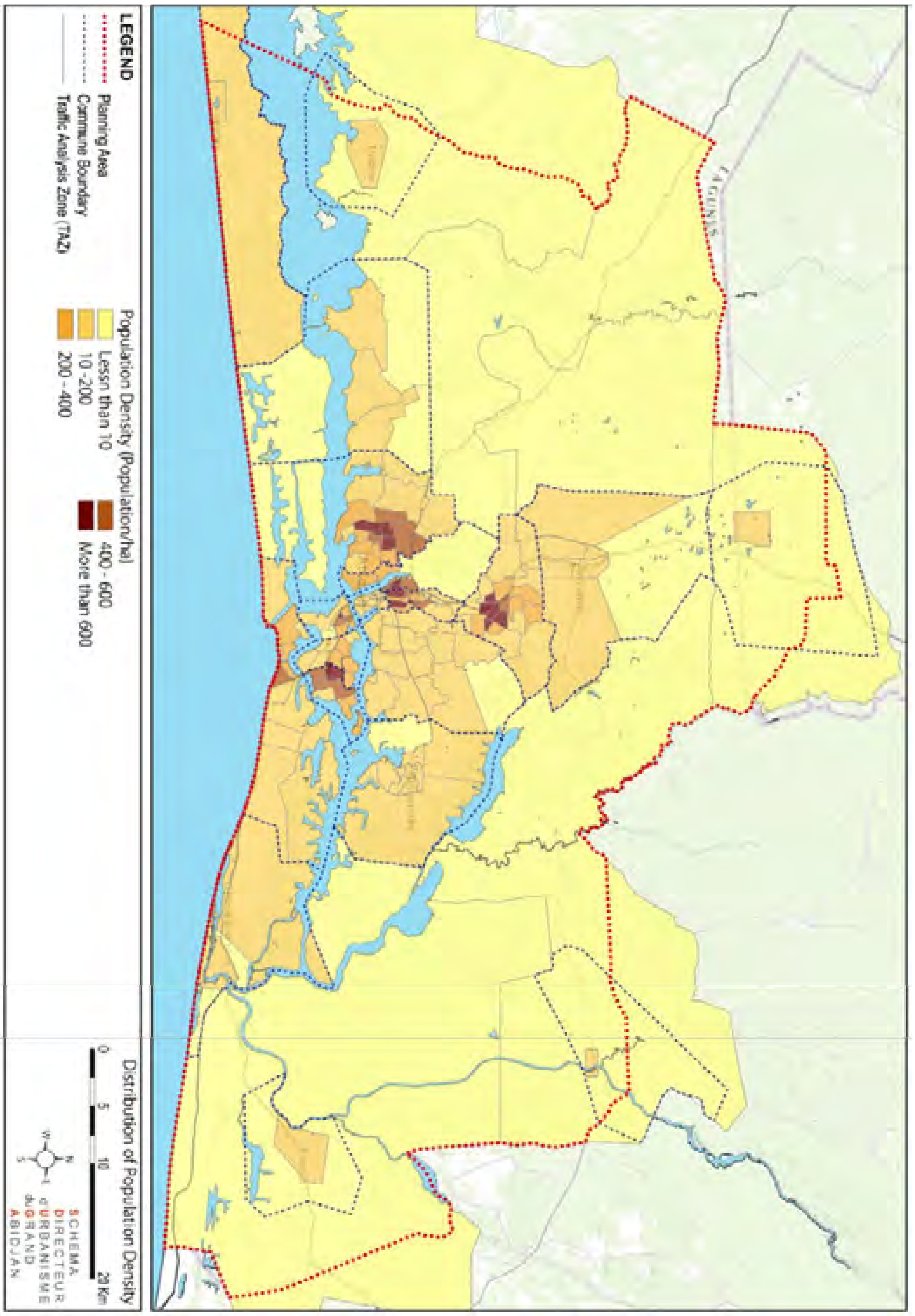
2.3.5 Socio-Economic Indicators

As base input data for the production/attraction model, socio-economic indicators were estimated as shown in Figure 2.6 to Figure 2.13. Cardinally, population density evenly increases in TAZs within AAD up to 2030. Employment density of primary industry disperses in peripheral part of AAD. New industrial area for secondary employment appears in the west side of the existing port area and tertiary industry holds to its current trend on its distribution.



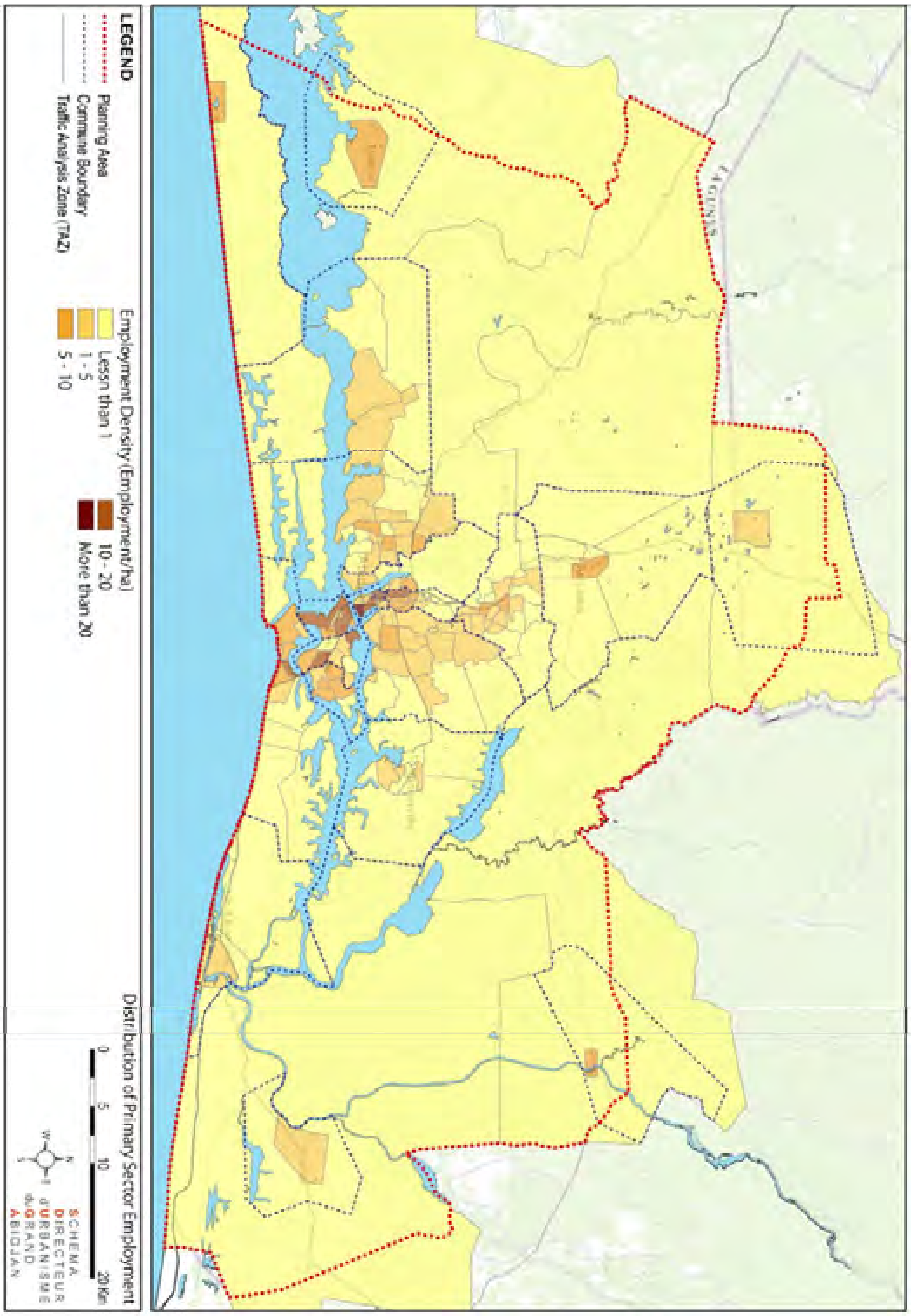
Source: JICA Study Team

Figure 2.6 Density of Population in 2013



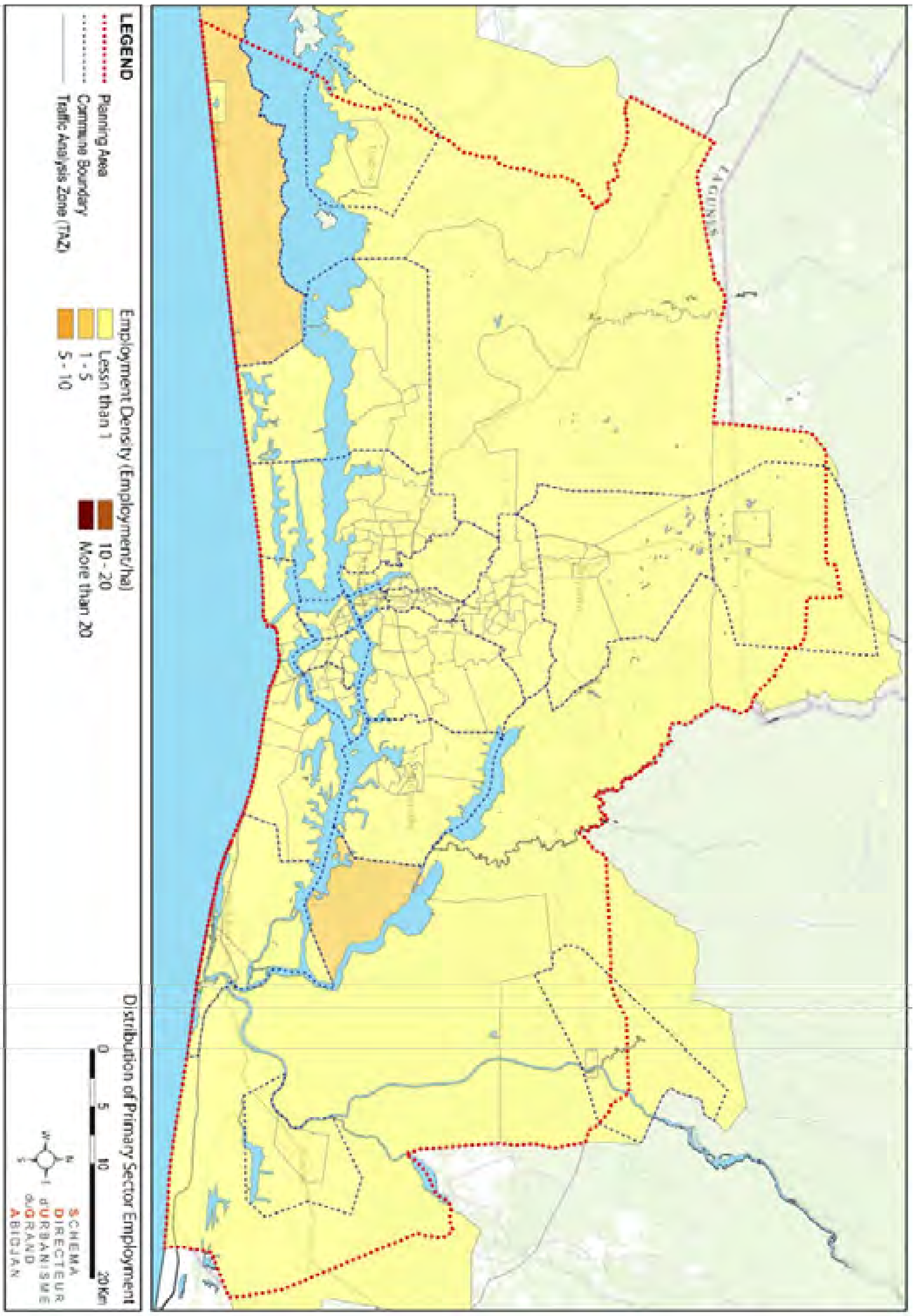
Source: JICA Study Team

Figure 2.7 Density of Population in 2030



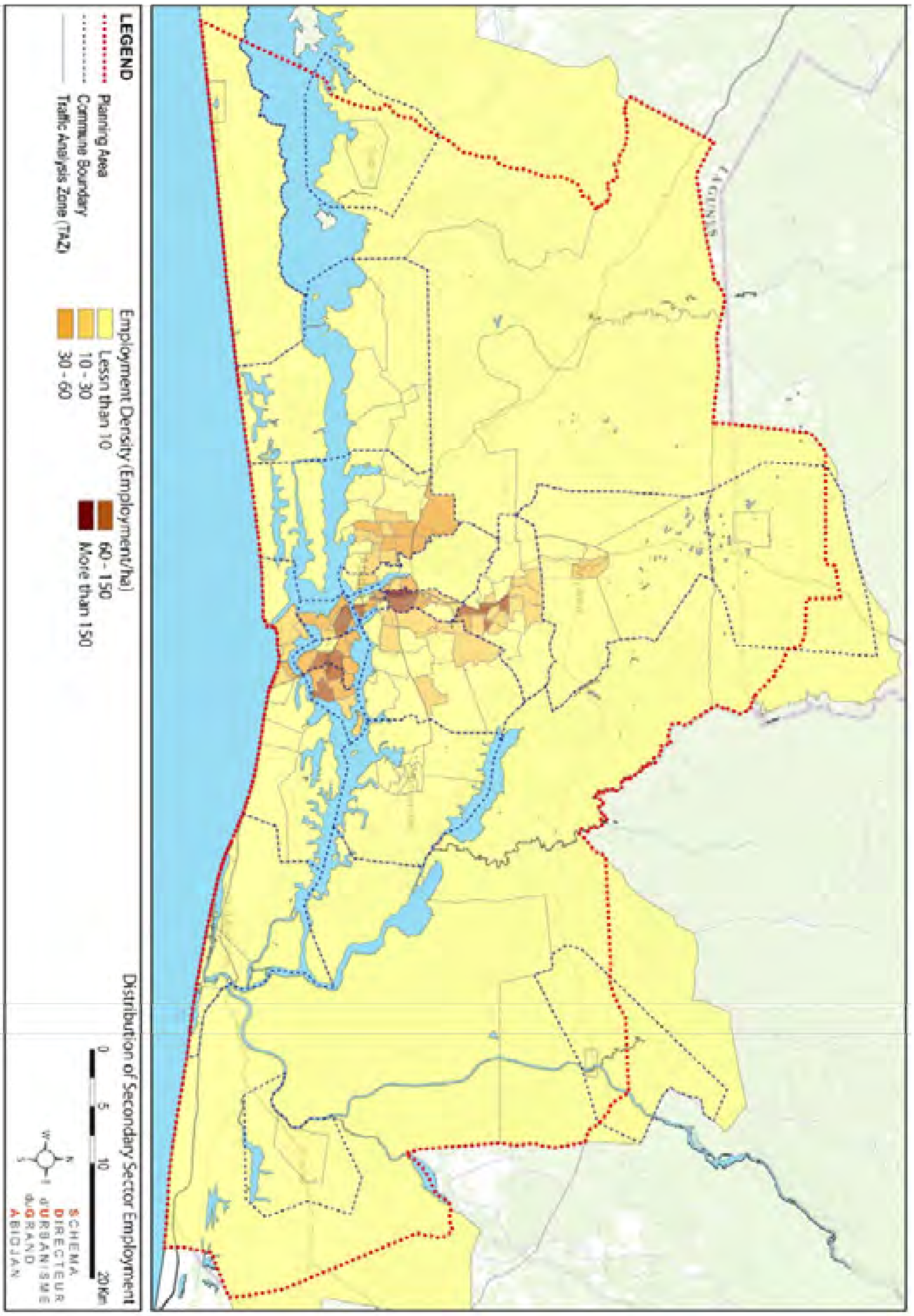
Source: JICA Study Team

Figure 2.8 Density of Primary Sector Employment in 2013



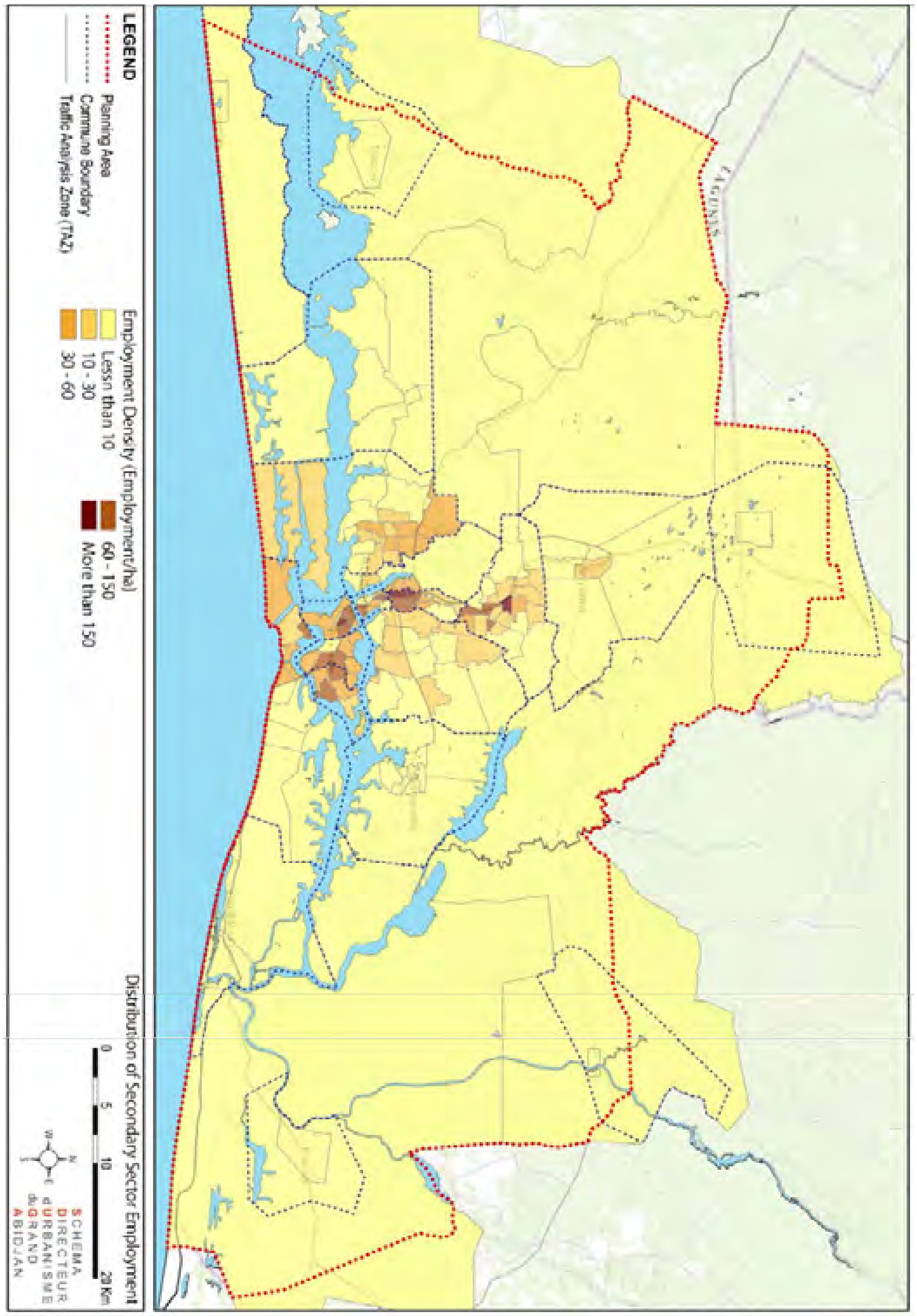
Source: JICA Study Team

Figure 2.9 Density of Primary Sector Employment in 2030



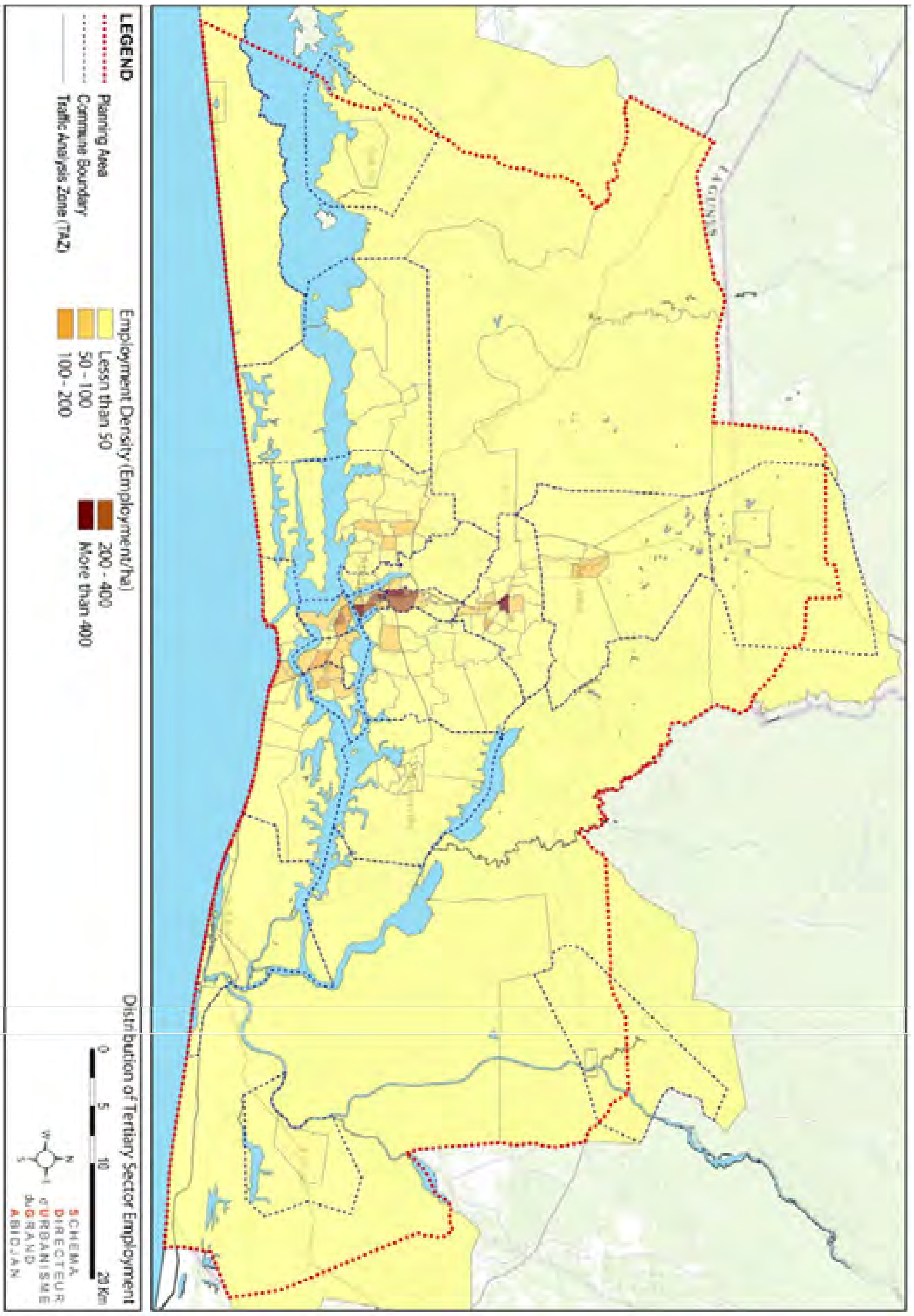
Source: JICA Study Team

Figure 2.10 Density of Secondary Sector Employment in 2013



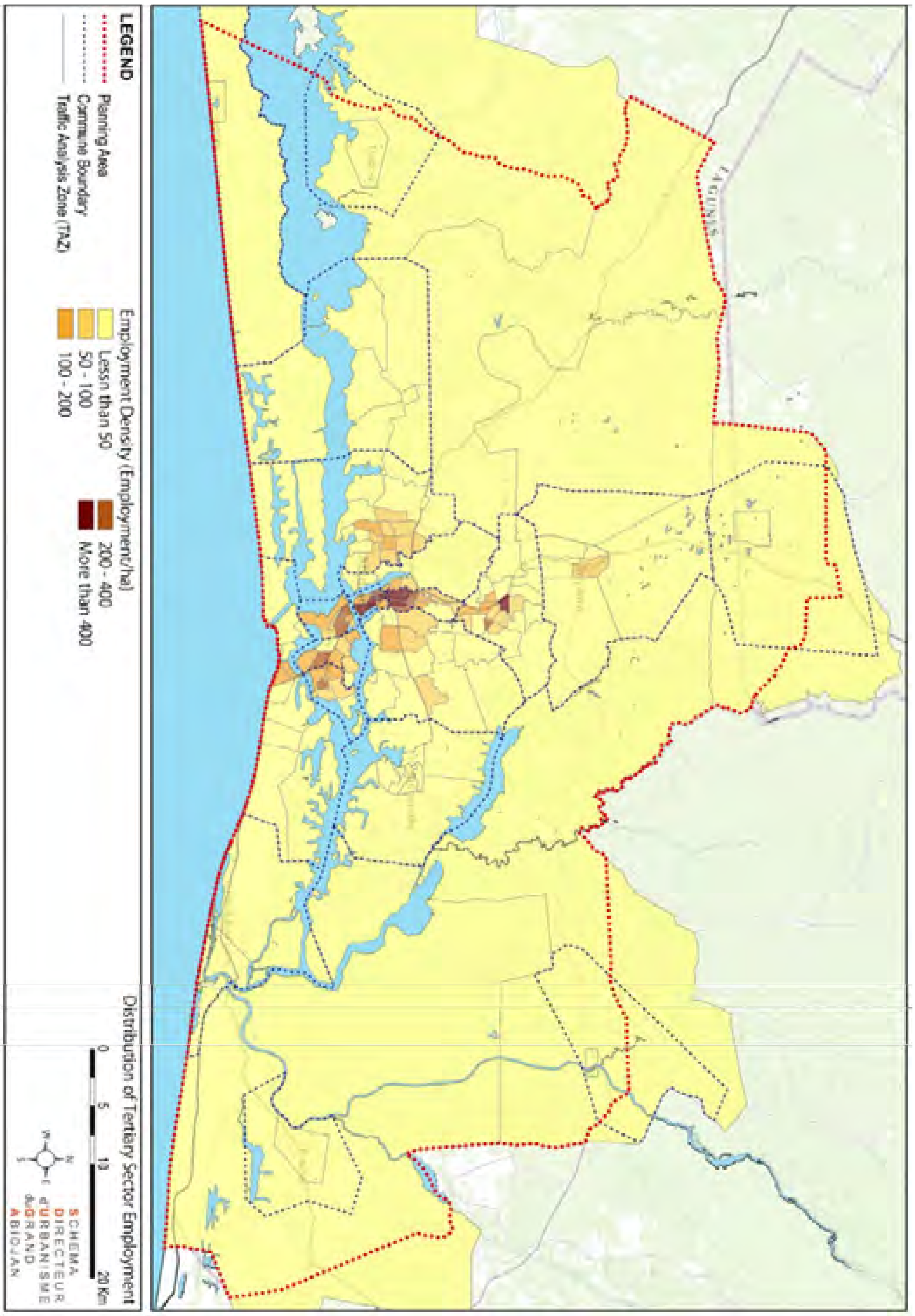
Source: JICA Study Team

Figure 2.11 Density of Secondary Sector Employment in 2030



Source: JICA Study Team

Figure 2.12 Density of Tertiary Sector Employment in 2013



Source: JICA Study Team

Figure 2.13 Density of Tertiary Sector Employment in 2030

2.4 Trip Distribution Module

2.4.1 Overview

In the next module of the model development, trips generated by various TAZs must be linked to trips attracted to zones. This is the Trip Distribution phase of the model. In this and subsequent stages of the model development, there is a need to estimate travel cost or impedance. This model has used the distance between TAZs.

2.4.2 The Gravity Model

The person-trip distribution for inter-zone travel is developed around the Gamma Function as the friction factors for the gravity model in the estimate of distribution. The gravity model function takes the following form for this study:

$$T_{ij} = P_i\ A_j\ F\ (c_{ij}) \qquad \text{……..Equation 3.3}$$

Where T_{ij} is the trips between zone *i* and zone *j*;

P_i is the number of trips produced in zone *i*;

A_j is the number of trips attracted to zone *j*;

$F(C_{ij})$ is the function presenting impedance to travel between zone *i* and zone *j*, often known as the F-Factor curve.

C_{ij} is the impedance of travel between zone *i* and *j* measured in units of distance.

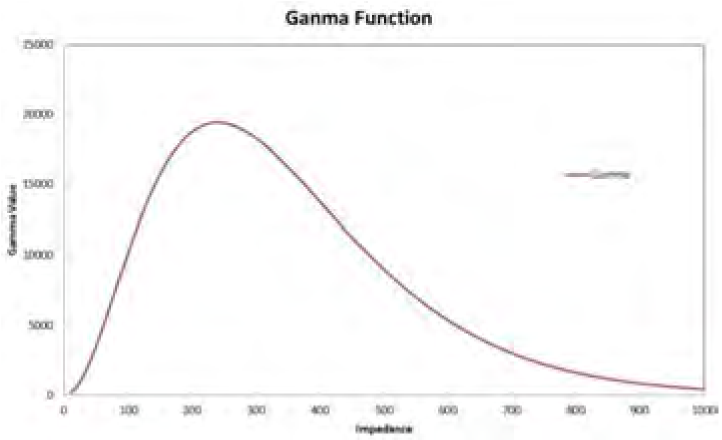
The objective of the model calibration is to develop an F-Factor curve that best fits the observed data. Calibration was performed based on the home interview survey. In this case, the F factor curve was initially designated as a Gamma function.

The form of the gamma function is as follows:

$$F(C_{ij}) = C_{ij}^{X1} * \exp(X2*C_{ij})$$

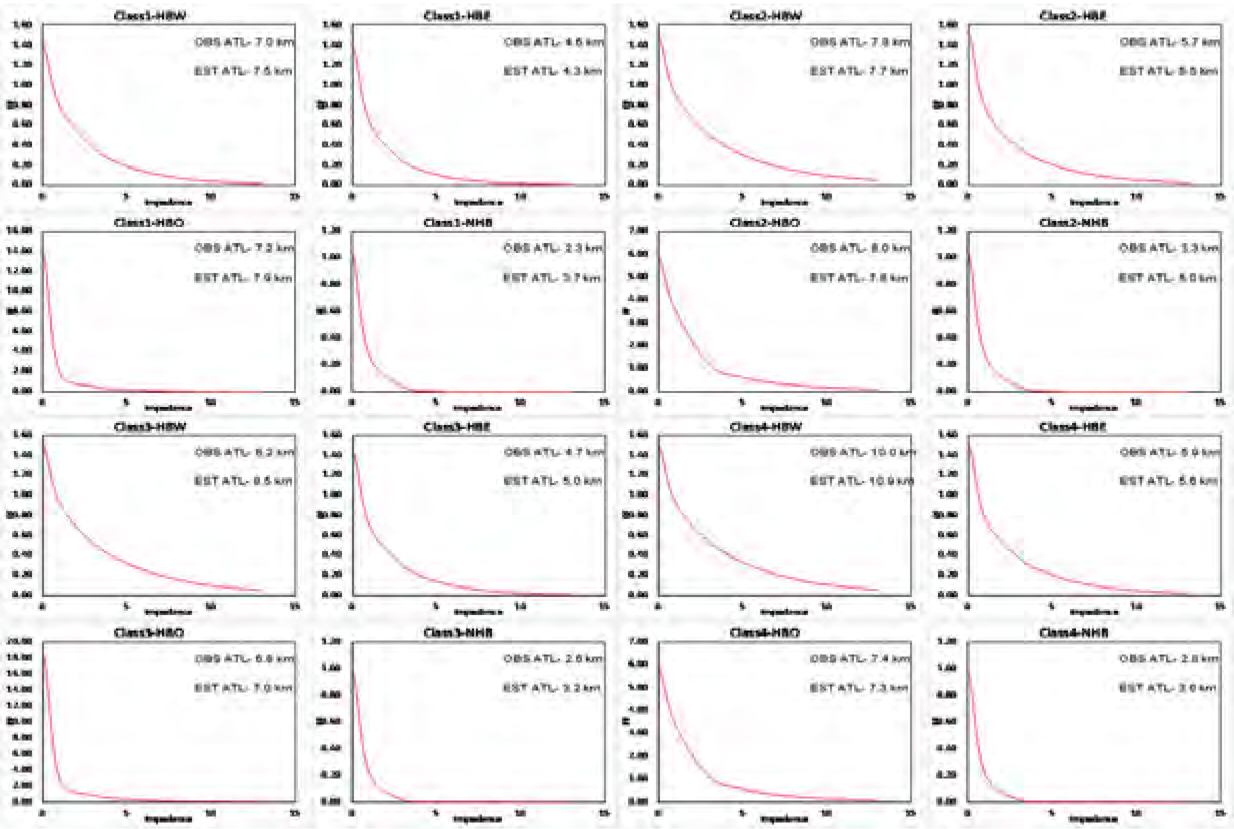
Where:

C_{ij} is the impedance of travel between zone *i* and *j*, measured in units of distance; and X1, X2 are calibration constants. The curve function form is shown in Figure 2.14. The distribution of trips travelling between any two travel zones is proportional to the propensity gravity function. The final version of the factor curve is presented in Figure 2.15.



Source: JICA Study Team

Figure 2.14 The Gamma Function



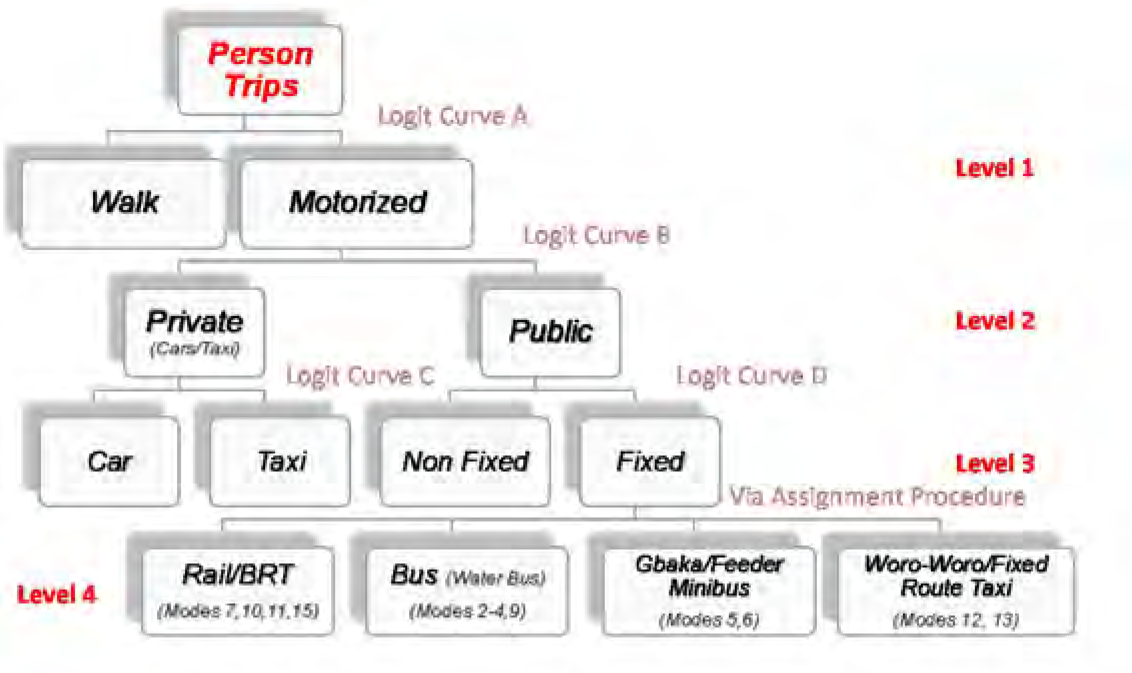
Note: OBS – observed, EST – estimated, ATL – Average Travel Length
Source: JICA Study Team

Figure 2.15 Shape of F Factor Curves

2.5 Mode Choice Module

2.5.1 Overview

The Mode Choice module is represented in the transport model by a series of models that reflect the choices available to the residents of the study area. These models are applied separately to different segments of the travel market as each segment has its own characteristics and range of choices. In the model there are, in fact, 16 models with one for each trip purpose and each economic activity class for all trips. The mode split model is a four-level hierarchical mode split with four logit curves, as seen in Figure 2.16. For each of the four trip purposes and four income classes, there are four logit curves. The final level allocation of four modes is achieved within the public transport assignment.



Source: JICA Study Team

Figure 2.16 Mode Choice Structure

2.5.2 Generalized Travel Costs

The behavioral values of time used to derive the value of time in the mode split models are derived for households with and without vehicles. The base year values are derived from the HIS and are a combination of workers' value of time for each household in the case of work trips, as shown in the following equation[6]:

Value of Time = Average Household Income/{(Number of Workers or Persons)*(Average Work Time)} …...Equation 3.4

The value of time for vehicle- and non-vehicle-owning households is 408 and 157 FCFA per hour, respectively. The future year value of time is linked to the growth in household income that in turn is linked to the regional GDP growth.

The behavioral operating cost for a car was estimated at 56 FCFA per km, which is related directly to the cost of fuel. For road links other than BHLS or BRT, the speed assumed for buses on a link is 50% of the road link speed.

The mode choice models were developed using generalized travel costs to represent the total costs each person faces when choosing between modes. For each mode, the cost expression (converted in terms of time) is as follows:

Generalized travel time = travel time + (out-of-pocket costs) / (value of time) ……..Equation 3.5

The travel time for public transport users includes in-vehicle time or line-haul time and walk time at each end of the journey and when transferring between services, and wait time. There is also a boarding penalty depending on the particular mode of public transport. For private modes, the travel time includes the in-vehicle time and additional terminal time, which represents the final access/egress to the travel origin or destination.

The out-of-pocket costs represent fares for the public transport user; for private modes it includes fuel cost, tolls and parking costs, which are assumed to be shared among the occupants of the vehicle. For taxi mode, the total taxi fare is calculated using the following formula:

Total Fare (FCFA) = 500 + 96.9*Distance (km) ……..Equation 3.6

This formula was derived from a review of the taxi trips reported in the Household Interview Survey.

2.5.3 Mode Split Characteristics

The mode split model is, as stated earlier, a series of hierarchical binary logit models with a choice between mode one and mode two. Mode two is often not a single mode but rather a group of modes. The probability of mode one is defined as:

[6] "Synthesis of Research on Value of Time and Value of Reliability" Final Report Contract No. BD549 46 January 2009 Florida Department of Transportation by Sisinnio Concas and Alexander Kolpakov Center for Urban Transportation Research.

$$\frac{1}{1+\exp(-\lambda(C_{ij}^{2}+\delta-C_{ij}^{1}))} \quad \text{..Equation 3.7}$$

Where:
λ is the scale parameter and δ is the bias as defined in Table 2.6;
C_{ij}^{1} is the generalized cost of travel for hierarchical mode choice 1 between any two traffic analysis zones *i* and *j*; and
C_{ij}^{2} is the generalized cost of travel for hierarchical mode choice 2 between any two traffic analysis zones *i* and *j*.

As depicted in Table 2.6, the calibration is accepted in consideration of the disaggregated nature of the calibration datasets.

Table 2.6 Mode Split Parameters

Economic Activity Class	Curve A *(Mode 1 = Walk)*			Curve B *(Mode 2 = Private)*			Curve C *(Mode 3 = Car)*			Curve D *(Mode 4 = Non-Fixed)*		
	λ	**δ**	R^2	**λ**	**δ**	R^2	**λ**	**δ**	R^2	**λ**	**δ**	R^2
Purpose: HBW												
Class 1	0.465	3.9	0.596	0.016	-32.6	0.616	0.005	-477.7	0.583	0.005	-234.1	0.594
Class 2	0.354	4.4	0.598	0.012	-15.7	0.624	0.019	200.0	0.855	0.005	-47.5	0.584
Class 3	0.443	2.7	0.597	0.011	72.6	0.599	0.005	152.2	0.610	0.005	183.9	0.576
Class 4	0.220	1.9	0.629	0.011	-49.0	0.640	-0.009	182.6	0.566	0.005	-252.7	0.996
Purpose: HBE												
Class 1	0.347	7.8	0.596	0.016	28.5	0.578	0.040	208.6	0.490	0.012	-101.0	0.593
Class 2	0.354	6.9	0.596	0.009	-110.1	0.636	0.003	33.1	0.529	0.012	166.4	0.567
Class 3	0.267	7.7	0.599	0.013	65.6	0.613	0.011	275.9	0.944	0.014	88.1	0.590
Class 4	0.395	3.0	0.619	0.009	81.2	0.609	0.057	228.7	0.592	0.012	-252.2	0.583
Purpose: HBO												
Class 1	0.310	3.9	0.595	0.043	-40.6	0.556	0.002	167.1	0.598	0.008	-291.1	0.595
Class 2	0.313	3.5	0.595	0.043	-24.7	0.350	0.002	-313.6	0.659	0.008	-165.9	0.574
Class 3	0.472	2.0	0.670	0.043	-29.5	0.563	0.002	-106.8	0.570	0.008	238.0	0.568
Class 4	0.235	2.6	0.515	0.043	40.2	0.337	0.005	271.8	0.503	0.008	238.0	0.568
Purpose: NHB												
Class 1	0.755	-0.2	0.521	0.161	-12.6	0.383	-0.083	73.2	0.526	0.056	-39.1	0.697
Class 2	0.853	2.0	0.572	0.375	8.0	0.642	-0.083	69.3	0.550	0.056	32.5	0.582
Class 3	2.798	0.7	0.658	0.209	12.1	0.423	-0.083	5.5	0.555	0.056	-16.0	0.568
Class 4	2.798	0.6	0.307	0.161	21.3	0.859	-0.083	5.5	0.555	0.056	-16.0	0.568

Source: JICA Study Team

2.6 Additional Trip Tables

2.6.1 Overview

Four additional sources of trip making were identified outside of the traditional four-step transport model. These are the movement of trucks or commercial vehicles, external vehicles and two special generators, namely, Felix Houphouet Boigny International Airport and Abidjan Sea Port.

2.6.2 Commercial Vehicle – Base Year

The commercial vehicle or truck movements were analyzed using the interview surveys. The number of trucks at the survey locations is provided in Table 2.7 and the estimated truck trips between communes are also shown in Figure 2.17. It is shown that the largest traffic volume is observed around the port area. Initially, it was intended to estimate the number of tons being carried by each truck class. However, this data was not available from the survey. The truck origin and destination dataset, in combination with traffic counts, is used in a matrix estimation procedure to prepare the base year truck matrix.

Table 2.7 Number of Trucks at Survey Locations

Survey Location	Small Trucks (PCU)	Large Trucks (PCU)
Dabou	400	1,240
Lagunes (Autoroute du Nord)	500	3,820
Azaguie	90	1,170
Alepe	90	60
Bonoua	1,370	1,700

Source: Cargo Transport Survey, JICA Study Team

Source: Estimated from Cargo Transport Survey, JICA Study Team

Figure 2.17 Desire Lines of Truck Trips

2.6.3 Commercial Vehicle – Future Year Forecast

GDP forecasts overall control the growth in the commercial vehicle growth. However, the distribution to each TAZ is linked to employment data. Findings from other cities, such as Cairo[7], suggest that internal small truck trips are influenced by total employment, while large truck trips are impacted by secondary employment.

In the case of small trucks, an area adjustment of data and a power relationship were adopted:

[7] CREATS: The Transport Master Plan for Cairo

$Y = a(x^b)$ ……..Equation 3.8

where Y = Internal small truck PCU trips per square kilometer of zone area
a,b = Calibration coefficients
x = Zonal socioeconomic data per square kilometer of zone area

Whilst in the case of large truck trips absolute totals and a linear regression of the form:

$Y = a + bx$ ……..Equation 3.9

where Y = Internal large truck PCU trips per zone
a,b = Calibration coefficients
x = Zonal secondary employment

were utilized. These relationships serve as trip-generation models using zonal truck trips as dependent variable, and employment as independent variables. The best-fit equation coefficients are provided in Table 2.8.

Table 2.8 Number of Trucks at Survey Locations

Category	Constant (a)	Secondary Employment Coefficient (b)	Total Employment per Square km Exponent (b)	Coefficient of Correlation (R2)
Small Truck	0.0055 (*-4.2*)		0.814 (*5.9*)	0.55
Large Truck	9.95 (*2.2*)	0.0084 (*11.7*)		0.57

Note: Values in parentheses indicate *t*-statistics.
Source: JICA Study Team

The coefficients of correlation are not high. In the development of the commercial vehicle model there was often a large scatter of the data. These were the best curves after trying several other combinations of data. To ensure that the use of these curves did not cause spot fluctuations in truck trips, for each TAZ the truck trips were estimated by class for base and future year. The growth between base and the future year was estimated and then applied as a growth factor to estimate the future trips. Thus, the use of base and future zonal socioeconomic variables results in the calculation of a relative rate of growth vis-à-vis observed conditions; that is,

$$T_F = T_B * \frac{T_{RF}}{T_{RB}}$$ ……..Equation 3.10

where, for each zone,

T_F = Estimated future-year trips
T_B = Base-year trips
T_{RF} = Trip estimate derived from future socioeconomic variables
T_{RB} = Trip estimate derived from base-year socioeconomic variables

The future year trip control total, T_F, is then, as stated earlier, linked to growth in GDP.

2.6.4 Development of External Trips

The cordon survey collected at the study area boundary allowed for the estimation of external person and vehicle movements. The vehicles are split into four classes, excluding public transport vehicles, namely, cars, taxis and small and large trucks. The traffic counts at the external locations are shown in Table 2.9.

Table 2.9 External Zone Locations

Zone Number	Location	Traffic Count (PCU)
169	Dabou	2 530
170	Lagunes (Autoroute du Nord)	5 980
171	Azaguie (Northwest)	990
172	Azaguie (Northeast)	1 770
173	Bonoua	4 920

Source: Cargo Transport Survey, JICA Study Team

2.6.5 Analysis for Special Generators

Two special generators are included in this study, namely, the port and the airport. In 2012, the number of passengers at the international airport was 0.9 million annual passengers[8]. This is not large by international standards. These trips are distributed on the basis of Home-Based Work to the population of Abidjan.

For the port, there are 760,000 tons per year or 2,000 tons per day, on daily average, that pass through. A proportion of this tonnage comes via the international railway, as a significant amount of the cargo is bound for destinations outside of the country.

2.7 Assignment Module and Base Year Calibration

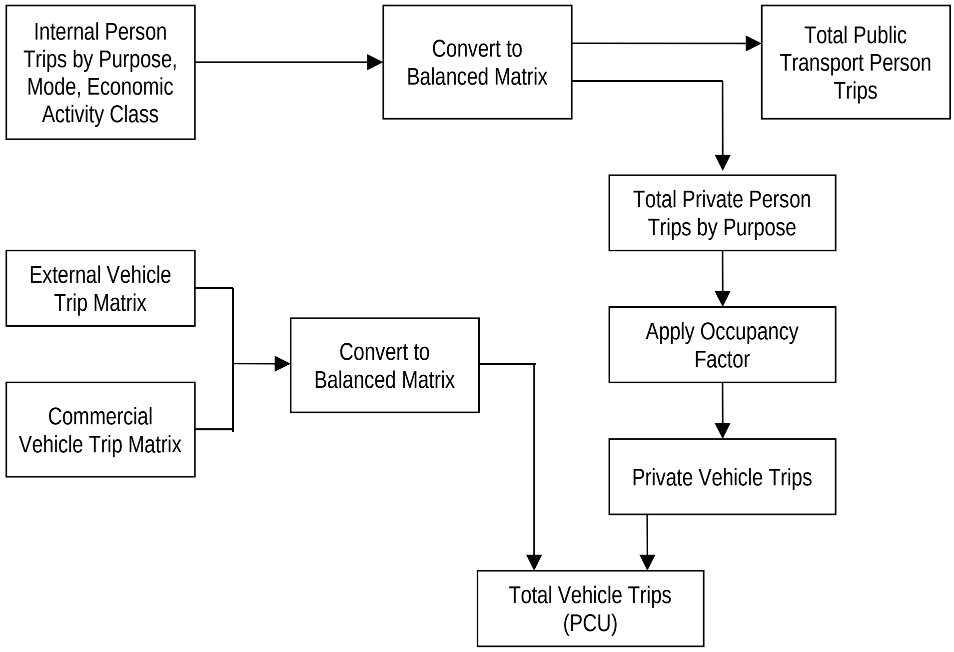
2.7.1 Overview

The assignment module combines the impact of all previous steps in the model and is, therefore, the final and major check on the model output. However, before the assignment process, which is two-fold, it is necessary to produce the trip tables needed for the vehicle and public transport assignment.

2.7.2 Matrix Combination

At the end of the mode split module, there are several trip tables by purpose, economic class and mode. The overall trip table for public and private transport is calculated as shown in Figure 2.18.

[8] a FratMat.info article published on the January 28, 2013, World Air Traffic Report and Airports Council International.



Source: JICA Study Team

Figure 2.18 Matrix Combination

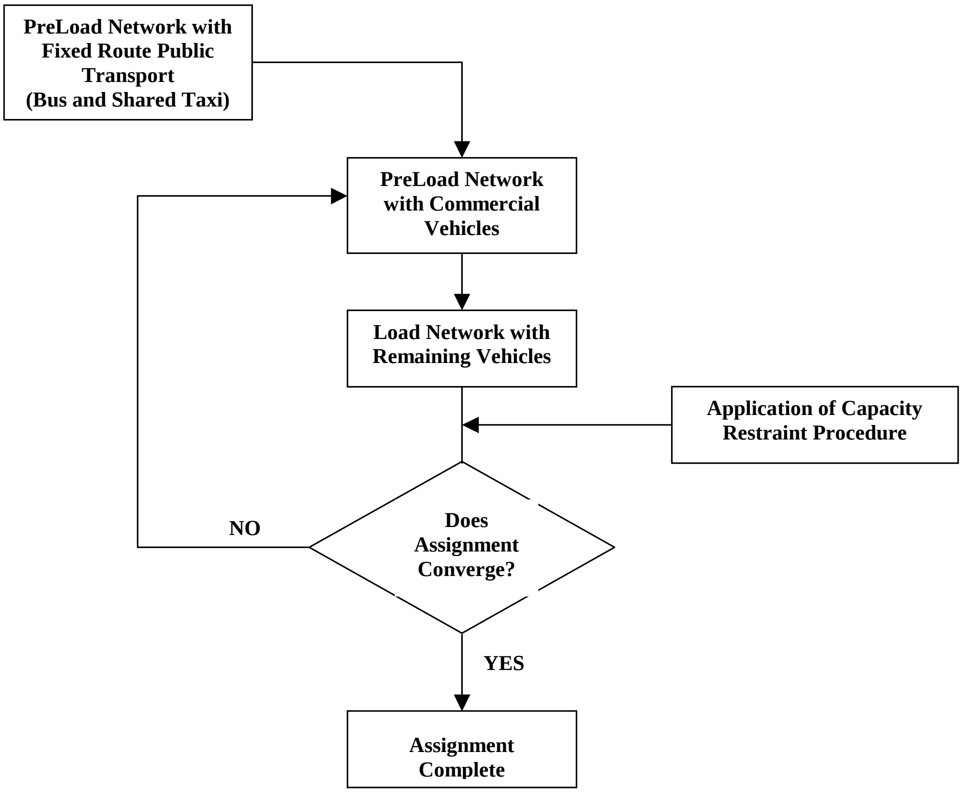
The trip table format after the completion of the mode split stage of the modeling process is in the production-attraction format discussed earlier in this chapter. As shown in the flowchart, it is first necessary to convert these matrices into an origin and destination matrix by adding the transpose of the matrix to itself.

2.7.3 Highway Assignment

At the citywide level of modeling, it is appropriate to use multi-routing path building and assignment techniques utilizing capacity restraint. By applying capacity restraint, account is taken of congestion altering journey speeds. The assignment technique used is an equilibrium procedure. This procedure combines flows from previous iterations, and the method calculates the optimum proportion of each intersection that should be combined to achieve a "user-optimized" solution.

Public transport vehicles are incorporated by pre-loading the network prior to assignment of all other vehicles. Pre-loading the network is usually applied to modes with "fixed" or "non-dynamic" routing, where there is a small likelihood of changing routing as a consequence of changing levels of congestion. The trucks are pre-loaded in an initial assignment because there is an option to bar trucks from certain links in the network. The public transport volumes, (obtained from the Public Transport Network) are pre-loaded because in the model they follow fixed routes.

This preloading will result in some reduction of capacity of the network prior to the assignment of other vehicles. After the preload, the remaining vehicles will be loaded. The iterative traffic assignment cycle is presented in Figure 2.19.



Source: JICA Study Team

Figure 2.19 Assignment Flowchart

In effect, the assignment is repeated until equilibrium is maintained on the following iteration. In the case, for example, of an expressway, on an early iteration little traffic is assigned to the expressway but as other city roads become more expensive as a result of congestion, traffic is diverted to the relatively cheaper expressway. This procedure is repeated continuously until network equilibrium. The assignment includes toll diversion. This is effectively achieved through obtaining a network in equilibrium balance.

In the initial conversion of the person trip tables to vehicle trip tables, there is an application of a vehicle occupancy factor (see Table 2.10). These are presented in Occupancy Factors. These are applicable only for private transport. The vehicle assignment for road-based public transport is included as a preloaded volume on the road network as stated earlier.

Table 2.10 Occupancy Factors

Vehicle Type	Occupancy Factor
Car	2.41
Taxi	1.63
Woro-Woro	3.22

Note: * Excluding the driver
Source: Cordon Line Survey and Screen Line Survey, JICA Study Team

2.7.4 Public Transport Assignment

Public transport network assignment is complex due to the number of factors that have to be considered when examining the optimal modal path. These include:

- In-vehicle time
- Waiting time (a function of headway)
- Decision on waiting for faster infrequent service or traveling via a slower frequent service
- Inconvenience of transferring between public transport services
- Different travel cost of a service, difference between modes
- Mode comfort factor
- Walk time to alternative services
- Which fast service stops closest to final destination

A range of parameters are available to control the path-building process, including:

- Mode-specific in-vehicle time weighting factors
- Mode-specific waiting time weighting factors
- Mode-specific boarding penalties
- Mode-specific value of time

These parameters are presented in Table 2.11 for the major modes in the base year. All parameters were estimated in the calibration of the public transport. The fare in particular for the various public transport routes was developed on a line basis and obtained from the SDUGA survey program.

Table 2.11 Mode-Specific Constants[9]

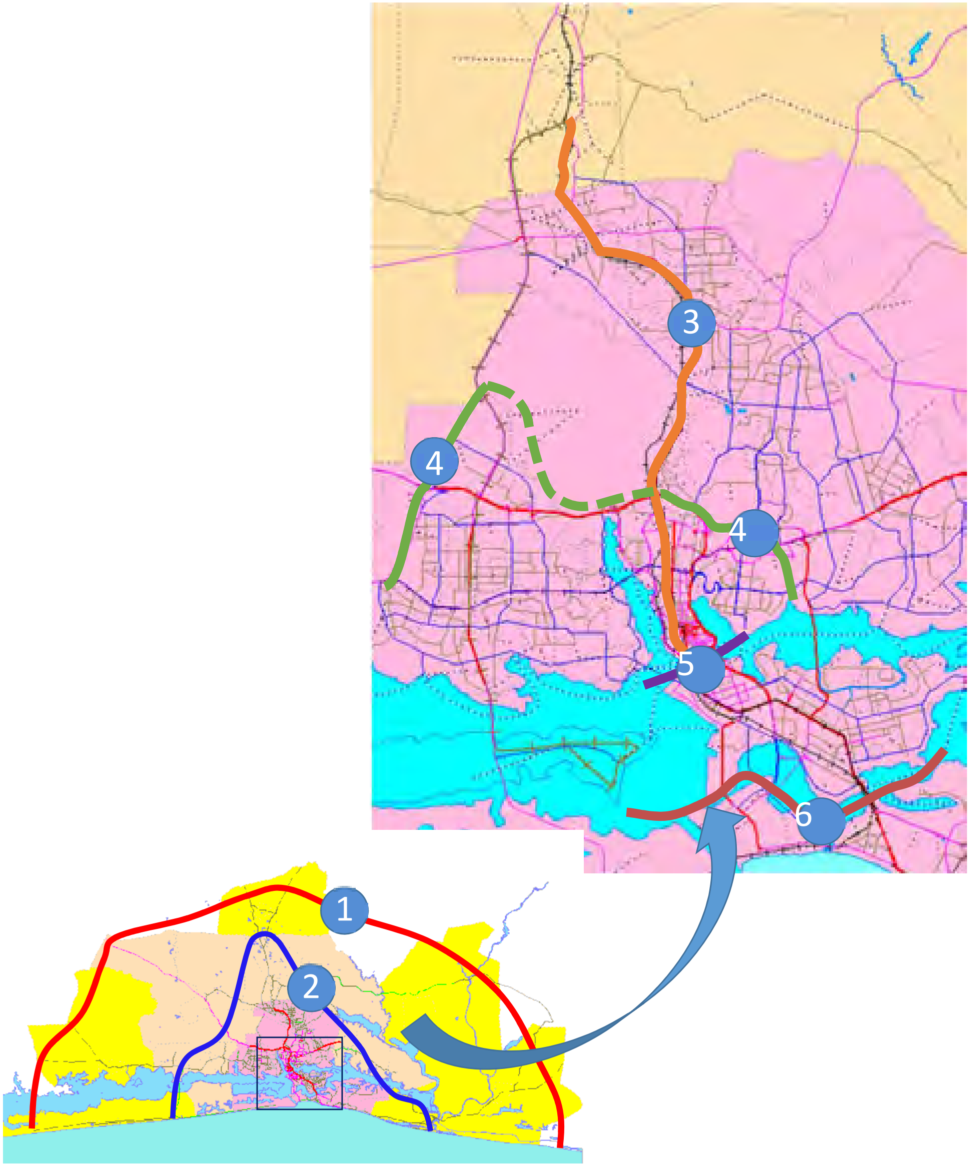
Mode	Run-Time Factor	Boarding Penalty (Equivalent Minutes)
SOTRA Normal BUS	1.2	20
SOTRA Express BUS	1.1	20
Gbaka	1.0	10
Woro-Woro	1.0	5

Source: JICA Study Team

2.7.5 Calibration

The traffic assignment is undertaken as part of the final validation process. As shown in Figure 2.20, observed and estimated traffic volumes crossing six screen lines in the study area are compared for validation. The comparison is based on two types of traffic volume, that is, vehicle trips and person trips. As for vehicle trips, all types of private vehicles and trucks are consolidated since it is not possible to make a clear comparison of observed vehicles by individual vehicle types due to the problems of identification of individual vehicle types in the vehicle traffic assignment. Therefore, all vehicle trips are converted into PCU. Person trips include all the passengers crossing those screen lines.

[9] These in fact become model calibration factors.



Source: JICA Study Team

Figure 2.20 Screen Line Location Map

Comparison across screen lines based on vehicle and person trips is shown in Table 2.12 and Table 2.13, respectively. Relatively large differences between observed and estimated vehicle trips and person trips appeared at screen lines No. 1 and 2 compared to those of the inner-city screen lines (No. 3 to 5). This may result from a lack of information outside the area of HIS which affects trip production/attraction in peripheral zones. With regard to person trips, a relatively large difference between observed and estimated person trips are confirmed at screen line No. 5 compared to vehicle trips due to the difference of observed mode share, that is, a lower percentage of Gbaka at No. 5, which carried fewer passengers compared to the other screen lines. The difference in the total number of vehicles is 1% and that of person trips is also 1% which is considered to reflect an appropriate calibration. By all indications, the assignment has accurately replicated the base year.

Table 2.12 Comparison across Screen Lines (Vehicle Trips)

Screen Line Number	Description	Traffic Count (PCU/day)	Model Estimate (PCU/day)	Estimation/Observation
1	Outer Screen Line	21,000	18,000	86%
2	Inner Screen Line	29,000	42,000	145%
3	Inner North-South Screen Line	174,000	167,000	96%
4	Inner East-West Screen Line	286,000	282,000	99%
5	Bridge Screen Line 1	166,000	161,000	97%
6	Bridge Screen Line 2	105,000	101,000	96%
Total		771,000	781,000	99%

Source: Screen and Cordon Line Survey, JICA Study Team

Table 2.13 Comparison across Screen Lines (Person Trips)

Screen Line Number	Description	Traffic Count (Passengers/day)	Model Estimate (Passengers/day)	Estimation/Observation
1	Outer Screen Line	94,000	60,000	64%
2	Inner Screen Line	165,000	272,000	165%
3	Inner North-South Screen Line	644,000	477,000	74%
4	Inner East-West Screen Line	787,000	730,000	93%
5	Bridge Screen Line 1	166,000	337,000	203%
6	Bridge Screen Line 2	232,000	201,000	87%
Total		2,088,000	2,078,000	99%

Source: Screen and Cordon Line Survey, JICA Study Team

For modal share, a comparison is presented in Table 2.14 between the synthesized passengers and the "observed" passengers from the SDUGA Household Interview Survey. There are approximately 13.6 million person trips[10] in Abidjan today. The estimated number of trips carried by public transport is smaller than that of the observed trips whereas that of walking trips are larger, which arises from the mode choice module. It may be interpreted that short distance trips, especially intra-TAZ trips, tend to be estimated as walking trips. However, as shown previously, the difference in the total number of estimated and observed vehicle and person trips on major screen lines are 1% in vehicle and person trips (Table 2.12 and Table 2.13), which could be accepted as the basis for the transport demand forecasts in the future.

Table 2.14 Overall Modal Comparison of Trips in Greater Abidjan

Mode	Observed (million person trips per day)	Model Estimate (million person trips per day)	Estimation/Observed (%)
Walk	5.7	6.3	109.1%
Public	6.4	4.6	70.9%
Private	1.5	1.4	98.6%
Total	13.6	12.3	90.3%

Note: Trip production/attraction in TAZs outside HIS area are eliminated.
Source: Household Interview Survey, JICA Study Team

[10] This comparison is based on an estimate of travel within the area of the 14 communes covered in the HIS.

Comparing passenger demand among public transport modes as shown in Table 2.15, a comparatively large difference in SOTRA bus and Gbaka passengers is observed. Gbaka passengers were underestimated due to lack of route information since it tends to be difficult to capture route information of informal transport across communes, which in turn resulted in a larger estimated number of SOTRA bus passengers. It should be recommended to conduct a further study on public transport based on SDUGA. However, the total number of estimated passengers is close to the observed passengers.

Table 2.15 Mode Comparison of Passenger Boarding for Public Transport

Mode	Observed (million person trips per day)	Model Estimate (million person trips per day)	Estimation/Observed (%)
SOTRA BUS	0.82	2.17	265
Gbaka	2.01	1.05	52
Woro-Woro	3.31	3.19	96
Total	6.14	6.41	104

Source: Household Interview Survey, JICA Study Team

2.8 Indicative Future Year Results

2.8.1 Overview

For the application of the transport model in the future, the two basic inputs needed are:

- Future Planning Data; and
- Future Year Network

As discussed in the previous chapter, planning data has been prepared for three future years, namely, 2020, 2025 and 2030. Selected key socioeconomic data is presented in Table 2.16. Detailed results of the application of the transport model are discussed elsewhere in this report. Included in this chapter is a discussion on the application of changing land-use data and the model reference case in all years. The reference case by year includes road projects that are opened in the specified year. The opening year is included as a variable in the road network. In the case of public transport, all new additional bus routes are also included.

Table 2.16 Summary of Key Future Planning Data for Study Area

Year	Population (Million)	Motorized Trips (Million)	% Households in Economic Class 3 and 4
2013	5.3	5.9	13
2020	6.3	7.7	17
2025	7.2	9.7	21
2030	8.4	11.7	25

Source: JICA Study Team

Key future additional public transport infrastructure included in the year reference cases are shown in Table 2.17. Further details on these transit projects are given in Chapter 5.

Table 2.17 Timing Assumptions for Major New Transit within Model

Year	North-South Rail Phase 1	North-South Rail Phase 2	East-West Rail	Improved Lagoon Transit
2013	X	X	X	X
2020	X	X	X	Complete
2025	Complete	X	Complete	Complete
2030	Complete	Complete	Complete	Complete

Source: JICA Study Team

2.8.2 Horizon Year Reference Case in 2030

The model reference case is for the year 2030. This reference case includes all the above-mentioned projects nominated for inclusion in the master plan for 2030. Key overall statistics are provided in Table 2.18 for the reference case in comparison to the base year of 2013 as well as the do-nothing case in 2030. Without the master plan, the average personal travel speed will deteriorate to 13.0 km/h whilst with the master plan the average travel speed is 31.1 km/h. In economic terms this means that the completion of the master plan will mean significant economic savings.

The impact of the master plan on transport demand across the central area of Abidjan is shown in Figure 2.23 while Figure 2.22 presents the impact of the network without the master plan. In the case without the master plan, there are significantly more red links in the network. These red links exhibit high volume to capacity ratios (over 1.3) which in practical terms means slow travel along these road links. Compared to the result of without the master plan, links with brown color increase excluding some major routes in the case with the master plan. The year 2013 is included in Figure 2.21 for the purpose of comparison, which shows significant traffic volume at General de Gaulle Bridge, Autoroute du Nord and Boulevard Latrille.

Passenger demand for public transport are shown in Figure 2.24 to Figure 2.26, indicating that a huge amount of transport demand concentrates on Autoroute du Nord and Autoroute d'Abobo in the case without the master plan whereas those demands can be dispersed to planned east-west corridors along with a fifth bridge and to north-south railway lines in the case with the master plan.

In addition, to appreciate the change in the number of both private and public transport trips between 2013 and 2030, desire line diagrams are illustrated in Figure 2.27 and Figure 2.28 for private transport travel in 2013 and 2030 respectively. Similar desire line diagram are depicted in Figure 2.29 and Figure 2.30 for public transport travel in 2013 and 2030 respectively. These figures show the growth in trips between 2013 and 2030. As stated in Table 2.16, the number of motorized person trips is expected to grow to nearly17 million by 2030.

In comparison with 2013, the traffic is compared across the same screen lines as with 2013 showing significant growth[11] as seen in Table 2.19.

[11] This comparison does not include new links such as the 3rd and 5th bridge.

Table 2.18 Model Results for the Year 2030

Measure	Base Year-2013	Do-Nothing Case	Reference Case
Vehicle Kilometers of Travel (Million)	10.4	29.9	29.1
Vehicle Hours of Travel (Million)	0.34	1.55	0.85
Average Network Vehicle Speed	30.4	19.3	34.1
% Public Transport of Mechanized Person Trips	48.5	54.0	55.4
Rail Mass Transit Boarding (Million)	-	-	4.63
Average Person Travel Speed (km/h)	25.4	13.0	31.1

Source: JICA Study Team

Table 2.19 Daily Screen Line Comparison 2013 to 2030 in Units of PCU

Screen Line Number	Description	Estimate in 2013 (PCU/day)	Estimate in 2030 (PCU/day)	Annual % Increase
1	Outer Screen Line	22,100	86,800	8.37
2	Inner Screen Line	67,500	211,600	6.96
3	Inner North-South Screen Line 1	34,200	93,800	6.12
4	Inner North-South Screen Line 2	79,900	107,400	1.75
5	Inner East-West Screen Line 1	95,600	170,600	3.46
6	Inner East-West Screen Line 2	242,000	537,800	4.81
7	Bridge Screen Line 1	184,400	282,500	2.54
8	Bridge Screen Line 2	105,500	138,500	1.61

Source: Screen Line Survey, JICA Study Team

The estimated daily person trips by three main modes are shown in Table 2.20. Total number of person trips will increase 1.7 times from 2013 to 2030. As a result, the shares of both public transport and private vehicle will increase slightly from 40% to 42% and 19% to 23% in the period from 2013 to 2030, respectively. The rate of increase of private vehicle is slightly higher than that of public transport. By 2030, the share of walk trips will decrease by 5%, though the number of trips itself will increase. Further discussion on modal share among public transport modes, which can be estimated in the transit assignment process, is discussed in Section 5.4.2.

Table 2.20 Estimated Person Trips by Three Main Modes

Unit: million person trips/day

Year	2013	2020	2025	2030
Walk	5.6 (40%)	6.6 (38%)	7.3 (37%)	8.0 (35%)
Public Transport	5.6 (40%)	6.9 (40%)	8.4 (42%)	9.8 (42%)
Private Vehicle	2.7 (19%)	3.7 (22%)	4.3 (21%)	5.3 (23%)
Total	13.8 (100%)	17.3 (100%)	20.0 (100%)	23.1 (100%)

Comparing the result of vehicle trip assignment in 2013 and that of the do-nothing case in 2030 shown in Figure 2.21 to Figure 2.26, larger increases in traffic demand in the major corridors are observed. Passenger volume is also illustrated in Figure 2.24 to Figure 2.26. The major findings are summarized below:

- Growth of transport demand on the north-south corridor, which connects Abobo/Anyama and the southern area is observed. In the southern area, there is large transport demand all through the industrial area on Petit-Bassam Island and new development area alongside the airport continuing up to Grand-Bassam. However, accessibility between central Abidjan and the southern area over Petit-Bassam Island is limited to a few routes, that is, FHB and GdG bridges, Boulevard de Vridi, and VGE, which currently limits the capacity of this corridor;

- Heavy traffic is observed on the limited number of routes on the east-west corridor, which connects a future high-density residential area in Yopougon and Cocody. Especially, the highest traffic is observed west of Autoroute du Nord, which is currently the only route to connect to the west side of Abidjan from the east. In addition, future peripheral sub-centers such as Dabou, Songon and Bingerville produces heavy transport demand on the corridor, of which connection to central Abidjan is also limited at present; and

- Private cars and cargo trucks cannot be isolated in terms of their route choices due to limited alternatives of both inter- and intra-regional trips. Cargo trucks originating from Petit-Bassam Island will go through Plateau in the current network, which impairs the potential of the city center not only as an aspect of efficiency of traffic management but also as an economic center of the country.

Further explanation of the result on the regional comparative analysis of the do-nothing and master plan cases is quantitatively explained below.

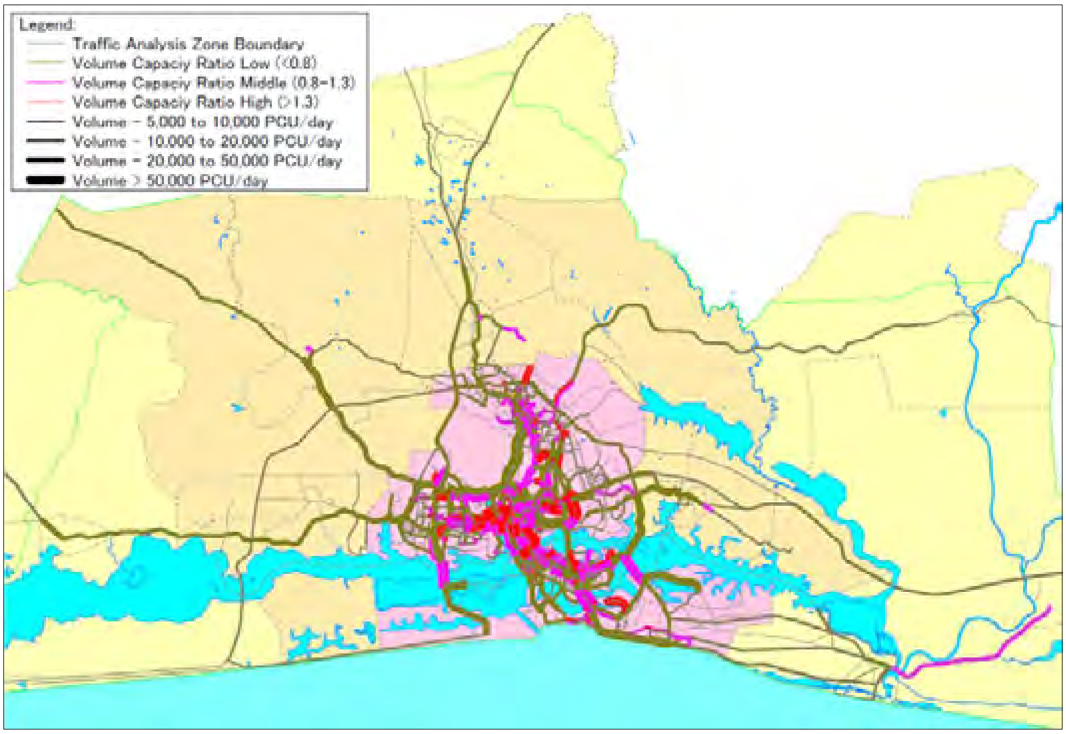
Currently, the major corridor connecting the west side of Abidjan, which is represented by Yopougon as the center of the area, is limited to the Autoroute du Nord, which is a natural bottleneck between the lagoon (Baie du Banco) and the national park of Banco. Therefore, most of the transport demand between west and east side of Abidjan is concentrated on this route, which will obviously become a serious issue in the future. The major issue in this region is dispersing such a concentration of transport demand by the development of new high-capacity corridors. It also should be considered to provide detours to avoid concentration of transport demand into the central area of Abidjan. The proposed new bridges will contribute to disperse the transport demand concentrated on the Autoroute du Nord in the future under the master plan case.

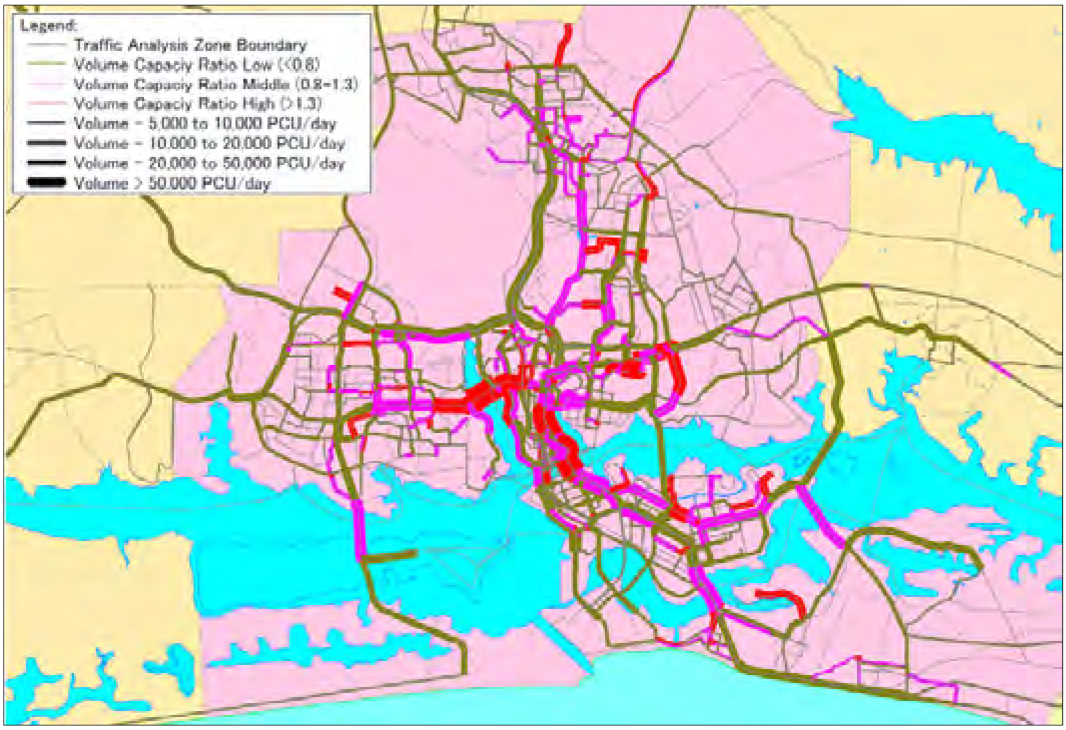
The areas extending from Petit-Bassam Island to Port-Bouet are expected to grow as industrial and residential zones with a rapid increase of population and employment in the future. However, those areas are currently connected to the center of Abidjan only by the two bridges. The transport demand shows a strong relation between Cocody, especially with larger transport demand on GdG bridge compared to that on FHB bridge, and this trend is expected to become more serious in the future. The proposed bridges and a tunnel in the master plan will provide alternative route choices for those demands to divert and ease the traffic concentration on the existing bridges. In addition, future extension of the urban rail to Grand Bassam, which is expected to develop as a tourism and advanced technology city, will improve connectivity of the area and accessibility to the airport. Urban rail can be developed without talking a huge ROW which may not affect the existing built-up areas in Petit-Bassam Island compared to the new construction of a primary road in this limited area.

The northern area represented by Anyama and Abobo has a few arterial roads such as Autoroute d'Abobo and Boulevard Latrille, which is currently known as one of the most congested corridors in this area in the morning and evening peak hours, will become an even greater bottleneck in accordance with rapid population growth in the future. Enhancement of the transport capacity by the expansion of those corridors and development of new urban rail will moderate the heavy traffic load in the area by encouraging a shift from private transport to public transport.

The eastern part of Abidjan extending from Cocody to Bingerville is connected by Boulevard Mitterand and its parallel highway (Boulevard Lycee Technique), of which transport demand is comparatively lower than in the other areas. Though Bingerville is expected to develop as a new residential area in the future, transport demand in this area cannot be accommodated by the existing corridor. Cocody has been built up as residential areas up to now; however, intra-communal roads are not sufficient and current inter-communal corridors such as Boulevard Latrille are also used for that purpose. Enhancement of the transport capacity on the existing corridor with development of BRT/BHLS as well as some few additional alternative routes is expected to disperse the transport demand in the future.

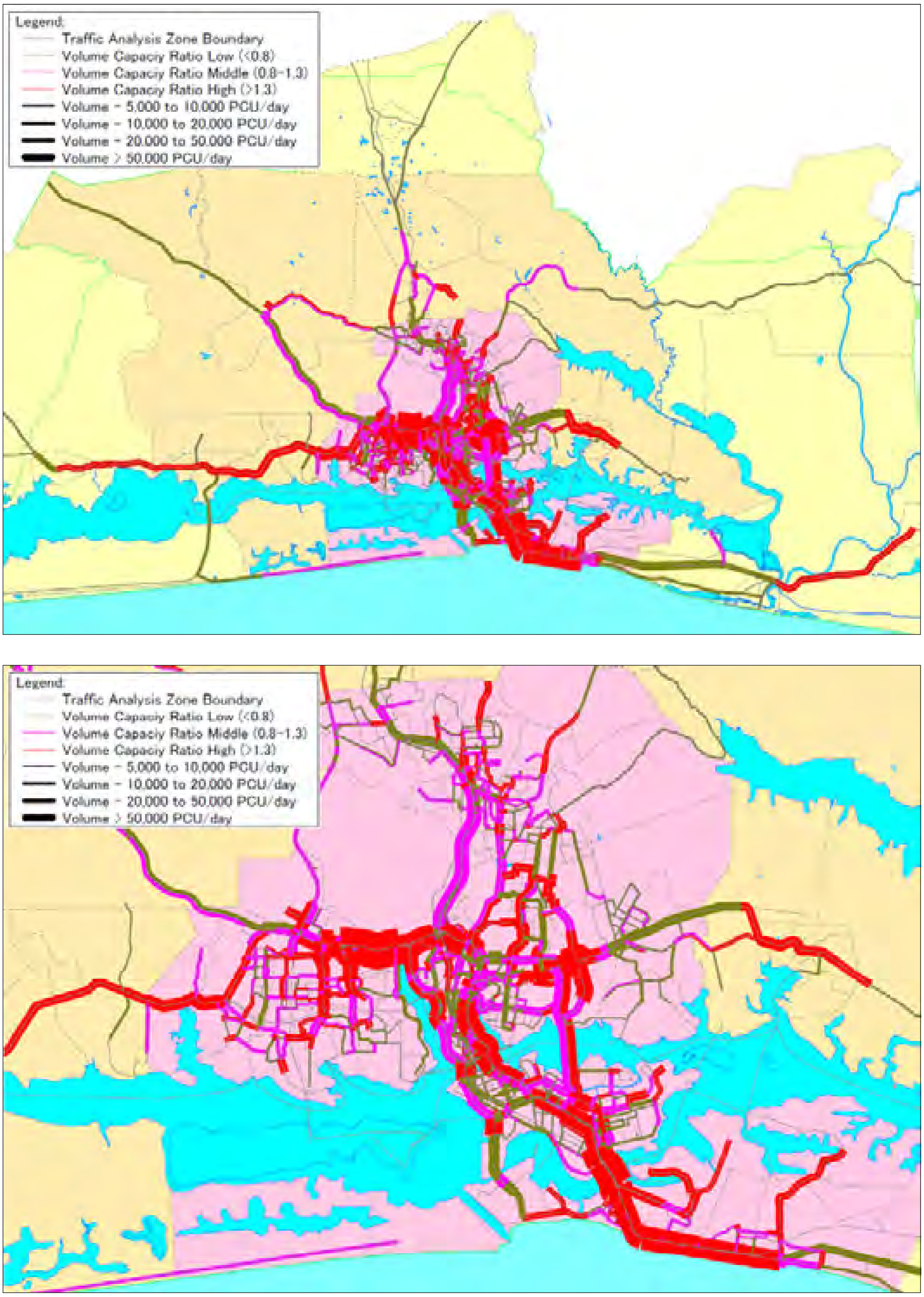
Regarding other satellite communes, Songon and Bingerville are expected to form the east-west corridors with large transport demand in accordance with its population growth as satellite cities under the concept of a compact city in the future. Considering the scale of those communes in the future, it may not be necessary to develop new railway corridors, but enhancement of transport capacity by a new public transport system such as BHLS will be sufficient for the region and can shift the private transport demand to the public transport without huge investment cost and period. It is a basic idea of a compact city to connect the city center and the satellite cities by effective public transport modes which do not excessively rely on the private transport. In addition, as the relationship between Abidjan and other surrounding cities/regions will be strengthened, intra- and inter-city cargo transport including through traffic will also increase in the future. Outer peripheral roads are expected to decrease the traffic which is currently passing through the city center.





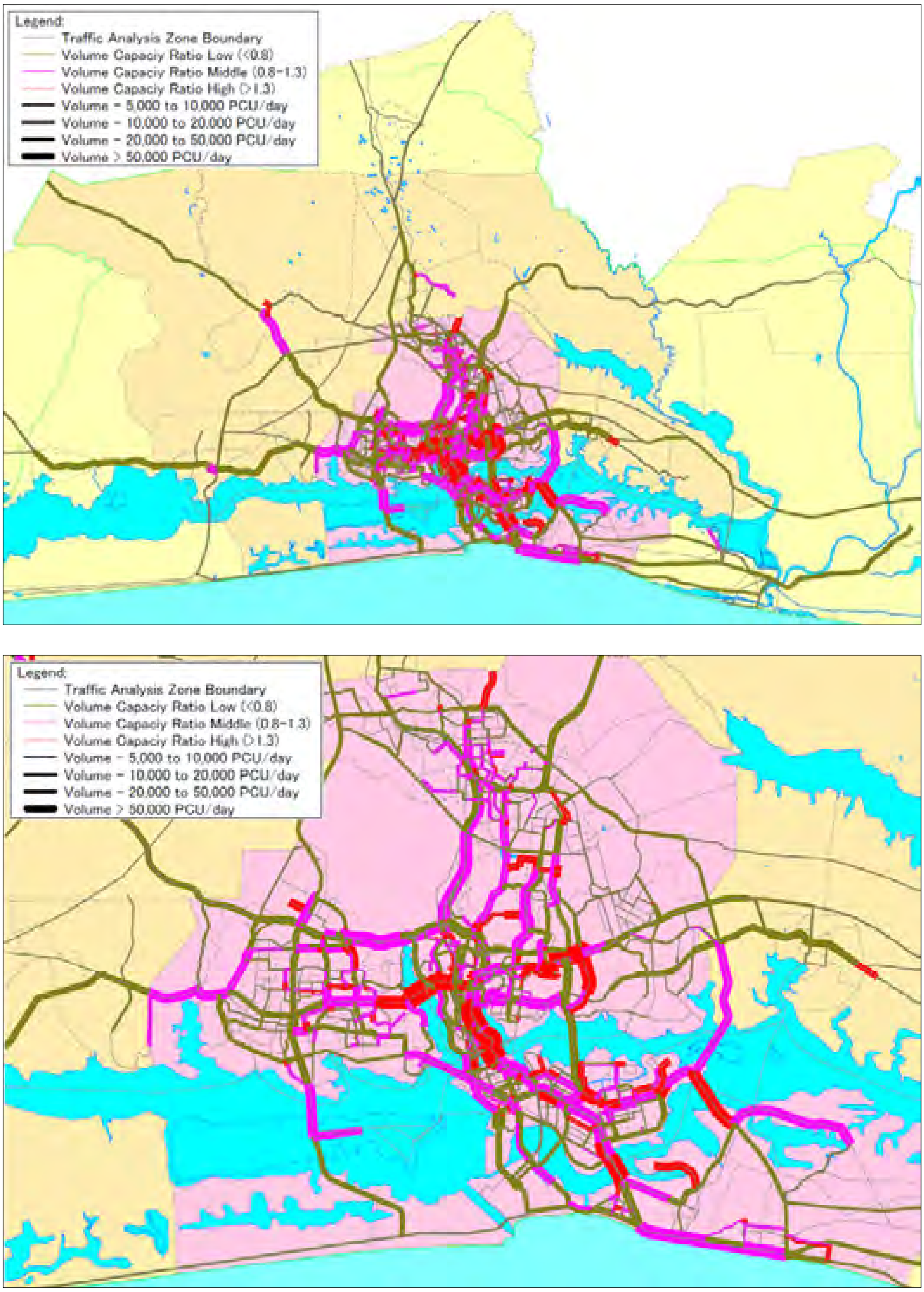
Source: JICA Study Team

Figure 2.21 Transport Demand in 2013 (Vehicle Trips)



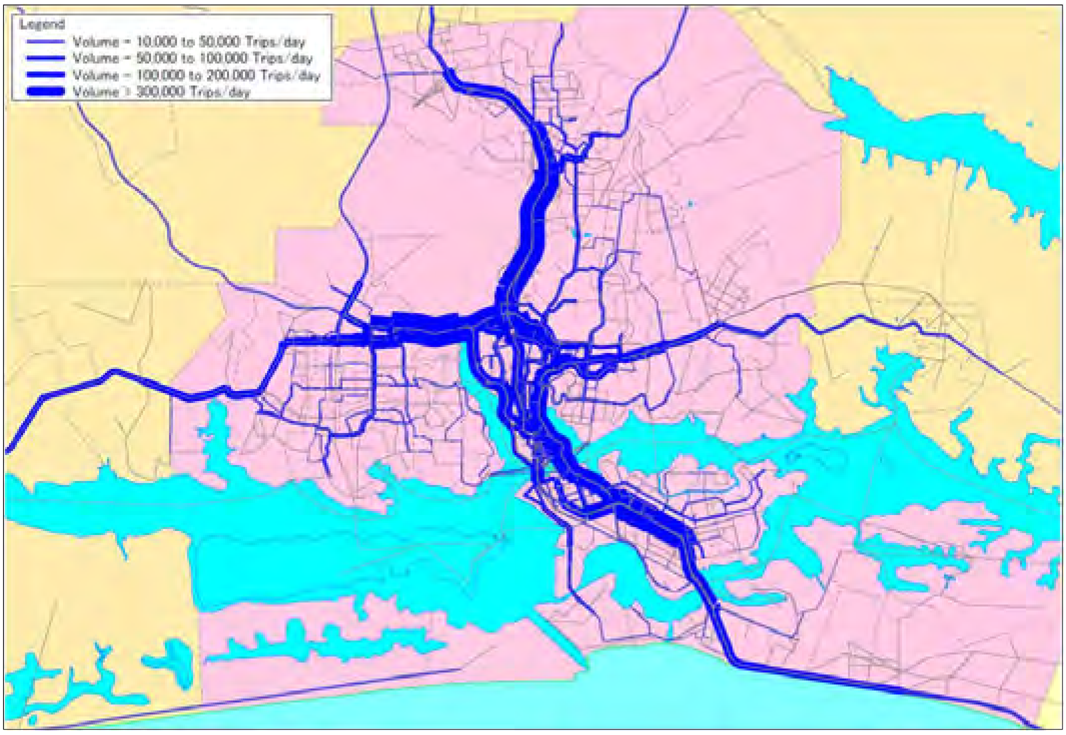
Source: JICA Study Team

Figure 2.22 Transport Demand in 2030 without the Master Plan (Vehicle Trips)



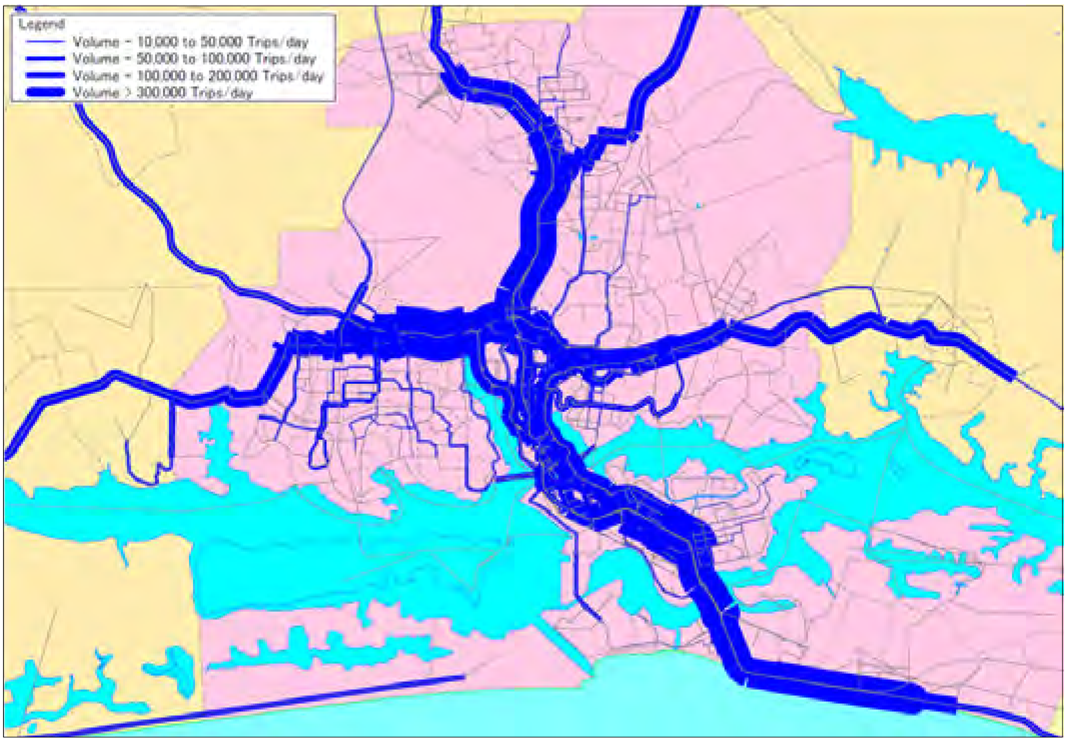
Source: JICA Study Team

Figure 2.23 Transport Demand in 2030 with the Master Plan (Vehicle Trips)



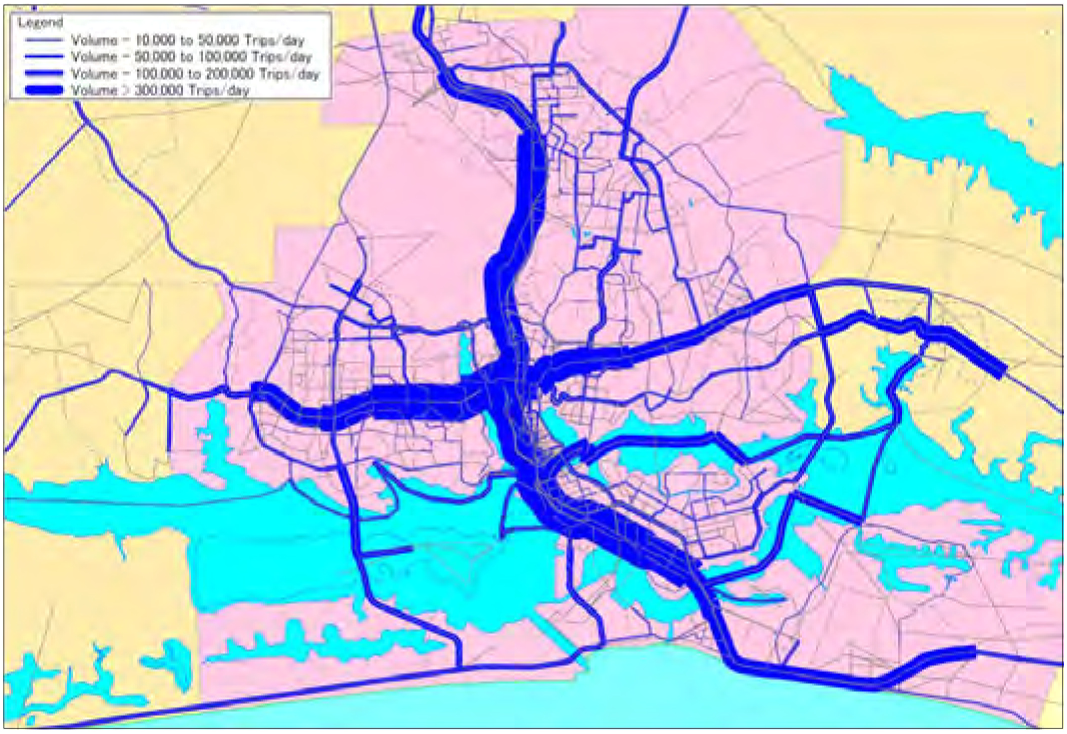
Source: JICA Study Team

Figure 2.24 Transport Demand in 2013 (Transit Trips)



Source: JICA Study Team

Figure 2.25 Transport Demand in 2030 without Master Plan (Transit Trips)



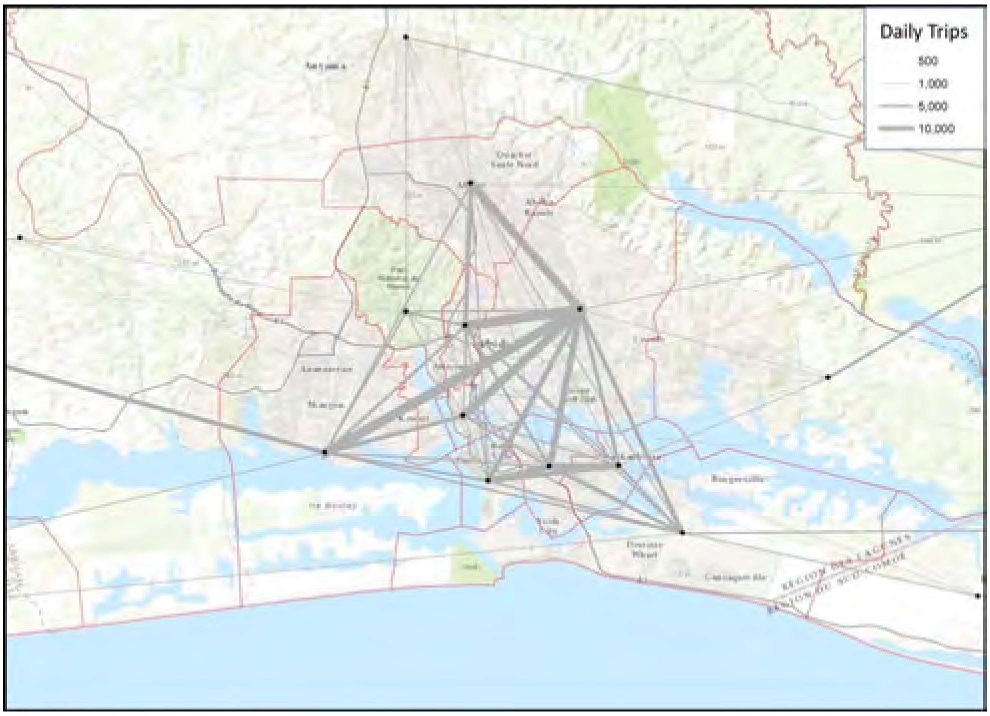
Source: JICA Study Team

Figure 2.26 Transport Demand in 2030 with Master Plan (Transit Trips)

Desire lines of person trips by private and public modes in 2013 and in 2030, estimated from the transport model, are shown in Figure 2.27 to Figure 2.30.

In 2013, the biggest transport demand of private mode is generated/attracted in Cocody, where the largest connection with Yopougon is expected, followed by Adjame and Plateau. Private mode trips within Petit-Bassam Island are also relatively frequent. As for the public transport mode, the largest trip generator is Yopougon, of which the strongest connection with other communes is observed with Adjame, followed by Plateau and Cocody. Private mode trips tend to be generated in the communes of which average household income is higher, as represented by Cocody and Petit Bassam. Public mode trips are obviously concentrated into Adjame, which is a crossing point of the north-south corridor through Abobo and the east-west corridor between Yopougon and Cocody.

In 2030, in addition to the close relationship of some specific communes predicted in 2013, a considerably large number of private mode trips will be made between Yopougon and Plateau or Adjame, while the trips generated/attracted crossing the lagoon are mainly to/from Port-Bouet. It should be considered to ensure the mobility of trips crossing the lagoon and to reinforce north-south and east-west corridor as a backbone of Abidjan.

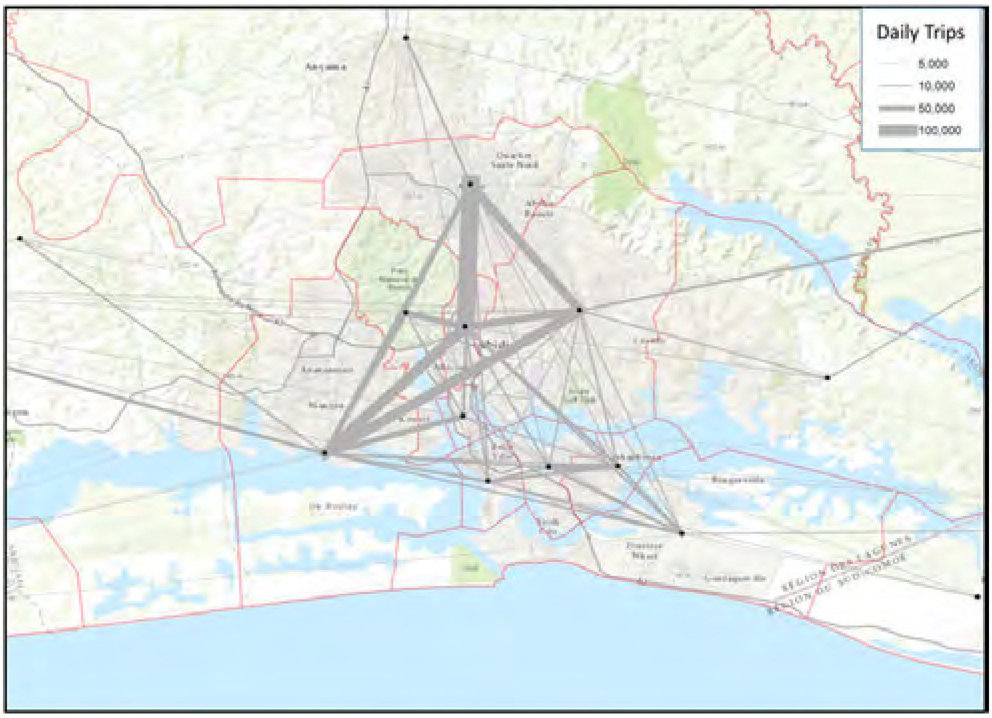


Source: JICA Study Team

Figure 2.27 Desire Line Diagram of Private Mode Person Trips in 2013

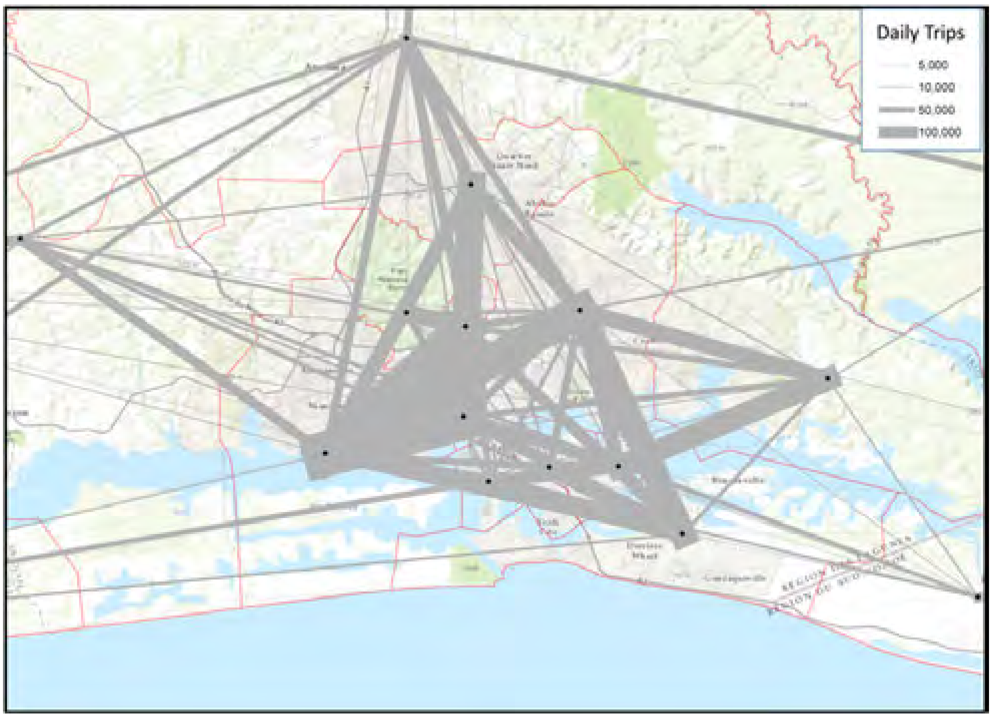
Source: JICA Study Team

Figure 2.28 Desire Line Diagram of Private Mode Person Trips in 2030



Source: JICA Study Team

Figure 2.29 Desire Line Diagram of Public Mode Person Trips in 2013



Source: JICA Study Team

Figure 2.30 Desire Line Diagram of Public Mode Person Trips in 2030

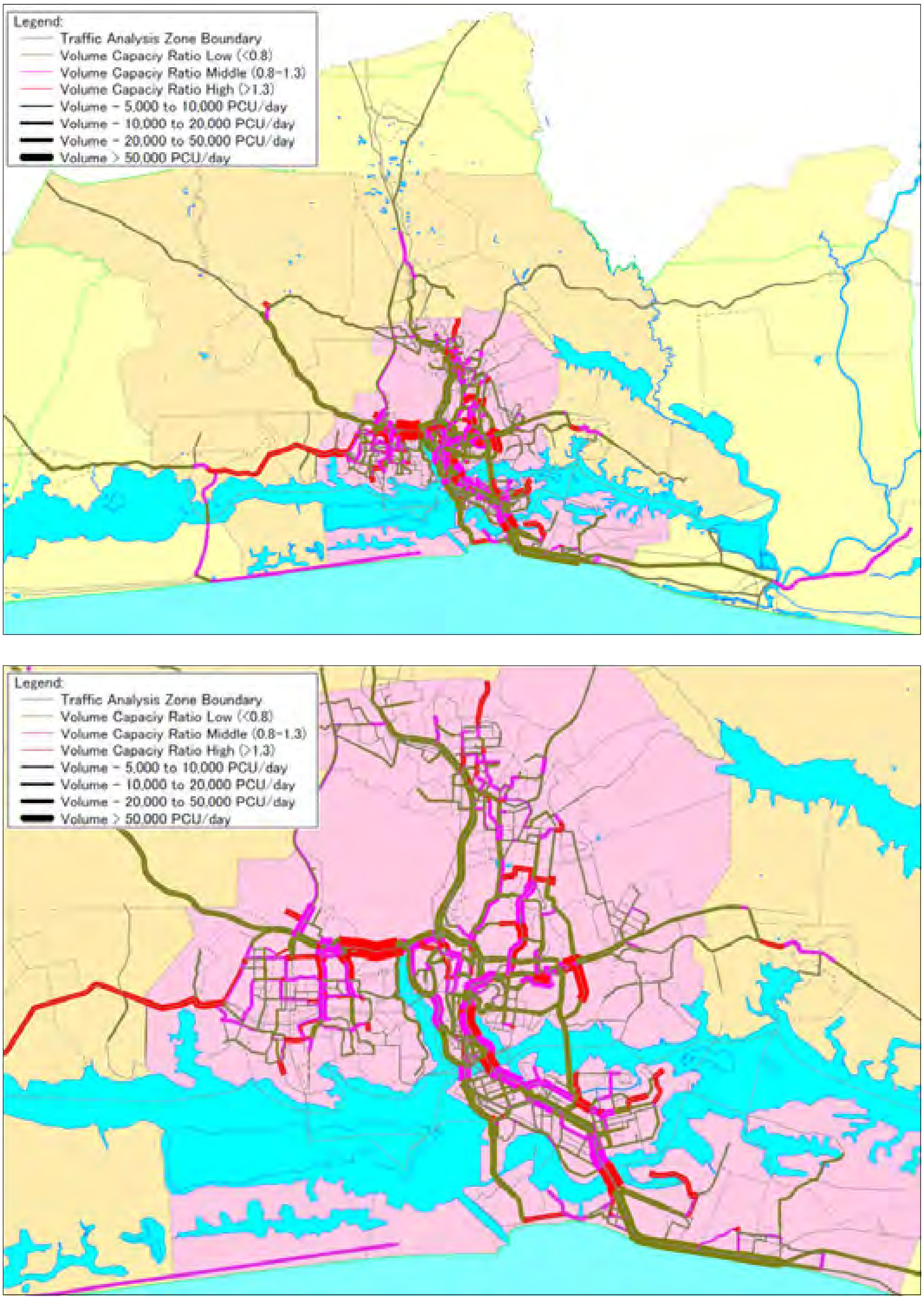
2.8.3 Intermediate Year Results

Key overall statistics are provided in Table 2.21 for intermediate years. The projects included in the intermediate years are those nominated. Remedial effect of transport master plan can be captured in vehicle kilometers (veh-km), vehicle hours (veh-hr) and average speed of travel. To calculate the rate of reduction of these indicators from the "do-nothing" case to the Master Plan case, veh-km shows a reduction of 1.9%, 6.8% and 2.7% in 2020, 2025 and 2030, respectively, while veh-hr shows 20.7%, 36.2% and 45.2% respectively. Significant impact is also reflected in 23.0%, 45.3% and 76.7% increase of average vehicle speed. In "do-nothing" case in 2030, there are significantly more red links in the network, which exhibit high volume to capacity ratios (V/C ratio over 1.3) with slow travel speed along those links. Compared to the result of do-nothing case, links with brown color (V/C ratio less than 0.8) increase excluding some major routes in the Master Plan case by dispersing transport demand into expanded links.

Table 2.21 Key Model Results for Intermediate Years

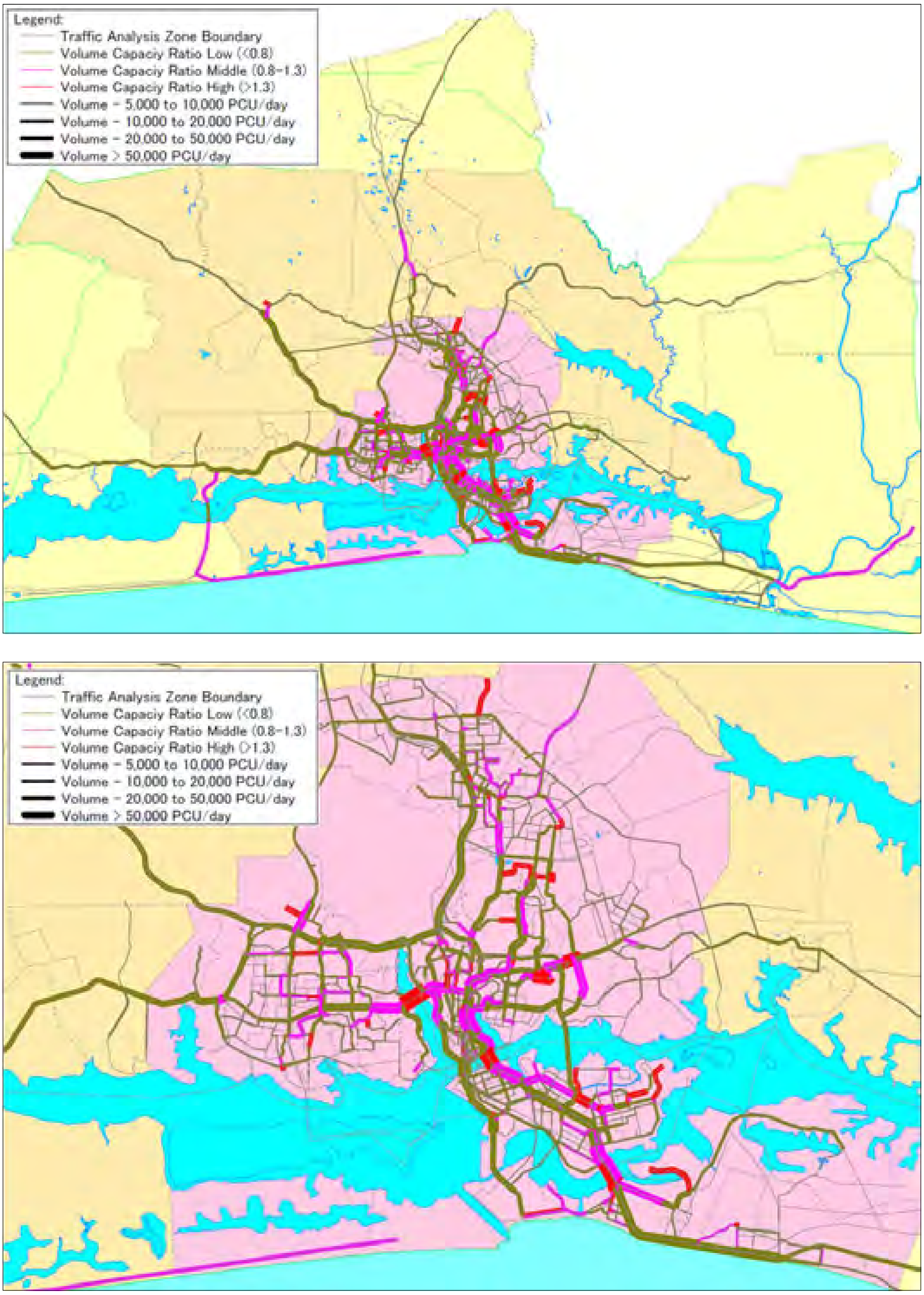
Measure	Year: 2020		Year: 2025		Year: 2030	
	Do Nothing	With M/P	Do Nothing	With M/P	Do Nothing	With M/P
Vehicle Kilometers of Travel (Million)	16.2	15.9	22.0	20.5	29.9	29.1
Vehicle Hours of Travel (Million)	0.58	0.46	0.94	0.60	1.55	0.85
Average Network Vehicle Speed	28.2	34.7	23.4	34.0	19.3	34.1
% Public Transport of Mechanized Person Trips	50.1	50.4	51.9	53.2	54.0	55.4
Rail Mass Transit Boarding (Million)	-	-	-	3.21	-	4.63
Average Person Travel Speed	24.0	26.0	17.0	31.3	13.0	31.1

Source: JICA Study Team



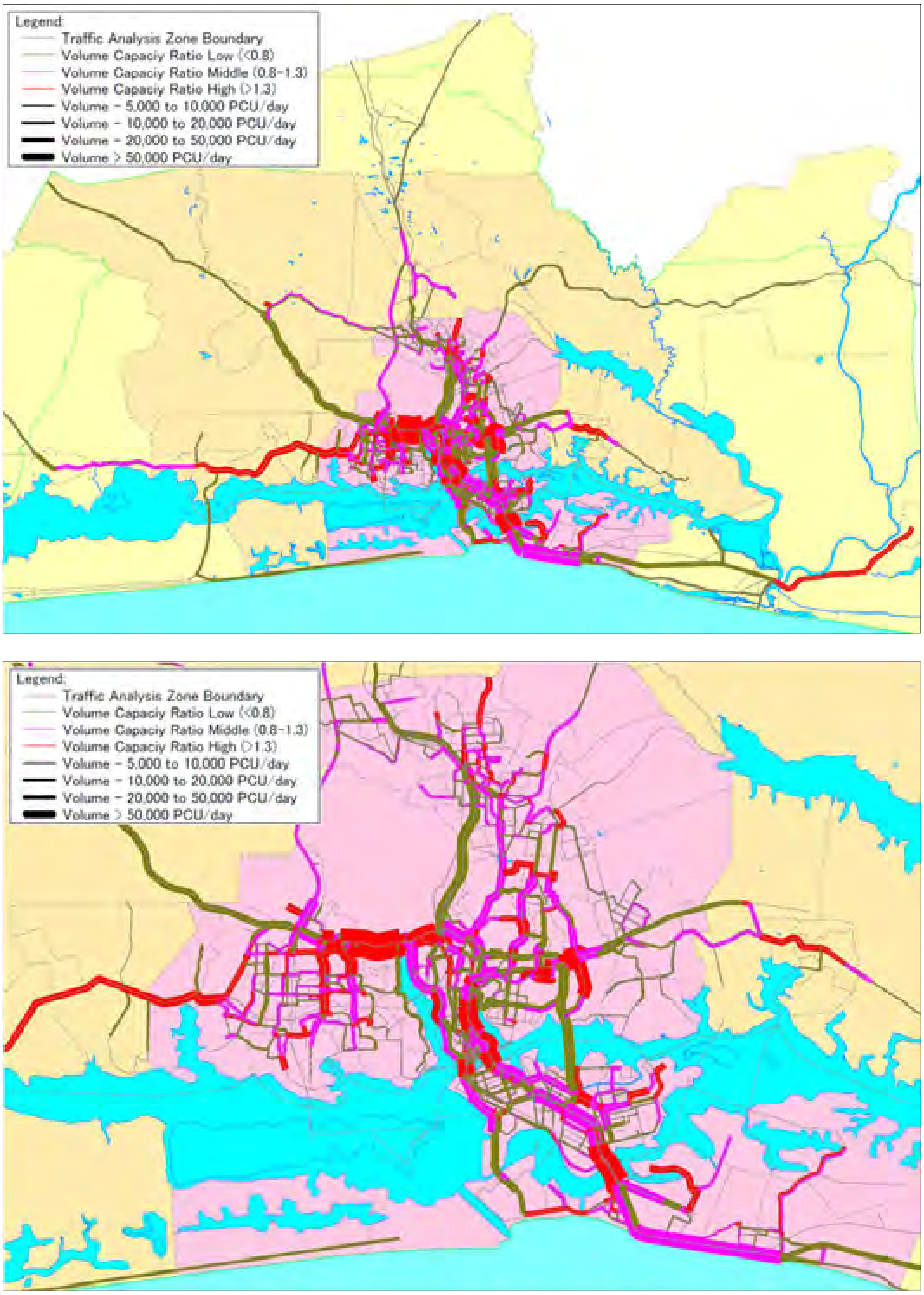
Source: JICA Study Team

Figure 2.31 Transport Demand in 2020 without the Master Plan (Vehicle Trips)



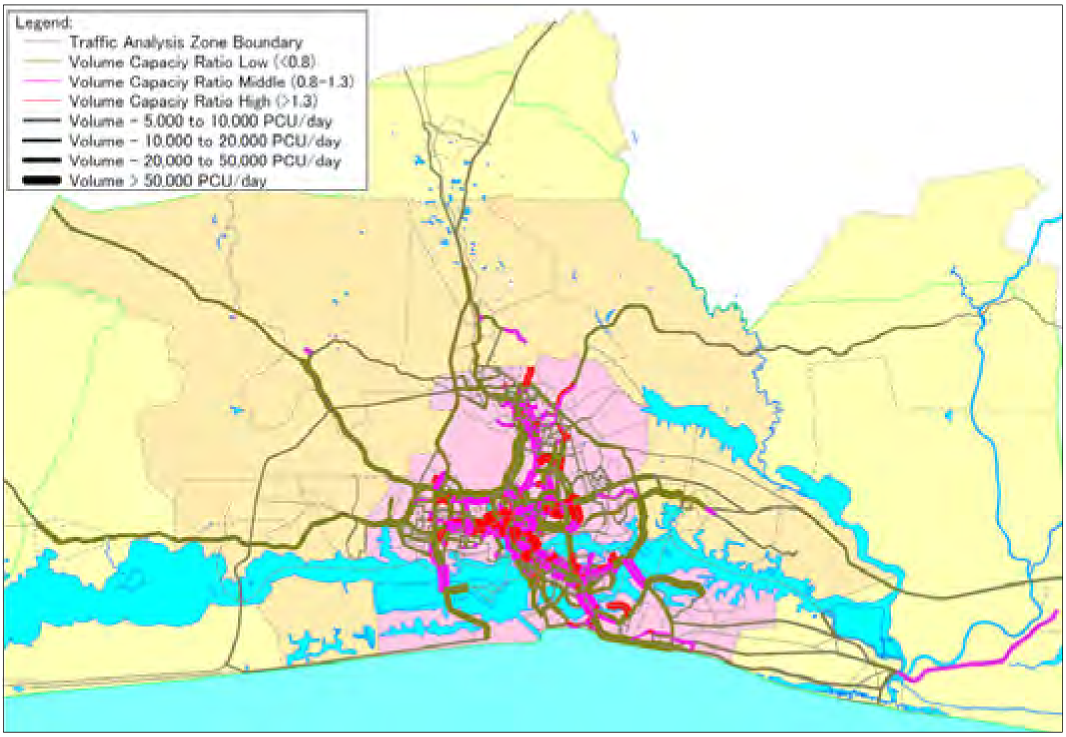
Source: JICA Study Team

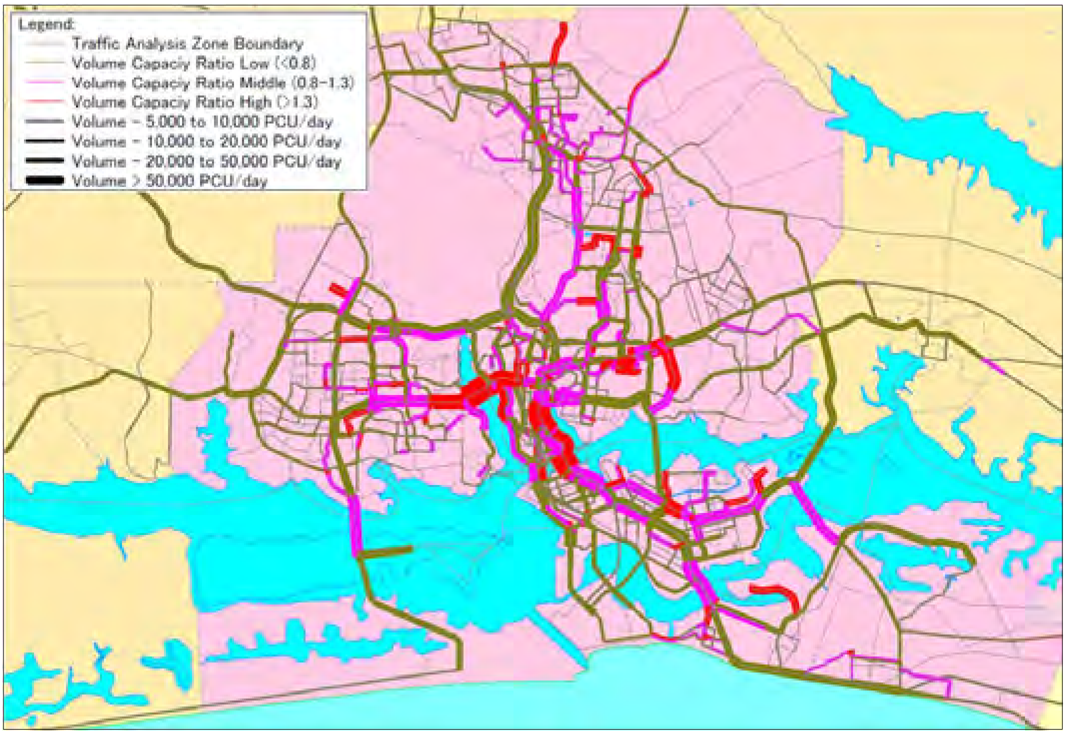
Figure 2.32 Transport Demand in 2020 with the Master Plan (Vehicle Trips)



Source: JICA Study Team

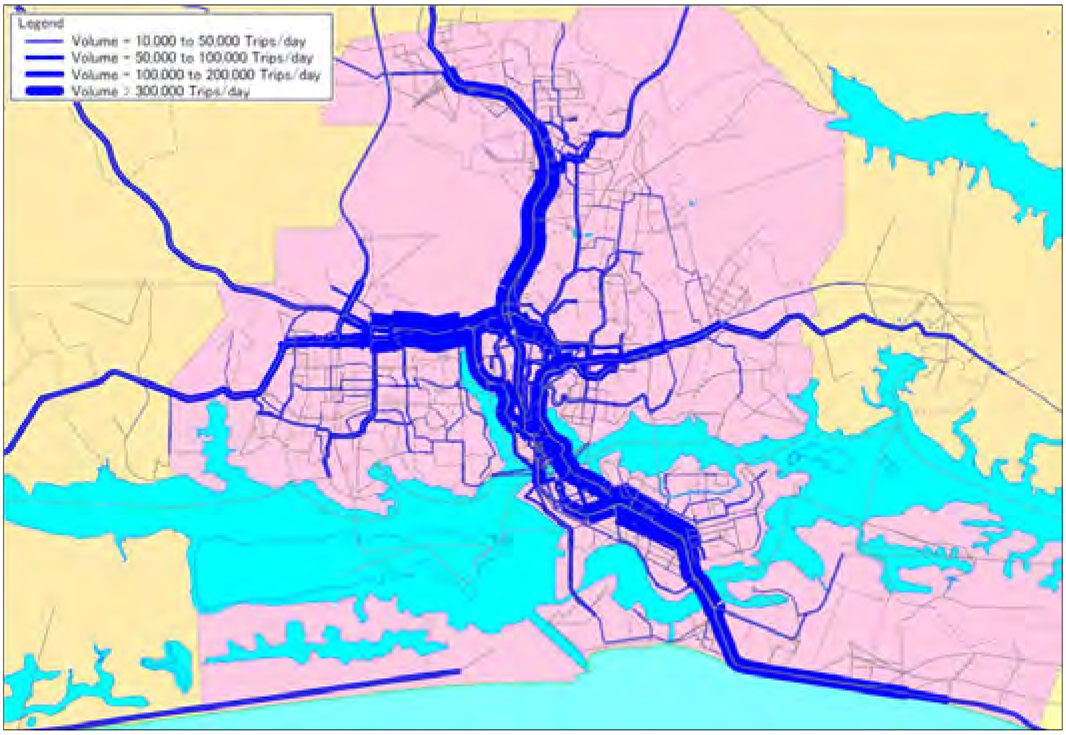
Figure 2.33 Transport Demand in 2025 without the Master Plan (Vehicle Trips)





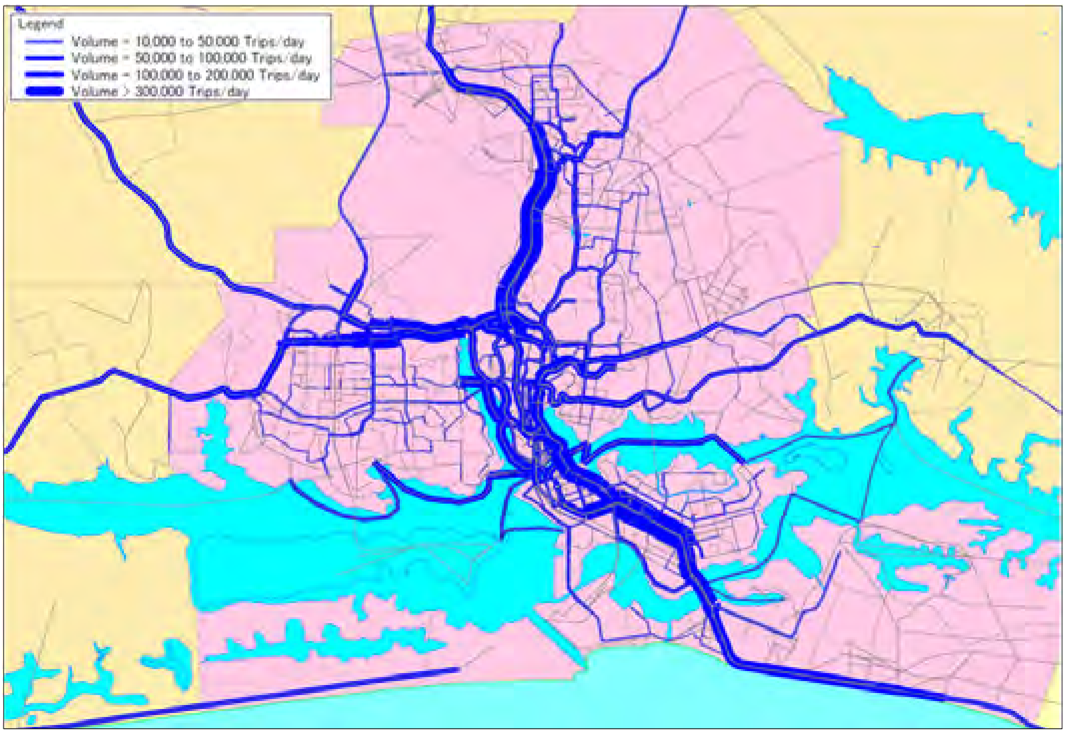
Source: JICA Study Team

Figure 2.34 Transport Demand in 2025 with the Master Plan (Vehicle Trips)



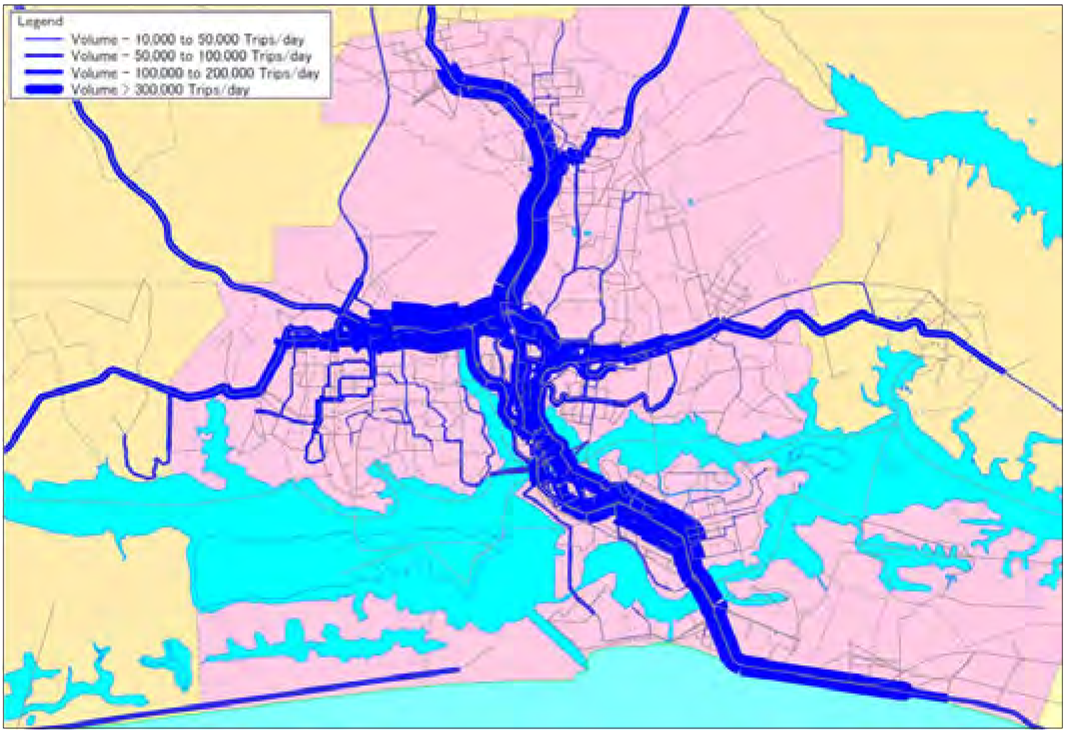
Source: JICA Study Team

Figure 2.35 Transport Demand in 2020 without Master Plan (Transit Trips)



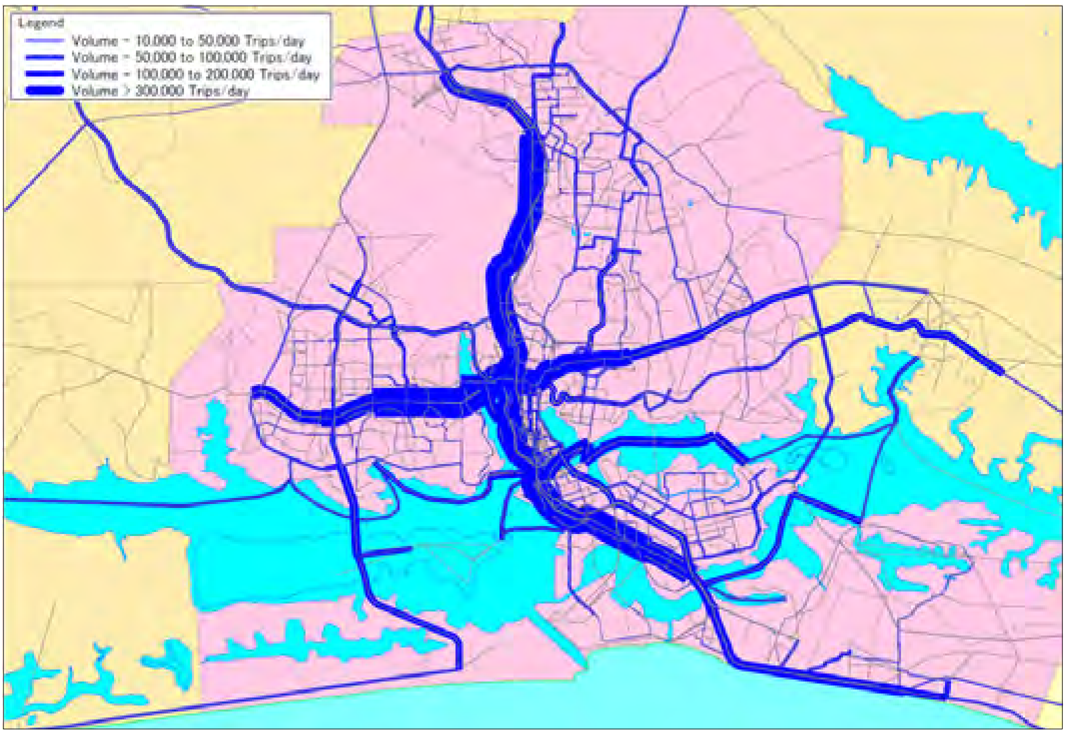
Source: JICA Study Team

Figure 2.36 Transport Demand in 2020 with Master Plan (Transit Trips)



Source: JICA Study Team

Figure 2.37 Transport Demand in 2025 without Master Plan (Transit Trips)



Source: JICA Study Team

Figure 2.38 Transport Demand in 2025 with Master Plan (Transit Trips)

2.9 Recommendations

2.9.1 Overview

Now, for the first time, the study area of Greater Abidjan has a detailed transport model developed to a level of 173 zones and available to the government for further analysis. This transport model has been developed from an extensive survey program in 2013. This is, in essence, the transport-planning database described in the transport survey working papers. This needs continual updating and development of even further databases, such as, for example, a detailed internal roadside interview survey inside the city.

2.9.2 Transport Demand Center

Human resource development of government staff should include training of staff that should maintain all the SDUGA databases and tools. The following is recommended:

- Development of Transport Planning Center of Excellence (Project Code: O-1-4). This center could also be developed into a regional training center.

Planning and managing urban transport in all its different dimensions is a difficult and multi-dimensional task where a numerical underpinning of the transport reality is needed to efficiently deal with complex issues such as:

- Understanding the nature of both public and private traffic flows;
- Identifying the interrelationships between transport systems;
- Accurate and updated traffic forecast models integrating GIS;
- Rational and balanced infrastructure investment planning; and
- Modern traffic (demand) management tools and techniques.

Transport planning is thus instrumental for the sustainability of future urban transport and is critical to rational transport infrastructure development. Given the wide range of necessary information, the complexity of managing this information and the difficulties of accurate traffic forecasting, efficient transport planning is not achieved only by the availability of professional expertise; it also requires modern and adequate tools and techniques.

During SDUGA, a significant transport database has been established including GIS mapping. The transport database and GIS are currently being linked together into a state-of-the-art transport model. This model will have the capability to analyze the impact of proposed transport infrastructure. The tools developed and the skills learned should be maintained within this center of excellence. This center could then serve as a model for the whole region.

2.9.3 Measures to Accommodate the Future Transport Demand

Based on the result of the transport network assignment discussed in section 2.8.2, the following measures are recommended for the development of an urban transport master plan for Greater Abidjan:

- Enhancement of the north-south and east-west corridors crossing the center of Abidjan;

- Ensuring that there is a bypass route choice which avoids concentration of the traffic into the center of Abidjan, which will also contribute to reducing the impact of cargo transport not only in terms of traffic volume but also environmental load; and
- Implementing transport policy, such as road pricing at some specific entrance points to the city center to avoid through traffic by cargo carriers and to enhance the usage of the bypass routes.

The creation of a compact city by developing high-capacity public transport on major corridors, and development of water transport that can serve as supplemental transport modes to cover the areas which are not covered in the catchment area of the high-capacity public transport corridors and to enhance the intermodality between transport modes will assure the accessibility between communes. Such improvement of the public transport corridor also enables the realization of a transit-oriented development (TOD) as a basis for the development of Abidjan with an efficient transport system.

3.0 Road Development Plan

3.1 Introduction

Source: JICA Study Team

Figure 3.1 Traffic Congestion on the Boulevard Lagunaire

Abidjan District faces the major problems of modern day cities, namely traffic congestion (Figure 3.1), which affects all the major arterial roads due to the volume of users commuting from the residential areas of Yopougon, Cocody and Abobo towards the business center and industrial zone of Plateau-Treichville-Marcory-Koumassi-Port Bouët.

Traffic congestion can be caused by various factors: narrow streets of the city center where many people gather to go to work; shortage in off-street parking resulting in people parking their cars on the roads, increasing at the same time congestion; underuse of public transport, either because it is less convenient, too expensive or not available; more people using their own cars.

Various solutions have been tried around the world to solve those traffic jams: construction of ring roads and bypasses, construction of parking areas at bus or train stations for one-way streets to speed up traffic flow, banning cars from the city center or charging them when they enter the city center. However, the complete solution to traffic congestion requires people to be able and willing to travel on public transport more. For Greater Abidjan, encouraging public transport is the key to solving traffic congestion.

During the past decade, commuters have been using fewer and fewer SOTRA buses due to their insufficient frequency, which results in long waiting times and packed buses. People turn to Woro-Woro, which provide a cheaper alternative to public buses, increasing the number of Woro-Woro on the roads and further degrading the traffic conditions. SOTRA has tried to reverse the trend recently by buying many new buses but the habits of commuters will now be difficult to change as they are now accustomed to using those types of transport. Moreover, SOTRA buses do not have a reserved traffic lane and are stuck in traffic jams during peak hours. SOTRA buses do not have sufficient advantages over Woro-Woro for commuters to come back towards public transport. The road development plan will thus have to integrate proper public transportation from the earliest stage of the project, by securing sufficient right-of-way to provide sufficient spaces for bus lanes and public transport facilities.

New road infrastructures will also be considered in Greater Abidjan, in particular between Cocody and Bingerville, which is currently developing at a very high pace. The development of the western part of the district is currently being slowed by the lack of infrastructure connecting Yopougon to the rest of the communes, as the Autoroute du Nord is currently the only link. Thus, the planning of this area will concentrate on the construction of a new link, the 5^{th} bridge, and the construction of the 4^{th} Bridge to connect Yopougon to the Ile Boulay.

Those new infrastructures will be used as an urban tool to organize urbanization. However, the traditional approach of addressing traffic demand by constructing more road infrastructure to cope with the increasing demand failed to address the problem because demand keeps increasing and authorities find it difficult to secure financial resources and land spaces for the expansion of its network. The size of those infrastructures will be limited as past experiences have shown that the increase of infrastructure capacity tends to also increase traffic demand, as those new roads become a temptation for people having sufficient financial resources to own a car and to utilize the newly created road spaces, which, as a result, does not ameliorate traffic flow.

3.2 Road Network Hierarchies

3.2.1 Redefinition of the Road Classification

The current road classification in Cote d'Ivoire is a jurisdictional system rather than a functional classification. Thus, from road-planning and engineering viewpoints, it is necessary to clarify the functional classifications and road hierarchy system for the Greater Abidjan area. A clear, functional road hierarchy system consisting of the following road classes is proposed:

- Primary Roads;
- Secondary Roads; and
- Local Roads.

(1) Primary Roads

The Primary Roads are defined as logistics routes whose major nodes are seaports, airports, other freight terminals and industrial zones, and which should also cover the international and regional trunk roads. They should be designed as high-capacity roads, with separated carriageways, or divided by traffic separators. Stopping areas or side belts to access the carriageway are also to be provided. Primary roads should serve the following three functions:

- To connect the city center with main rural roads that lead to Abidjan;
- To bypass the city center; and
- To connect different sub-centers (communes) or major transportation facilities of Greater Abidjan.

(2) Secondary Roads

Secondary roads are defined as urban roads of medium to high capacity with separated carriageways. Stopping areas or side belts to access the carriageways are also to be provided. Secondary roads should serve the following two functions:

- To collect/disperse traffic between primary roads and lower-capacity roads of the network; and
- To interconnect quartiers in a commune.

The secondary road network will connect all the major urban centers, which will have to be connected to each other by the arterial road network. In addition, a by-pass network including ring roads should be taken into account as part of the arterial road network.

(3) Local Roads

Local Roads are defined as lower-capacity roads.

(4) Summary

The characteristics of those three types of roads are summarized in Table 3.1.

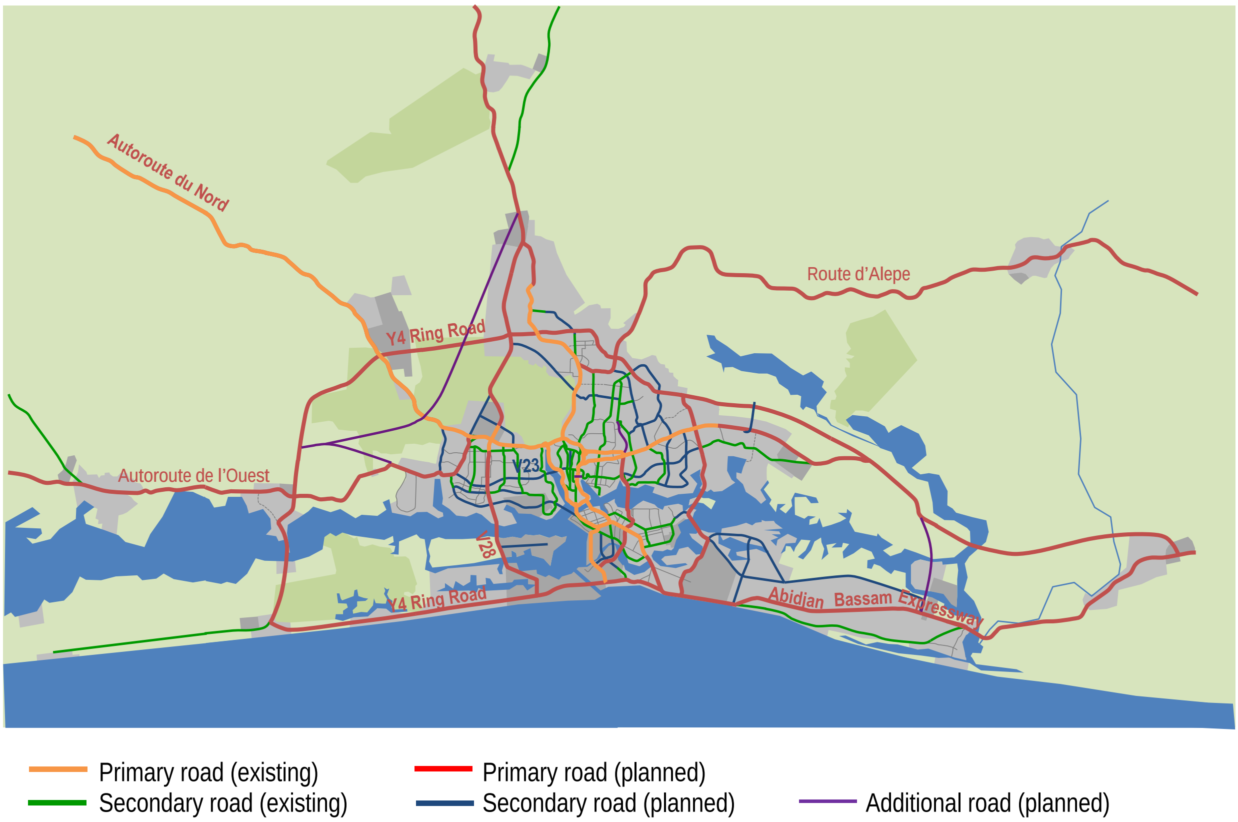
Table 3.1 Characteristics of Roads According to their Classification

Road Classification	Desired Grid Distance	Access	Transit	Desirable (Minimum) Speed (km/h)
Primary Roads	5,000 m to 10,000 m	No plot access, No intersections with local roads	City-wide transit, and link to higher networks, No non-motorized transits allowed	100 (80) or 80 (60)
Secondary Roads	2,000 m to 5,000 m	No plot access, No intersections with access roads	City-wide transit, and link to higher networks, Non-motorized transits are separated	80 (60)
Local Roads	500 m to 2,000 m	Access to plots and buildings	Transit to/from/in city districts. Limited use for city-wide transit traffic	60 (40)

Source: JICA Study Team

The access roads to/from primary and secondary roads will be limited to access from lower hierarchal roads. When primary roads pass through urbanized areas, additional service roads along the primary arterial roads should be prepared and direct access from urbanized roadsides with primary arterial roads should be prohibited.

In addition to those main arterial roads, it is necessary to promote the realization of secondary roads for better traffic circulation, mainly by upgrading existing roads (Figure 3.2).



Source: JICA Study Team

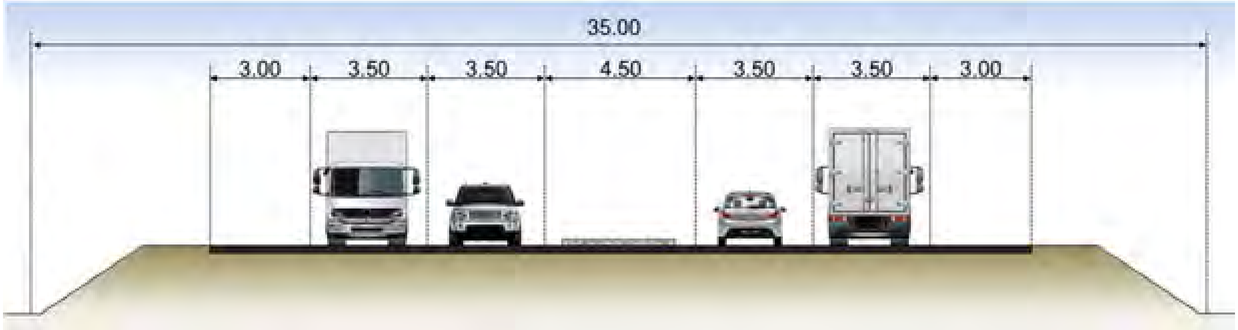
Figure 3.2 Future Road Network

3.2.2 Typical Cross Section and ROW

Although the number of traffic lanes should be determined after preliminary studies taking into account traffic data and forecast, service level objectives and economic and political factors, primary and secondary roads should be designed with at least 4 traffic lanes. The criteria for the number of traffic lanes, between four to six lanes, will be determined based on the results of the traffic model.

The width of the traffic lanes should normally be 3.50 meters for new roads. This width can be reduced to 3 meters in cases of site constraint or when the total traffic or heavy traffic is not considered important. For primary roads, a shoulder should be designed on the right side of the carriageway with sufficient width to create a “security zone” without any obstacles. A median can also be considered to avoid any U-turns or left-turn movements

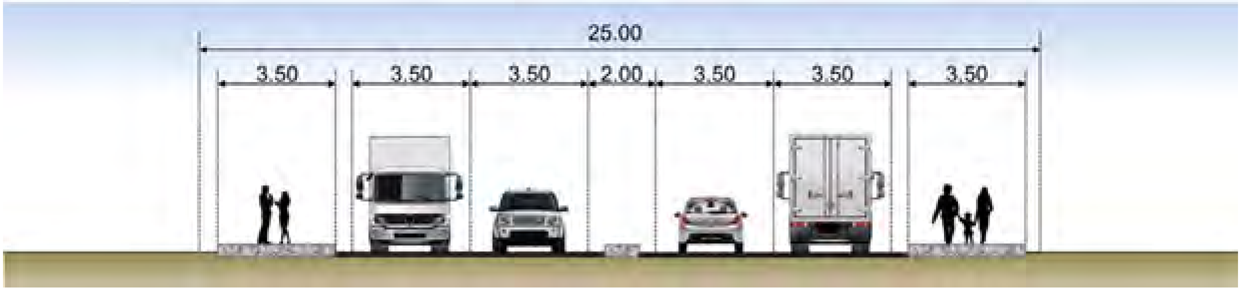
Based on the above, the proposed typical road cross section should be as in Figure 3.3 for primary roads.



Source: JICA Study Team

Figure 3.3 Proposed Typical Cross Section for Primary Roads

For secondary roads, sidewalks on both sides should be considered for pedestrians (Figure 3.4).



Source: JICA Study Team

Figure 3.4 Proposed Typical Cross Section for Secondary Roads

To implement BRT projects, the road width should be increased to provide sufficient space for dedicated bus lanes. The typical cross section of the road is shown in Figure 3.5.

Source: JICA Study Team

Figure 3.5 Proposed Typical Cross Section for Secondary Roads

3.2.3 Intersection Types

Many roads are connected to principal roads, slowing down the flow of traffic due to vehicles entering the principal road. It is also dangerous for road users and is a possible cause of accidents. Only secondary roads should be allowed to have junctions with primary roads, and local roads should not be allowed to cross primary roads directly. Intersections between primary and secondary roads should be by roundabout or grade separation, depending on the traffic demand (Figure 3.6). Roundabout can be considered with hourly traffic volume up to 2,000 to 2,200 PCU per hour. The intersection type will be selected based on the results of the traffic estimation model.

Land available will also be considered for grade separation type intersections, which require more space than a roundabout. For instance, the outer diameter of a four-lane road (two lanes for each direction) is approximately 40 to 60 meters.

Roundabout Type

Grade Separation Type

Source: JICA Study Team

Figure 3.6 Types of Primary Road Intersections

3.2.4 Road Alignment and Design Speed

During the conception of a road project, checking the visibility conditions is necessary for security reasons. The recommended approach is as follows:

- Design of the alignment (horizontal alignment, vertical alignment, cross section, as described previously, location and types of intersections);
- Reduction of the maximum speed for each section of the alignment, taking into account sight distance requirements; and
- Comparison with sight distances actually available, detection of possible shortcomings and possible changes in alignment.

The primary roads should be designed with design speeds of 80 km/h or 60 km/h, the choice between 80 and 60 being made by considering the site constraints and the share between medium-distance traffic and local traffic. They will be noted U80 and U60 hereinafter.

The minimum radius for those types of roads should be as shown in Table 3.2:

Table 3.2 Minimum Radius by Design Speed

Category	U60	U80
Radius Without Bend	200 m	400 m
Minimum Radius	120 m	240 m

Source: JICA Study Team

No slope or ramp should have an average gradient (between horizontal tangents of the longitudinal alignment) higher than 6%. Stronger instantaneous gradients are allowed on lengths of less than 30 meters; they cannot exceed 9%.

3.3 Principal Policy Measures for Road Development

Policy measures will have to be taken to provide safe and efficient access to urban centers and sufficient capacity to meet the demand from population and employment growth. It will consist in the upgrade and improvement of roads and also in the construction of new roads in line with the strategic road hierarchy.

To improve the efficiency of the current road network, the following can be done:

- Identify the major arterial roads;
- Reorganize the hierarchy of roads within Greater Abidjan;
- Develop the mass transportation network's infrastructure along the following corridors: Yopougon-Cocody and Anyama-Port Bouët. These corridors will have to be widened to accommodate those mass transportation systems (two-lanes per direction is desirable);
- Effort should be concentrated on the construction of the Y4 Ring Road to cope with the development of the eastern part of Cocody and to provide diversion routes to truck traffic moving not only to Ghana through Alepe but also to Autoroute du Nord through its expansion. This ring road will be constructed in different phases, as the western and southern part is not as urgent as the other sections;
- The other main primary arterial road that will have to be constructed is the V28 road going through Yopougon up to Azito and crossing the lagoon Ebrie. This link will allow the start of the development of the Ile Boulay, which is targeted as a Port expansion; and
- Define the roads that will need to be widened.

3.3.1 Roads Upgrading

Some important roads connecting the District of Abidjan and the six outer communes of Greater Abidjan will have to be upgraded. Currently, most of those roads provide only two traffic lanes and some are in very bad condition, like the Route d'Alepe. To attract industries in the six outer communes as it is actually projected for the 2020 to 2030 period, roads connecting the outer communes with the city center will have to be upgraded to provide fast and reliable access to cargo transport.

3.3.2 New Arterial Roads Construction

During the last 15 years, the development of the Greater Abidjan road network has been very slow. Although many roads were planned to support urban growth areas, only a few of them have been built. Developers have planned new expansion areas having only local roads with limited capacity, increasing the traffic pressure on the existing road network. To relieve the existing arterials roads, new roads with sufficient capacity should be built to support the development of the city.

3.3.3 Intersection Improvement

Abidjan has been experiencing rapid expansion and, as a result, most of the intersections that were surveyed at the beginning of the project have shown signs of high congestion. Intersections such as Siporex, CHU Treichville and St. Jean are traffic bottlenecks and changing the light sequence or increasing the number of traffic lanes would not be sufficient to solve the problem. New infrastructures such as flyovers or underpasses need to be considered to solve those traffic congestions.

3.3.4 Road Maintenance and Road Safety Monitoring

During the last decade, the budget allocated for road maintenance has been insufficient, accelerating the degradation of the roads. Recently, the Road Maintenance Fund (FER) has been able to secure a loan of 130 billion FCFA from a joint venture of banks and will use it to finance road maintenance for the year 2014, in particular the road network of Abidjan. However, it is estimated that 280 billion FCFA are necessary each year over a period of 10 years for the total renovation of the Ivorian road network and in particular the Greater Abidjan road network.

3.3.5 Implementation of Pedestrian Crossings

As shown by the HIS survey, walking is the main trip mode in Greater Abidjan. However, most of the arterial roads inside urban areas do not provide sufficient crossings for pedestrians, cutting communities into two and obliging pedestrians to walk long distance before they are able to safely cross the road. To save time, some pedestrians are even crossing those arterial roads at inappropriate locations, putting their lives in danger. Thus, more pedestrian crossings are necessary, in particular along the main black spots, which are the Boulevard Francois Mitterrand, the Boulevard Valery Giscard d'Estaing, the Autoroute d'Abobo and the Boulevard Latrille.

3.4 Road Development Projects

According to the results of the household interview survey, less than 9% of households own their own car. However, it is estimated that the number of trips made by private cars in Greater Abidjan will increase drastically along the forecast of economic development of Cote d'Ivoire if no actions are taken as more and more people turn their back on public transport. Although provision of transport measures such as the north-south and east-west mass transit corridors, which might help ease traffic congestion in the mid- and long-term, demand of private transport modes will still keep increasing.

A number of road projects have been planned in the Greater Abidjan area, some from a very long time ago. However, due to insufficient funding, only a few projects have been implemented, such as the Third Bridge and the Abidjan-Bassam Highway, both of which have been financed by foreign funding agencies.

All the road infrastructures that are deemed necessary in the Greater Abidjan area in order to sustain urban development have been identified and listed in a long list. The following paragraphs will present all of those projects, explaining the reason each of them was considered. Traffic demand will be evaluated with the traffic model that has been prepared. A more detailed description of the project is included in the Project Profiles.

Based on the future travel patterns and volumes, the future traffic demand on each road project is extracted from the approximately corresponding links in the demand forecast result. The average and maximum volumes on each section (i.e., north, east, south and west) of the five ring roads are summarized by section and presented for each area. These projects, especially the short-list priority project, were studied further in terms of the future demand forecasts as well as the feasibility, as described later. Furthermore, based on the future demand, which stands for the population of beneficiaries, some road projects with extremely little future traffic volume could be removed from the original proposal.

Selection of route alignment has already been discussed in the Appendices B.

3.4.1 Development of Y4 Ring Road

(1) Background

The Master Plan 2000 proposed the construction of a ring road (Y4 Ring Road) linking Songon, Abobo, Cocody and Port Bouet, that will re-direct traffic away from the city center as well as improve access to the port at Abidjan. The Y4 Ring Road is expected to enhance the function of the road network to eliminate vehicle flow though urban areas and also to disperse traffic coming into the urban center of Plateau and Adjame.

(2) List of Road Projects (Table 3.3)

Table 3.3 List of Y4 Ring Road Projects

Code	Project	Traffic Lanes	Function	Class
V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section	2x2	Truck Route	Primary
V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18	2x2	Truck Route	Primary
V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section	2x2	Truck Route	Primary
V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterrand Section	2x2	Truck Route	Primary
V-1-5	Development of Y4 Ring Road - François Mitterrand / Riviéra 6 Section	2x2	Truck Route	Primary
V-1-6	Development of Y4 Ring Road - Désirée Island Bridges Section	2x2	Truck Route	Primary
V-1-7	Development of Y4 Ring Road - Aérocité Section	2x2	Truck Route	Primary
V-1-8	Development of Y4 Ring Road - Canal du Vridi Section	2x2	Truck Route	Primary
V-1-9	Development of Y4 Ring Road - Jacqueville Section	2x2	Truck Route	Primary

Source: JICA Study Team

(3) Location Map (Figure 3.7)

Source: JICA Study Team

Figure 3.7 Y4 Ring Road Development (2030)

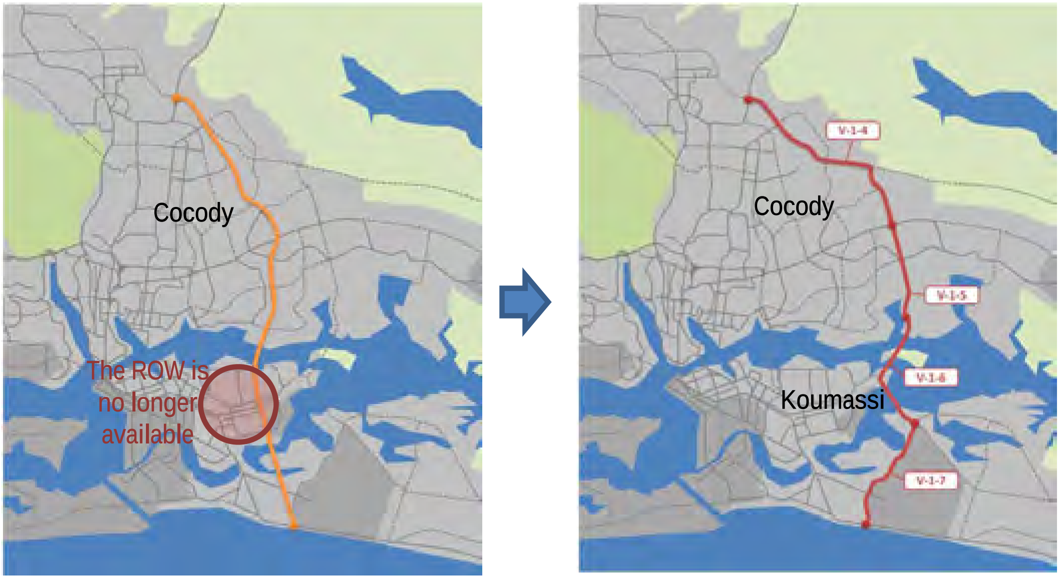
(4) Objectives of the Y4 Ring Road Development

The main objective of the Y4 Ring Road is to divert transit traffic and allow cargo transport to avoid the city center. This will be explained in more detail in section 6.4.

(5) Alignment of the Y4 Ring Road Development

Although planned long ago, the Y4 Ring Road project has not been implemented because urbanization pressure along the original proposed alignment of the road made land acquisition and property compensation very difficult. Considering this situation, the alignment should be revised and an appropriate corridor for the Y4 Ring Road should be selected from the viewpoint of future spatial development of Greater Abidjan.

After a review of the current condition of the ROW, the alignment of the eastern section of the ring road has been modified since the land is no longer available in Koumassi (cf. Figure 3.8 and Appendix B). The rest of the alignment is following the planned route of the Master Plan 2000.



Master Plan 2000 SDUGA Master Plan

Source: JICA Study Team

Figure 3.8 Changes Made to the Alignment of the Y4 Ring Road

(6) Traffic Demand Forecast

A traffic model, described in section 2.0, was used to assess the impact of the Y4 Ring Road on the traffic conditions inside Greater Abidjan and to verify that the number of traffic lanes (two traffic lanes in each direction) has been correctly designed. The results from the model are shown in Table 3.4.

Table 3.4 Daily Traffic Volume in 2030 of Y4 Ring Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section	6,422
V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18	3,692
V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section	10,960
V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterrand Section	8,836
V-1-5	Development of Y4 Ring Road - François Mitterrand / Riviéra 6 Section	19,875
V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section	32,412
V-1-7	Development of Y4 Ring Road - Aérocité Section	10,574
V-1-8	Development of Y4 Ring Road - Canal du Vridi Section	10,567
V-1-9	Development of Y4 Ring Road - Jacqueville Section	3,841

Source: JICA Study Team

The section of the Y4 Ring Road with the most traffic volume is located between Cocody and Koumassi (V-1-5 and V-1-6) where it crosses the lagoon. The numbers show that the Y4 Ring Road has been designed with sufficient traffic lanes to cope with the forecast traffic volume.

3.4.2 Development of Bingerville Area Road Network

(1) Background

The development of the Bingerville area is projected to occur during the 2020 to 2025 period. Located between the Lagoon Ebrie and the Lagoon Aguien, the water catchment area of the Lagoon Aguien must be protected by limiting urban sprawl. In the eastern part of this strip of land, there is a planned tourist area near Eloka-Te that also needs to be protected.

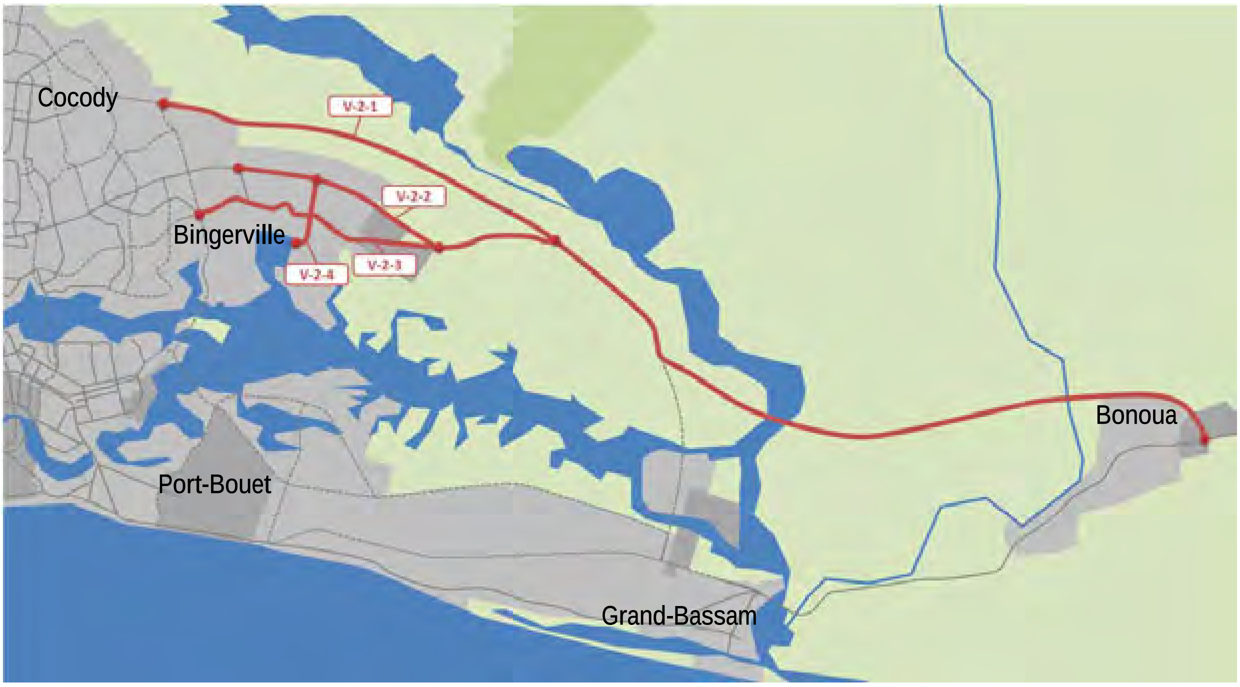
(2) List of Road Projects (Table 3.5)

Table 3.5 List of Bingerville Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-2-1	Development of BiARN - Bingerville Northern Bypass	2x2	Truck Route	Primary
V-2-2	Development of BiARN - Extension of the Boulevard François Mitterrand	2x2		Primary
V-2-3	Development of BiARN - Widening of the Route de Bingerville	2x2		Secondary
V-2-4	Development of BiARN - Bingerville BHLS Road	2x2		Secondary

Source: JICA Study Team

(3) Location Map (Figure 3.9)



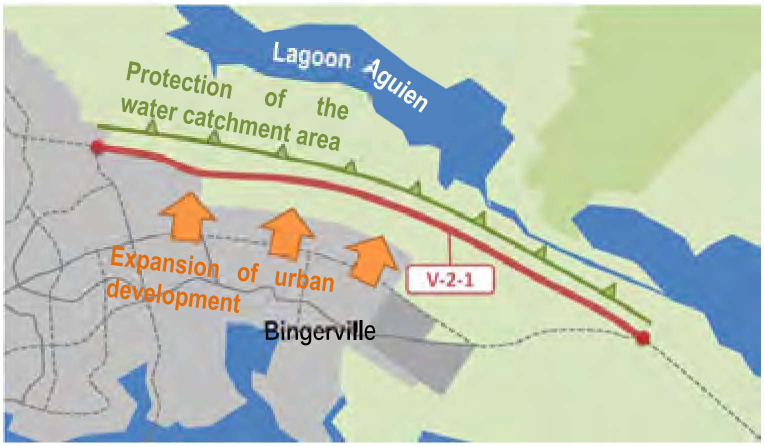
Source: JICA Study Team

Figure 3.9 Road Development in Bingerville Area (2030)

(4) Objectives of the Bingerville Area Road Network Development

[V-2-1] Bingerville Northern Bypass

The Bingerville Northern Bypass has several functions. The first one is to create a distinct limit to urban sprawl by creating an obstacle to urban development expanding towards the North. The Lagoon Aguien and its catchment area, which could provide the necessary water resources for Greater Abidjan needs to be protected and could soon be threatened by urban sprawl, as shown in Figure 3.10.



Source: JICA Study Team

Figure 3.10 Limit to Urbanization

The second function of this road is to complete the east-west truck corridor, allowing the transit traffic circulating on the Trans-African Dakar-Lagos Highway to avoid the city center, as illustrated in Figure 3.11. This will be explained in more detail in section 6.1. Since it will serve as one of the trunk roads of the country with considerable traffic, it is preferable to connect directly to Bonoua to integrate it as part of the Greater Abidjan in terms of the road network connection, rather than to go through Grand Bassam, which is a great touristic site designated as a world heritage. This road will also function as a northern bypass of Bonoua.

Truck Corridor

Source: JICA Study Team

Figure 3.11 Truck Route

[V-2-2] Extension of the Boulevard François Mitterrand

The extension of the Boulevard François Mitterrand will be running mainly along rural areas, allowing freedom for the selection of its alignment. In the eastern part of Bingerville, large pieces of land are devoted to palm plantations. Thus, the road will head north in front of those cultivated lands up to the Bingerville Northern Bypass. The road will then cross the Lagoon Aguien before entering Bonoua from the North, as shown in Figure 3.12.

Urban Rail · BHLS · Water Bus · Multimodal station · Water bus station

Source: JICA Study Team

Figure 3.12 BRT Line along the Extension of the Boulevard François Mitterrand (2030)

[V-2-4] Bingerville BHLS Road

The BHLS line connecting Bingerville to Bonoua will be mainly running along the extension of the Boulevard Francois Mitterrand. However, near Bingerville, the alignment of the BHLS line has to leave the Boulevard Francois Mitterrand running north of Bingerville to enter the city and reach the water bus station located along the water front. Thus, this Bingerville BHLS Road is the missing link of the road network supporting the Bingerville-Bonoua BHLS line inside Bingerville.

(5) Traffic Demand Forecast

The traffic volume for the year 2030 on the 4 road projects mentioned above has been estimated using the traffic model. The results of this simulation are presented in Table 3.6.

Table 3.6 Daily Traffic Volume in 2030 of Bingerville Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-2-1	Development of BiARN - Bingerville Northern Bypass	1,692
V-2-2	Development of BiARN - Extension of the Boulevard François Mitterrand	6,114
V-2-3	Development of BiARN - Widening of the Route de Bingerville	13,576
V-2-4	Development of BiARN - Bingerville BHLS Road	4,023

Source: JICA Study Team

The traffic is mainly concentrated on the extension of the Boulevard Francois Mitterrand and on the Route de Bingerville. The Bingerville Northern Bypass, which is planned as a truck route, does not attract as much traffic as it will probably collect only transit traffic, which is not very important. From the forecast traffic volume, it can be said that the number of lanes has been correctly designed for all the projects.

3.4.3 Development of Bassam Area Road Network

(1) Background

Between Port-Bouet and Grand-Bassam, a large area located between two waterfronts is targeted as a priority urban development area in the years 2015 to 2020. This development has already started with the Aérocité project planned around the airport and the Abidjan-Bassam Expressway.

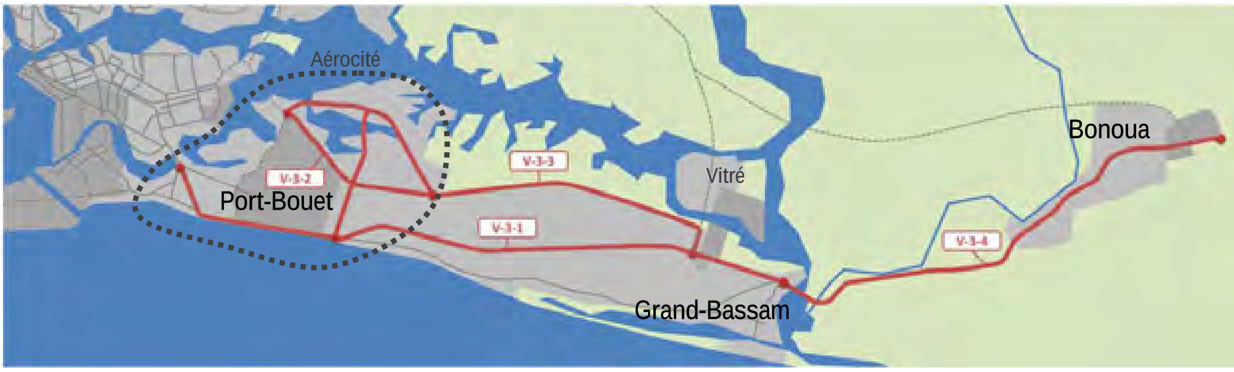
(2) List of Road Projects (Table 3.7)

Table 3.7 List of Bassam Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-3-1	Development of BaARN - Abidjan-Bassam Expressway (under construction)	2x3		Primary
V-3-2	Development of BaARN - Aérocité Area	2x2		Secondary
V-3-3	Development of BaARN - Bassam Northern Bypass	2x2		Secondary
V-3-4	Development of BaARN - Widening of the Route de Bonoua	2x2		Primary

Source: JICA Study Team

(3) Location Map (Figure 3.13)



Source: JICA Study Team

Figure 3.13 Road Development in Bassam Area (2030)

(4) Objectives of Bassam Road Network Development

[V-3-1] Abidjan-Bassam Expressway

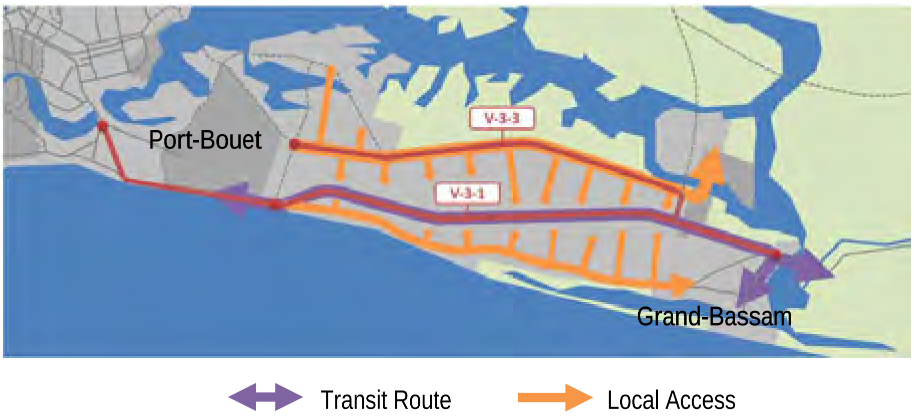
The Abidjan-Bassam Expressway is currently being built and is expected to be completed by 2015. It is expected to relieve the existing road along the coastline from transit traffic.

[V-3-2] Aérocité Area

The development of the Aérocité Area has been awarded to a private company. Thus, the road network will be defined by the concessionaire.

[V-3-3] Bassam Northern Bypass

As the Bassam area will be cut in two after the completion of the Abidjan-Bassam Expressway, the Bassam Northern Bypass, as a secondary road, will provide access to all the land developed along the northern part of the Abidjan-Bassam Expressway, as illustrated in Figure 3.14.



Source: JICA Study Team

Figure 3.14 Road Development in Bassam Area (2030)

The Bassam Northern Bypass has the same function as the Bingerville Northern Bypass, which is to limit urban sprawl by creating an obstacle to urban development towards the North.

[V-3-4] Widening of the Route de Bonoua

The Abidjan-Bassam Expressway, currently being built, has 2x3 traffic lanes and will be connected with a two-lane road after Grand Bassam. This road needs to be upgraded by building new bridges and widening the existing carriageway.

(5) Traffic Demand Forecast

To analyze the benefit of developing the road network in the Grand-Bassam area, the traffic on the above four road projects was simulated for the year 2030. The results of the future demand forecasts are presented in Table 3.8.

Table 3.8 Daily Traffic Volume in 2030 of Bassam Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-3-1	Development of BaARN - Abidjan-Bassam Expressway (Under Construction)	18,302
V-3-2	Development of BaARN - Aérocité Area	13,124
V-3-3	Development of BaARN - Bassam Northern Bypass	6,302
V-3-4	Development of BaARN - Widening of the Route de Bonoua	12,649

Source: JICA Study Team

According to these results, the planned road network for the Bassam Area is designed with sufficient traffic lanes. The Abidjan-Bassam Expressway will be the main traffic corridor, while the Bassam Northern Bypass will collect the remaining local traffic.

3.4.4 Development of Yopougon Area Road Network

(1) Background

The Commune of Yopougon was developed during Cote d'Ivoire's economic boom as a new town that could be self-dependent with residential areas mixed with activities areas. However, due to various social crises, the urban program has not been completed, and, in particular, the road network of Yopougon is still lacking many arterial roads. A number of statutory rights-of-way have been reserved for future infrastructure projects inside Yopougon but all have, to some extent, been occupied by illegal buildings.

Furthermore, the bridges that were supposed to connect Yopougon to Plateau where never built and, as a result, the road network of Yopougon is almost disconnected from the rest of the road network of Greater Abidjan as the only link is a highway that opened in 1979, which is often congested and in very bad condition.

(2) List of Road Projects (Table 3.9)

Table 3.9 List of Yopougon Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-4-1	Development of YoARN - Voie V23 - Parkway Section	2x2		Secondary
V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section	2x2		Secondary
V-4-3	Development of YoARN - Voie V2	2x2		Secondary
V-4-4	Development of YoARN - Voie V6	2x2		Secondary
V-4-5	Development of YoARN - Voie V9	2x2		Secondary
V-4-6	Development of YoARN - Yopougon Industrial Zone Arterial Road	2x2		Secondary
V-4-7	Development of YoARN - Voie V28 - Northern Section	2x3	Truck Route	Primary
V-4-8	Development of YoARN - Voie V28 - 4th Bridge	2x2	Truck Route	Primary
V-4-9	Development of YoARN - Voie V28 - Southern Section	2x2	Truck Route	Primary
V-4-10	Development of YoARN - Autoroute de l'Ouest	2x2		Primary
V-4-11	Development of YoARN - Yopougon Western Bypass	2x2		Secondary
V-4-12	Development of YoARN - Widening of the Voie V1	2x2		Secondary
V-4-13	Development of YoARN - Central Road of Ile Boulay	2x2	Truck Route	Secondary
V-4-14	Development of YoARN – Widening of Siporex-Sable Link	2x2		Secondary

Source: JICA Study Team

(3) Location Map (Figure 3.15)

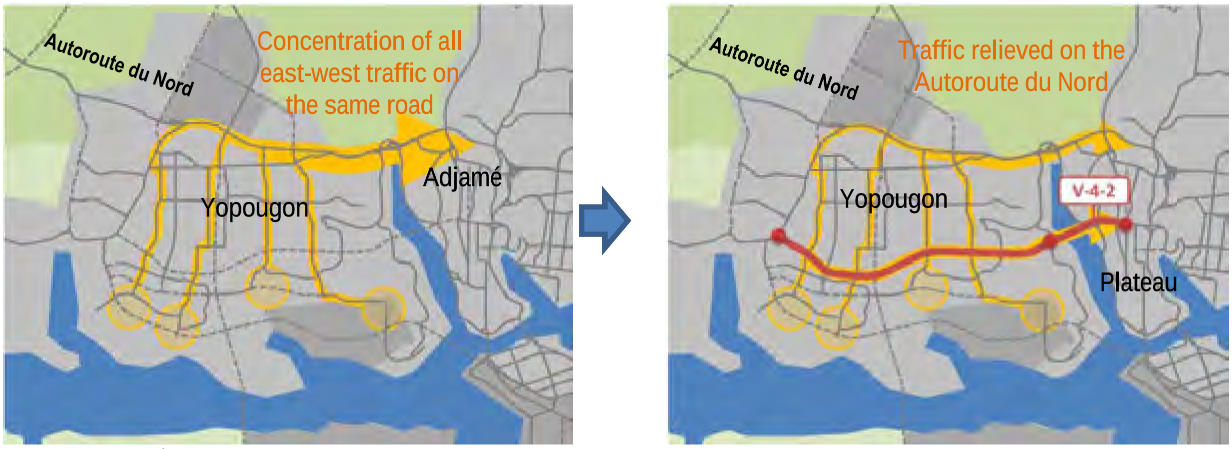
Source: JICA Study Team

Figure 3.15 Road Development in Yopougon Area (2030)

(4) Objectives of Yopougon Area Road Network Development

[V-4-1] and [V-4-2] Voie V23 – Parkway and 5th Bridge Sections

The Voie V23 is an east-west arterial road running through the center of Yopougon Commune, connecting the Route de Dabou to the Plateau, via the 5th Bridge. It is expected to relieve the Autoroute du Nord, which is the only current link between Yopougon and the eastern part of Greater Abidjan, as shown in Figure 3.16.



Source: JICA Study Team

Figure 3.16 New Connection between Plateau and Yopougon

[V-4-3] and [V-4-4] Voie V2 and Voie V6

As the Autoroute du Nord is the only link between Yopougon and Plateau, the existing arterial roads inside Yopougon are almost all along the north-south axis. However, with the expansion of Yopougon towards the South and the West, more east-west roads are required. The Voie V2 is the central of three planned parallel routes that run from west to east across southern Yopougon. It is expected to provide alternative routes for drivers and help reduce traffic congestion on the existing arterial roads inside Yopougon, as illustrated in Figure 3.17.

The Voie V6 will connect the Route de Dabou directly with the future expansion of the port in the southern area of Yopougon. The western section will accommodate a BRT line connecting Yopougon to Dabou.

Source: JICA Study Team

Figure 3.17 Densification of the Arterial Road Network

[V-4-5] and [V-4-6] Voie V9 and Yopougon Industrial Zone Arterial Road

The Voie V9 and the Yopougon IZ Arterial Road have been considered to provide new accesses to the Yopougon industrial zone, as shown in Figure 3.18. Currently, the industrial zone is experiencing congestion at its two main entrances, slowing down cargo transport and increasing transportation costs.

Source: JICA Study Team

Figure 3.18 Upgrading Accessibility to the Yopougon IZ

[V-4-7], [V-4-8] and [V-4-9] Voie V28 - Northern Section, 4th Bridge and Southern Section

The Voie V-28 is a planned expressway running north-south through Yopougon, from the Autoroute du Nord to the southern section of the Y4 Ring Road. The expansion of the port to Ile Boulay depends on this new road as the Ile Boulay is currently not connected with the rest of the road network.

[V-4-10] Autoroute de l'Ouest

The Route de Dabou is the main road for traffic heading to or coming from the western part of the country. It is currently a two-lane road that needs to be widened in order to accommodate further traffic that goes along with the development of Dabou.

[V-4-11] Yopougon Western Bypass

As Yopougon is expected to expand towards the west, and in order to define a clear limit to the expansion of the Commune, this Western Bypass could be built. In addition, it will relieve the traffic on the section of the Route de Dabou inside Yopougon.

[V-4-12] Widening of the Voie V1

The widening of the Voie V1 is the widening of an existing north-south road in the western part of Yopougon. The project is expected to improve traffic flow inside Yopougon.

[V-4-13] Central Road of Ile Boulay

The Ile Boulay is targeted for expansion of the port, which is currently constrained inside Treichville. To allow such expansion, basic infrastructures are needed, such as a central road that will concentrate all traffic from the port extension.

A dedicated truck route going east-west from Ile Boulay has also been considered as an alternative for cargo transport to avoid the city center and have faster access towards the east.

[V-4-14] Widening of Siporex-Sable Link

The Siporex-Sable Link is an East-West arterial road running parallel to the Autoroute du Nord in the northern part of Yopougon. This road has been in poor shape and upgrade works are necessary to increase the capacity of this road.

(5) Traffic Demand Forecast

Many roads are planned inside the Yopougon area and their benefits have been assessed using the traffic model. The traffic demand on each of the 14 road projects above has been evaluated for the year 2030. The results of the future demand forecasts are presented in Table 3.10.

The east-west road corridor created with the upgrade of the route de Dabou and the construction of the Voie V23 will attract the most significant traffic volume in the Yopougon area, relieving the Autoroute du Nord, which is currently the only east-west link between Plateau and Yopougon. The north-south corridor connecting Ile Boulay with the Autoroute du Nord will also become an important traffic corridor.

Overall, the road projects in the Yopougon area have been designed with sufficient traffic lanes to cope with the future traffic volume.

Table 3.10 Daily Traffic Volume in 2030 of Yopougon Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-4-1	Development of YoARN - Voie V23 - Parkway Section	24,028
V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section	58,772
V-4-3	Development of YoARN - Voie V2	11,979
V-4-4	Development of YoARN - Voie V6	9,667
V-4-5	Development of YoARN - Voie V9	3,409
V-4-6	Development of YoARN - Yopougon Industrial Zone Arterial Road	5,451
V-4-7	Development of YoARN - Voie V28 - Northern Section	19,846
V-4-8	Development of YoARN - Voie V28 - 4th Bridge	29,427
V-4-9	Development of YoARN - Voie V28 - Southern Section	13,933
V-4-10	Development of YoARN – Autoroute de l'Ouest	19,676
V-4-11	Development of YoARN - Yopougon Western Bypass	5,506
V-4-12	Development of YoARN - Widening of the Voie V1	3,116
V-4-13	Development of YoARN - Central Road of Ile Boulay	10,977
V-4-14	Development of YoARN – Widening of Siporex-Sable Link	15,842

Source: JICA Study Team

3.4.5 Development of Abobo Area Road Network

(1) Background

The Abobo area is one of the fastest growing areas in Abidjan. The surrounding area is expected to accommodate around two million residents. This will further exert urbanization pressure, mainly due to inexpensive accommodation on subdivided properties. Nearly all of the roads in this area are unpaved dirt tracks. A major logistics center is expected to be implemented in the surrounding area. Additional arterial roads are thus needed for distribution of goods for local Abidjan manufacturers and markets.

(2) List of Road Projects (Table 3.11)

Table 3.11 List of Abobo Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-5-1	Development of AbARN - Extension of Q1	2x2		Secondary
V-5-2	Development of AbARN - Western Abobo Bypass	2x2		Secondary
V-5-3	Development of AbARN - Extension of Voie N'Dotre	2x2		Primary
V-5-4	Development of AbARN - Widening of the Route d'Alépé	2x2		Primary
V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo	2x2		Secondary
V-5-6	Development of AbARN - East-West Abobo-Cocody Link	2x2		Secondary

Source: JICA Study Team

(3) Location Map (Figure 3.19)

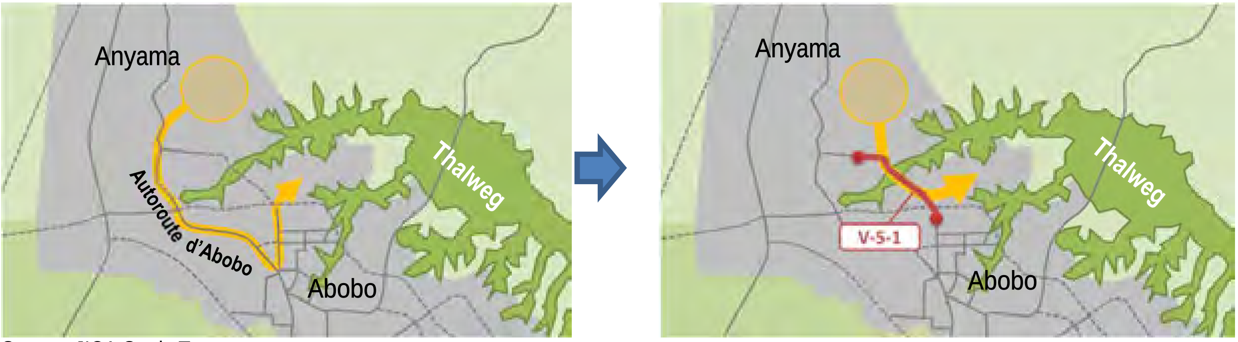
Source: JICA Study Team

Figure 3.19 Road Development in Abobo Area (2030)

(4) Objectives of Abobo Area Road Network Development

[V-5-1] Extension of Q1

Abobo and Anyama are currently separated by a thalweg, which creates a natural obstacle for development and creates discontinuity in the local road network and forces all the traffic on the Autoroute d'Abobo. The extension of the Q1 road between Abobo and Anyama is expected to relieve the Autoroute d'Abobo of local traffic travelling between Anyama and Abobo, as shown in Figure 3.20.



Source: JICA Study Team

Figure 3.20 Continuity of the Road Network Across Thalwegs

[V-5-2] Western Abobo Bypass

Lands are available along the high voltage electricity lines in the northern area of Banco Forest. This land should be used for the construction of a new road that will allow traffic to avoid Abobo center.

[V-5-3] Extension of Voie N'Dotre

With the future construction of the Voie V28 connecting the Autoroute du Nord with the expansion of the port on Ile Boulay, an increase in traffic going towards the northern part of the country can be expected. The existing road, which has only one traffic lane in each direction, should be widened to avoid any congestion and upgrade the road as a truck route.

[V-5-4] Widening of the Route d'Alépé

The Route d'Alépé is a two-lane road that requires important rehabilitation on some sections. In order to provide fast and secure access to cargo transport travelling between Abidjan and Ghana, this road needs to be widened up to Alépé in the first stage, and then up to Ghana in the second stage.

[V-5-5] Widening of the Autoroute d'Abobo

The Autoroute d'Abobo is currently being upgraded to a four-lane expressway between the quartier PK 18 of Abobo and the Hospital of Anyama. This widening will have to be extended up to Azaguié, in order to provide a fast and reliable north-south link between Adjamé and the northern area of Greater Abidjan.

[V-5-6] East-West Abobo-Cocody Link

The implementation of the North-South Urban Train will require the reorganization of the bus network with the creation of feeder lines connected to this rail project. This link will allow the implementation of an East-West bus line providing a fast access for Cocody residents to mass transit.

(5) Traffic Demand Forecast

The planned road network for the Abobo area has been tested with the traffic model to determine the traffic demand for the year 2030 and see if the proposed projects are sufficient. The results of the future demand forecasts are presented in Table 3.12.

Table 3.12 Daily Traffic Volume in 2030 of Abobo Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-5-1	Development of AbARN - Extension of Q1	10,425
V-5-2	Development of AbARN - Western Abobo Bypass	6,484
V-5-3	Development of AbARN - Extension of Voie N'Dotre	9,431
V-5-4	Development of AbARN - Widening of the Route d'Alépé	7,645
V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo	4,410
V-5-6	Development of AbARN - East-West Abobo-Cocody Link	5,465

Source: JICA Study Team

All the road projects have been designed with sufficient traffic lanes considering the daily traffic volume estimated with the model.

3.4.6 Development of Cocody Area Road Network

(1) Background

The population of Cocody is expected to grow from 420,000 in 2013 to 560,000 in 2030. To accommodate this additional population, the urban area of Cocody is expected to expand towards the East with the construction of new residential areas. To connect all those new residential areas with the primary road network, the secondary road network will have to be developed.

As urban sprawl is developing at a very high pace, delay in the construction of those routes could result in extensive illegal occupation of the right of way by both formal houses and informal settlements. Thus, all the road projects should be implemented in the short- to mid-term.

(2) List of Road Projects (Table 3.13)

Table 3.13 List of Cocody Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-6-1	Development of CoARN - Extension of Boulevard Latrille	2x2		Secondary
V-6-2	Development of CoARN - Voie Y3	2x2		Secondary
V-6-3	Development of CoARN - Old Y4 Alignment	2x2		Secondary
V-6-4	Development of CoARN - Extension of the Boulevard de France	2x2		Secondary
V-6-5	Development of CoARN - Boulevard de France Redressé	2x2		Secondary
V-6-6	Development of CoARN – Widening of the Boulevard Latrille	2x3		Secondary
V-6-7	Development of CoARN – Widening of the Rue des Jardins	2x2		Secondary
V-6-8	Development of CoARN – Widening of the Boulevard de la Corniche	2x3		Secondary
V-6-9	Development of CoARN – Widening of the Boulevard Attoban	2x2		Secondary
V-6-10	Development of CoARN – Widening of the Boulevard de la 7e Tranche	2x2		Secondary

Source: JICA Study Team

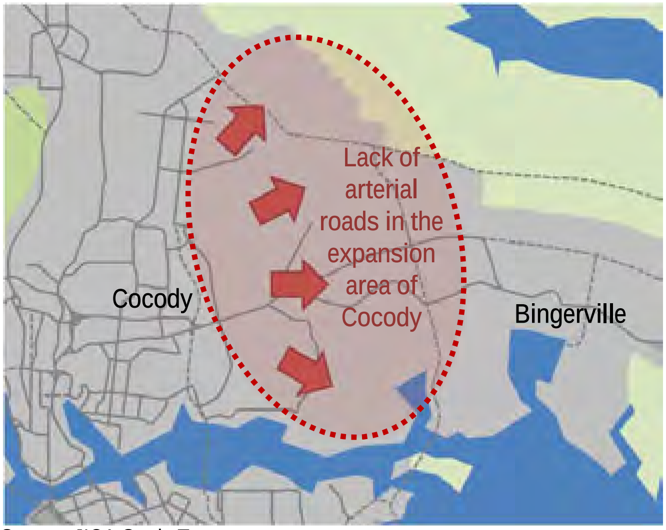
(3) Location Map (Figure 3.21)

Source: JICA Study Team

Figure 3.21 Road Development in Cocody Area (2030)

(4) Objectives of Cocody Area Road Network Development

As explained previously, the eastern part of Cocody is developing at a very rapid pace. There is a clear lack of arterial roads in this area, as shown in Figure 3.22, and most of the planned infrastructures in the Master Plan 2000 have not been implemented. The road projects considered in the Cocody area have been planned to provide sufficient road network in this fast developing area.



Source: JICA Study Team

Figure 3.22 Urban Development Toward the East

[V-6-1] Extension of Boulevard Latrille

The Cocody area is quickly expanding toward the northeast. So this fast developing area will need proper access. The Boulevard Latrille will thus be extended through this new residential area.

[V-6-2] Voie Y3

The Voie Y3 will connect the Route d'Alépé with the Boulevard Francois Mitterrand and relieve the other north-south arterial road running between Abobo and Cocody, in particular the Boulevard Latrille and the Rue des Jardins. Furthermore, with the completion of the Riviera-Marcory Bridge, this road will provide direct access to the Petit-Bassam Island from Abobo.

[V-6-3] Old Y4 Alignment

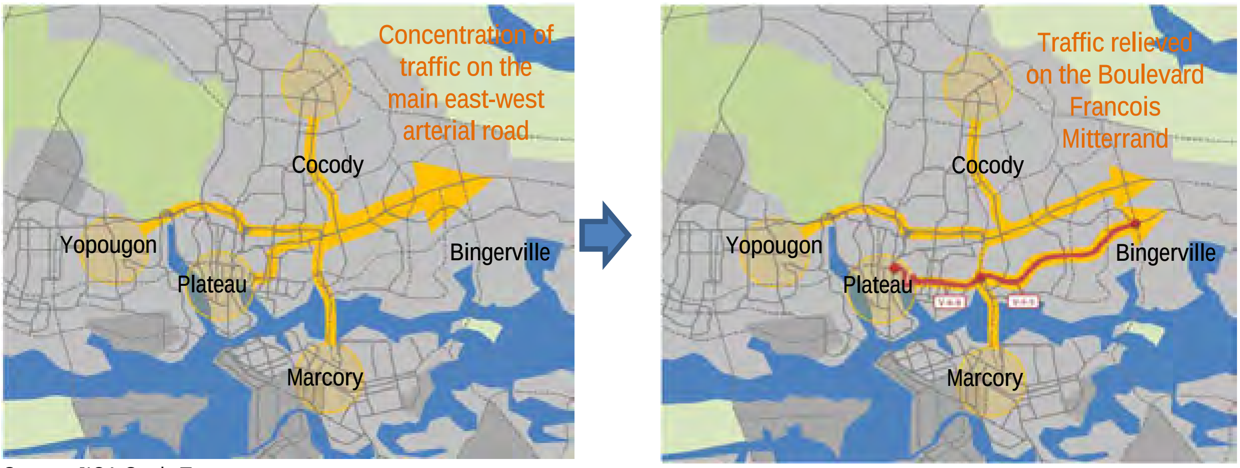
As the alignment of the Y4 Ring Road inside Cocody has been modified from its original alignment, land secured for its ROW could be used to build an important urban road that would help relieve traffic from the other north-south arterial road between the Voie Y3 and the Y4 Ring Road.

[V-6-4] Extension of Boulevard de France

The extension of the Boulevard de France along the lagoon will provide a much-needed access to the fast-growing residential area of Riviera 6.

[V-6-5] Boulevard de France Redressé

Currently, all the east-west traffic is concentrated on the Boulevard Francois Mitterrand. The Boulevard de France Redresse is a proposed link road near the Golf Course in Cocody Riviera 1 and 4, connecting the Boulevard de France from the Third Bridge with the Route de Bingerville (V-2-3). It will function as an alternative east-west arterial road to the Boulevard Francois Mitterrand, between Cocody and Bingerville, as illustrated in Figure 3.23.



Source: JICA Study Team

Figure 3.23 Additional East-West Arterial Road

[V-6-6] Widening of the Boulevard Latrille

During peak hours, the Boulevard Latrille is highly congested as it is one of the major north-south arterial roads used by commuters. The widening is expected to increase the capacity of the road and ameliorate the traffic flow along this road.

[V-6-7] Widening of the Rue des Jardins

The Rue des Jardins, which connects Boulevard Mitterrand with the Route du Zoo, is also experiencing traffic congestion during peak hours. The increase of traffic lanes will solve part of the problem, but intersections at both ends of this road will also have to be improved to ameliorate the current traffic conditions along this road.

[V-6-8] Widening of the Boulevard de la Corniche

With the implementation of the 5^{th} Bridge, traffic volume is expected to increase along this east-west axis. The widening of the Boulevard de la Corniche will allow this additional traffic to flow freely up to the Boulevard de France Redresse.

[V-6-9] Widening of the Boulevard Attoban

The Boulevard Attoban is a 2x1 traffic-lane road running North-South and that is highly congested during morning and evening peak yours. Additional traffic lanes are required to increase the capacity of the road.

[V-6-10] Widening of the Boulevard de la 7e Tranche

The traffic on the Voie de la 7e Tranche is expected to increase with the widening of the Boulevard Attoban. The widening of this north-south arterial road will be necessary to ameliorate traffic conditions in this northern area of Cocody.

(5) Traffic Demand Forecast

Cocody is a fast urban expansion area and major roads have been planned. To analyze the impact of those five major roads, the traffic on those planned roads were simulated for the year 2030. The results of the future demand forecasts are presented in Table 3.14.

Table 3.14 Daily Traffic Volume in 2030 of Cocody Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-6-1	Development of CoARN - Extension of Boulevard Latrille	2,203
V-6-2	Development of CoARN - Voie Y3	3,810
V-6-3	Development of CoARN - Old Y4 Alignment	4,142
V-6-4	Development of CoARN - Extension of the Boulevard de France	1,725
V-6-5	Development of CoARN - Boulevard de France Redressé	11,950
V-6-6	Development of CoARN – Widening of the Boulevard Latrille	20,725
V-6-7	Development of CoARN – Widening of the Rue des Jardins	14,630
V-6-8	Development of CoARN – Widening of the Boulevard de la Corniche	28,020
V-6-9	Development of CoARN – Widening of the Boulevard Attoban	11,481
V-6-10	Development of CoARN – Widening of the Boulevard de la 7e Tranche	18,302

Source: JICA Study Team

The roads planned in the Cocody area have been designed with sufficient traffic lanes to handle the traffic volume forecasted for the year 2030. Two projects (V-6-1 and V-6-4) have a very low traffic volume, which shows that they should not be considered as priority projects. The extension of the Boulevard de France, which will be connected to the Route de Bingerville, will collect the most traffic among the planned road projects, relieving the Boulevard Francois Mitterrand.

3.4.7 Development of the Central Area Road Network

(1) Background

For Abidjan to be internationally recognized as the leading city in West Africa, the central business district located at the Plateau will have to display an image of high quality urban environment. Vehicle traffic restriction in the city center, through the promotion of public transit, should be supported through the provision of multimodal connection and removal of on-street parking. Trucks should also be prohibited from entering the city center.

The development of the Port of Abidjan, which is the heart of Ivorian economic activities, should also be given priority and adequate infrastructure; the surrounding area should be built to increase the efficiency and reliability of road freight transport.

(2) List of Road Projects (Table 3.15)

Table 3.15 List of Central Area Road Projects

Code	Project	Traffic Lanes	Function	Class
V-7-1	Development of CeARN - Voie Triomphale	2x4+4		Primary
V-7-2	Development of CeARN - 3rd Bridge (under construction)	2x3	Truck Route	Primary
V-7-3	Development of CeARN - Widening of the Boulevard de Marseille	2x2		Secondary
V-7-4	Development of CeARN - Vridi Bridge	2x2	Truck Route	Secondary
V-7-5	Development of CeARN - Petit-Bassam Northern Bypass	2x2		Secondary
V-7-6	Development of CeARN - Grand-Campement Arterial Road	2x2	BRT	Secondary
V-7-7	Development of CeARN – Upgrade of Felix Houphouet Boigny Bridge	2x2		Primary
V-7-8	Development of CeARN – Upgrade of General de Gaulle Bridge	2x3		Primary
V-7-9	Development of CeARN – Vridi-Bietry Bridge	2x2		Primary
V-7-10	Development of CeARN –Yopougon-Treichville Tunnel	2x2	Truck Route	Secondary

Source: JICA Study Team

(3) Location Map (Figure 3.24)

Source: JICA Study Team

Figure 3.24 Road Development in Central Area (2030)

(4) Objectives of the Central Area Road Network Development

[V-7-1] Voie Triomphale

To revitalize Abidjan and transform it into a modern urban center, the central business area of Plateau and Adjame will require significant urban renewal. The Voie Triomphale would provide the opportunity for a major restructuring of the central core of the city that would display the city's future international role.

[V-7-2] Third Bridge

The Third Bridge is currently being built between Cocody and Marcory and should relieve traffic from the two bridges connecting Plateau to Treichville.

[V-7-3] Widening of the Boulevard de Marseille

The Boulevard de Marseille is a road with just one traffic lane in each direction. The widening of this road would relieve the traffic on the Boulevard Valery Giscard d'Estaing.

[V-7-4] Vridi Bridge

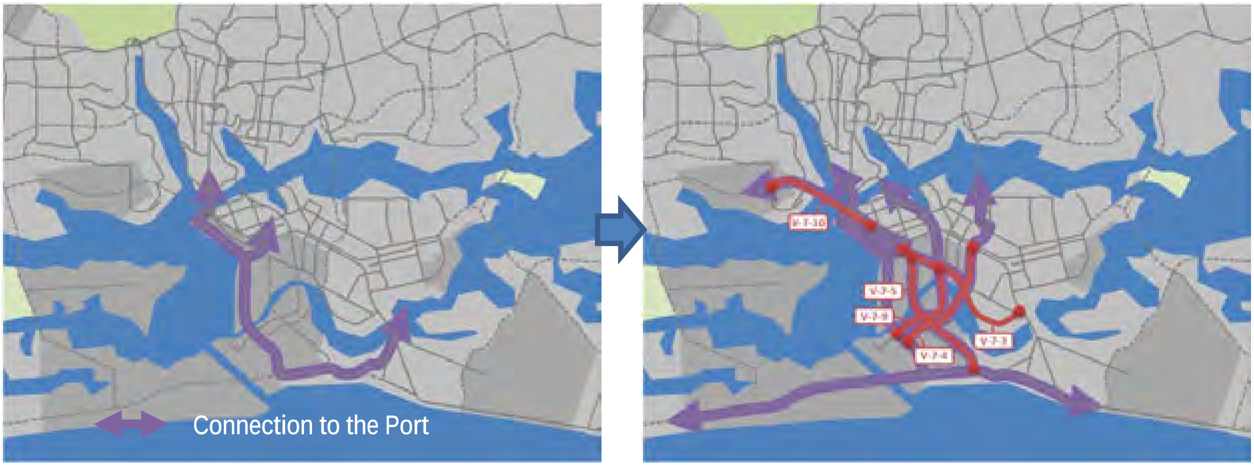
In the Master Plan 2000, the Vridi Bridge was connected to the Route du Canal. However, in such configuration, all the cargo traffic coming from the port area would be headed towards the city center, which is what should be avoided. The alignment of the Vridi Bridge has thus been changed to allow trucks from the port and the surrounding industrial area to go directly on the Third Bridge (V-7-2) and avoid the city center, as illustrated in Figure 3.25.

Source: JICA Study Team

Figure 3.25 Diversion of Cargo Transport from the Plateau

[V-7-5] Vridi Bypass

The Autonomous Port of Abidjan is currently connected to the rest of the road network by only one road, limiting its development. The Vridi Bridge and the Vridi Bypass should provide new accesses and alternatives for port users, as shown in Figure 3.26. Those infrastructures will reinforce the reliability of the cargo transport as one incident along the lone arterial road inside the port could block the whole industrial area surrounding the port.



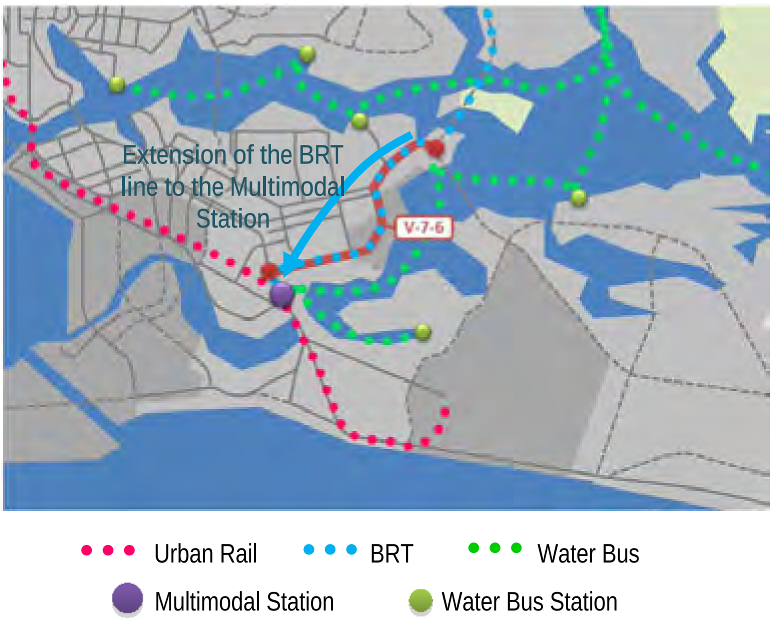
Source: JICA Study Team

Figure 3.26 Multiple Connections to the Port with Vridi Bridge and Vridi Bypass

[V-7-6] Grand-Campement Arterial Road

A good public transport system must be easy and convenient and the key word would be "interconnectivity". A BRT system should not be considered independently from other means of transport and, as such, should provide many connections with other public transport networks. The BRT system, which is planned along the Y4 Ring Road between Abobo to Koumassi, is no exception and the location of the BRT terminal in Koumassi has been selected to become a multi-modal interchange of three public transport modes (Urban Rail, BRT and Water Bus).

To allow the BRT line to access such location, the road from the Y4 Ring Road up to the center of Koumassi must be widened (Figure 3.27). Inside the quartier of Grand-Campement, the slum area will have to be removed to allow such road to be implemented.



Source: JICA Study Team

Figure 3.27 Extension of the BRT on Grand-Campement Arterial Road

[V-7-7] Upgrade of Felix Houphouet Boigny Bridge (FHB Bridge)

The Felix Houphouet Boigny Bridge is starting to show signs of damages and rehabilitation works seem necessary to extend the life span of this infrastructure. Furthermore, with the North-South Rail Project expected to use this bridge to cross the lagoon, a study will have to be carried out to evaluate if the construction of a new bridge, rather than just rehabilitation, is not a better solution.

[V-7-8] Upgrade of General de Gaulle Bridge (GdG Bridge)

The General de Gaulle (GdG) Bridge was built 57 years ago and although it is still in good condition, maintenance works may be necessary to prevent deterioration of the concrete structure and replace facilities that have been damaged such as expansion joints and guardrails.

[V-7-9] Vridi-Bietry Bridge

The only arterial road of the Port area is the Boulevard de Vridi, which carriageway is narrowed by trucks parked on both sides of the road. Vridi-Bietry Bridge, in the extension of the Boulevard Canal, is expected to provide an alternative access to the Port from Solibra intersection, increasing the efficiency of cargo transport.

[V-7-10] Yopougon-Treichville Tunnel

The traffic volume on the two existing bridges will increase significantly over the next 15 years. A new tunnel directly connecting Yopougon with Treichville has been considered to alleviate traffic from the FHB Bridge and the GdG Bridge and to allow public authorities to divert truck traffic from the city center. For analysis of the demand on the bridges crossing the lagoon with and without this tunnel, refer to Section 6.2.5 (7).

(5) Traffic Demand Forecast

The impact of the six road projects inside the central area of Greater Abidjan around the Plateau and Treichville/Marcory/Koumassi has been tested with the traffic model to assess the benefits of such infrastructure. Table 3.16 shows the results of the demand forecast.

Table 3.16 Daily Traffic Volume in 2030 of Central Area Road Projects

Code	Project	Daily Traffic Volume (PCU/km)
V-7-1	Development of CeARN - Voie Triomphale	20,080
V-7-2	Development of CeARN - 3rd Bridge (under construction)	26,028
V-7-3	Development of CeARN - Widening of the Boulevard de Marseille	10,074
V-7-4	Development of CeARN - Vridi Bridge	20,455
V-7-5	Development of CeARN - Petit-Bassam Northern Bypass	20,178
V-7-6	Development of CeARN - Grand-Campement Arterial Road	20,361
V-7-7	Development of CeARN – Upgrade of Felix Houphouet Boigny Bridge	51,869
V-7-8	Development of CeARN – Upgrade of General de Gaulle Bridge	50,305
V-7-9	Development of CeARN – Vridi-Bietry Bridge	4,241
V-7-10	Development of CeARN –Yopougon-Treichville Tunnel	24,104

Source: JICA Study Team

All the roads planned in the central area will attract an important traffic volume. The Third Bridge across the Lagoon Ebrie will see the most important traffic volume but it has been designed with sufficient traffic lanes (2x3 traffic lanes). Other roads projects will require two traffic lanes in each direction, as all will handle an important traffic volume.

3.5 Intersection Improvement Projects

One of the most urgent issues to reduce traffic congestion in Greater Abidjan is the improvement of intersections. Traffic surveys have been carried out at 13 intersections inside Greater Abidjan to understand traffic patterns at each junction. The congestion level has been evaluated and the results of this analysis have shown that most of the intersections surveyed need urgent improvement.

(1) Improvement Measures

Flyovers or underpasses can be built on the main road corridors to the city center in order to alleviate congestion by minimizing the conflicts of traffic movements by providing grade separation. Such infrastructure is assumed to cause minimal impact on the surrounding area as it can sometimes be built inside the ROW of the road or requires only limited widening.

As those projects would have an immediate impact locally on the traffic flow, they can all strongly be considered as priority projects. In such case, an appraisal of the benefits and cost of a flyover or underpass against other reasonable alternatives to obtain similar results will be evaluated and compared to see the economic benefits of introducing flyovers or underpasses against other short- or long-term alternatives.

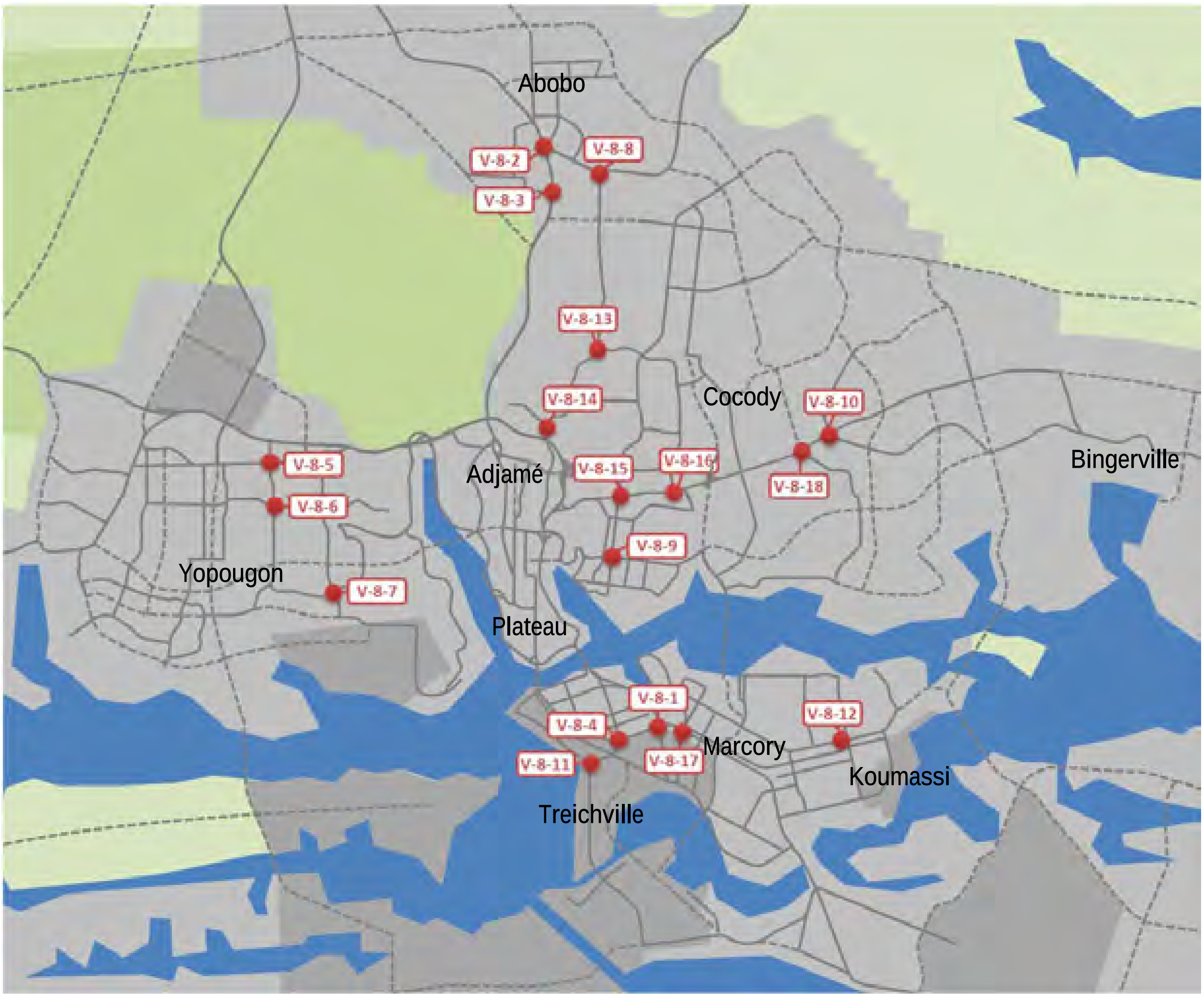
(2) List of Intersection Improvement Projects (Table 3.17)

Table 3.17 List of Intersection Improvement Projects

Code	Project	Traffic Lanes	Type
V-8-1	Intersection Improvement – Solibra (Treichville)	2x2	Flyover
V-8-2	Intersection Improvement – Mairie d'Abobo (Abobo)	2x1	Flyover
V-8-3	Intersection Improvement – Banco (Abobo)	2x1	Flyover
V-8-4	Intersection Improvement – Palais des Sports (Treichville)	2x2	Flyover
V-8-5	Intersection Improvement – Siporex (Yopougon)	2x1	Flyover
V-8-6	Intersection Improvement – Kenaya (Yopougon)	2x1	Flyover
V-8-7	Intersection Improvement – Sapeur Pompiers (Yopougon)	2x1	Flyover
V-8-8	Intersection Improvement – Samake (Abobo)	2x1	Flyover
V-8-9	Intersection Improvement – St Jean (Cocody)	2x1	Flyover
V-8-10	Intersection Improvement – Palmeraie (Cocody)	2x2	Flyover
V-8-11	Intersection Improvement – CHU Treichville (Treichville)	2x1	Flyover
V-8-12	Intersection Improvement – Inchallah (Koumassi)	2x1	Flyover
V-8-13	Intersection Improvement – Zoo (Adjame-Cocody)	2x1	Flyover
V-8-14	Intersection Improvement – Williamsville (Adjame)	2x1	Flyover
V-8-15	Intersection Improvement – Carrefour de la Vie (Cocody)	2x1	Flyover
V-8-16	Intersection Improvement – Carrefour de l'Ecole Nationale de Police (Cocody)	2x1	Flyover
V-8-17	Intersection Improvement – Carrefour de Marcory (Marcory)	2x1	Flyover
V-8-18	Intersection Improvement – Carrefour Orca (Cocody)	2x2	Flyover

Source: JICA Study Team

(3) Location Map (Figure 3.28)



Source: JICA Study Team

Figure 3.28 Intersection Improvement Project Locations (2030)

(4) Traffic Demand Forecast

The six road projects inside the central area of Greater Abidjan around the Plateau and Treichville/Marcory/Koumassi have been put inside the traffic model to evaluate the benefits of such infrastructure. Table 3.18 shows the results of the demand forecast.

Table 3.18 List of Intersection Improvement Projects

Code	Project	Daily Traffic Volume (PCU/day)
V-8-1	Intersection Improvement – Solibra (Treichville)	111,500
V-8-2	Intersection Improvement – Mairie d'Abobo (Abobo)	89,213
V-8-3	Intersection Improvement – Banco (Abobo)	89,175
V-8-4	Intersection Improvement – Palais des Sports (Treichville)	52,250
V-8-5	Intersection Improvement – Siporex (Yopougon)	82,788
V-8-6	Intersection Improvement – Kenaya (Yopougon)	38,425
V-8-7	Intersection Improvement – Sapeur Pompiers (Yopougon)	45,538
V-8-8	Intersection Improvement – Samake (Abobo)	65,513
V-8-9	Intersection Improvement – St Jean (Cocody)	91,363
V-8-10	Intersection Improvement – Palmeraie (Cocody)	37,438
V-8-11	Intersection Improvement – CHU Treichville (Treichville)	81,263
V-8-12	Intersection Improvement – Inchallah (Koumassi)	65,175
V-8-13	Intersection Improvement – Zoo (Adjame-Cocody)	55,625
V-8-14	Intersection Improvement – Williamsville (Adjame)	75,600
V-8-15	Intersection Improvement – Carrefour de la Vie (Cocody)	83,288
V-8-16	Intersection Improvement – Carrefour de l'Ecole Nationale de Police (Cocody)	142,763
V-8-17	Intersection Improvement – Carrefour de Marcory (Marcory)	111,963
V-8-18	Intersection Improvement – Carrefour Orca (Cocody)	55,538

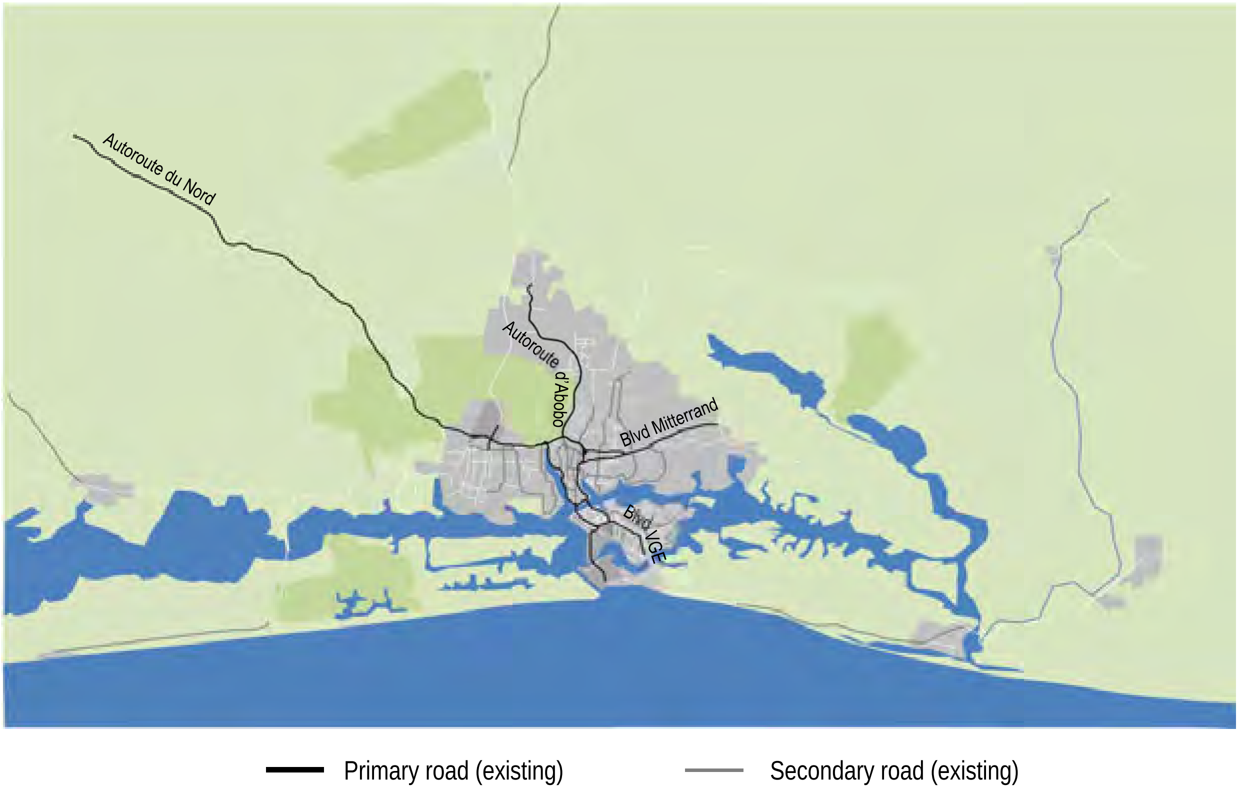
Source: JICA Study Team

Most of the intersections will have a traffic volume above 20,000 PCU/day, showing that there is an urgency to build all those flyovers.

3.6 Implementation Schedule of Road Projects

The implementation timing of each road project should be consistent with the forecast urban development. In the following paragraphs, arterial road network development will be represented for the years 2020, 2025 and 2030, showing that it sufficient road projects have been planned to support urban development.

The current road network is shown in Figure 3.29.



Source: JICA Study Team

Figure 3.29 Current Arterial Road Network

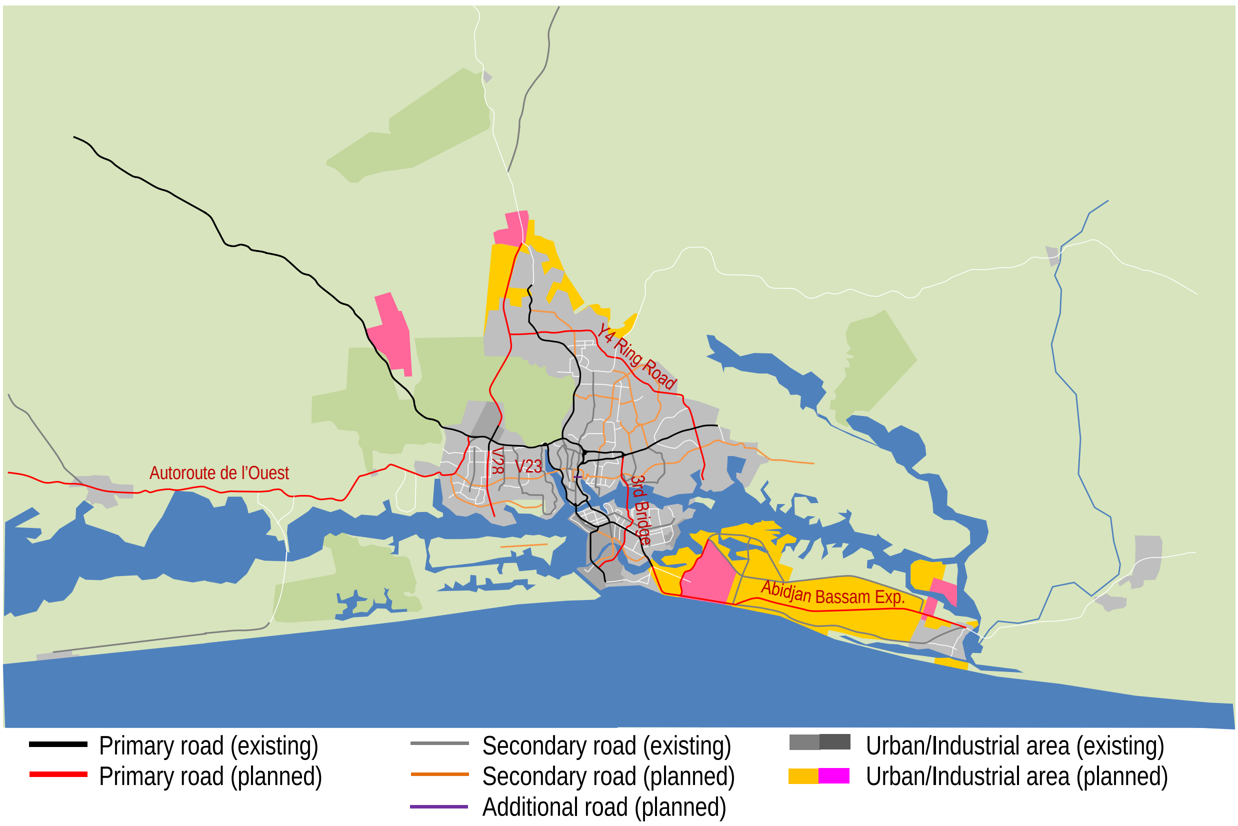
3.6.1 Short-Term Road Development Plan (2015-2020)

During this period, the urban development will mainly focus on:

- The urban renewal of Plateau, Adjame and Treichville
- The creation of industrial zones in Attinguie, Anyama, Grand-Bassam and Vridi Port
- The provision of public transit: north to south by urban rail, BRT to Abobo and Cocody, high-speed ferry west to east along Ebrie Lagoon.

The two main urban expansion areas are expected to be the northern area of Abobo and the land strip between Port-Bouet and Grand-Bassam. The northern area of Abobo is expected to experience urban sprawl in response to the probable growth in population. This land-consuming development will have to be limited as much as possible and, for this reason, new arterial roads should not be built in this area as it would further encourage urban sprawl.

The land strip between Port-Bouet and Grand-Bassam is, on the contrary, targeted as a high potential area surrounded on both sides by water. High-quality residential areas are expected to flourish and the land should be well structured along arterial roads. This process has already started in Port-Bouet with the Aérocité project, which is supposed to be quickly implemented under a concession scheme. The Abidjan-Bassam, which is under construction, is expected to divide the area in two and many overpasses will have to be built to re-establish connection between the northern and southern parts of the land strip, as shown in Figure 3.30. The road network in this area should be quickly implemented while urban sprawl is still limited and land can be easily secured for the ROW of those infrastructures.



Source: JICA Study Team

Figure 3.30 Road Network in 2020

Road projects that will be implemented during the 2015 to 2020 period are listed in Table 3.19.

Table 3.19 List of Road Projects to be Implemented before 2020

Code	Project Name	Implementation Schedule																
		Short-Term						Mid-Term					Long-Term					
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18				■	■	■										
V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section		■	■	■	■	■										
V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section		■	■	■	■											
V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section		■	■	■												
V-1-7	Development of Y4 Ring Road - Aérocité Section	■	■	■													
V-2-3	Development of BiARN - Widening of the Route de Bingerville			■	■	■	■										
V-3-1	Development of BaARN - Abidjan-Bassam Expressway (under construction)	■															
V-3-2	Development of BaARN - Aérocité Area	■	■	■													
V-3-3	Development of BaARN - Bassam Northern Bypass				■	■	■										
V-4-1	Development of YoARN - Voie V23 - Parkway Section	■	■	■	■	■	■										
V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section			■	■	■	■										
V-4-4	Development of YoARN - Voie V6		■	■	■	■											
V-4-7	Development of YoARN - Voie V28 - Northern Section	■	■	■	■	■	■										
V-4-10	Development of YoARN - Autoroute de l'Ouest			■	■	■	■										
V-4-13	Development of YoARN - Central Road of Boulay Island					■	■										
V-5-1	Development of AbARN - Extension of Q1			■	■	■											
V-5-3	Development of AbARN - Extension of Voie N'Dotre				■	■	■										
V-5-6	Development of AbARN - East-West Abobo-Cocody Link	■	■	■													
V-6-1	Development of CoARN - Extension of Boulevard Latrille		■	■	■	■											
V-6-2	Development of CoARN - Voie Y3			■	■	■	■										
V-6-5	Development of CoARN - Boulevard de France Redressé		■	■	■	■											
V-6-6	Development of CoARN - Widening of the Boulevard Latrille		■	■	■												
V-6-7	Development of CoARN - Widening of the Rue des Jardins					■	■										
V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche			■	■	■											
V-6-9	Development of CoARN - Widening of the Boulevard Attoban				■	■	■										
V-7-2	Development of CeARN - 3rd Bridge (under construction)																
V-7-3	Development of CeARN - Widening of the Boulevard de Marseille		■	■	■												
V-7-4	Development of CeARN - Vridi Bridge		■	■	■												
V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge		■	■	■	■	■										
V-7-9	Development of CeARN - Vridi-Bietry Bridge				■	■	■										
V-9-3	Development of an Elevated Road over Cocody Bay				■	■	■										

Source: JICA Study Team

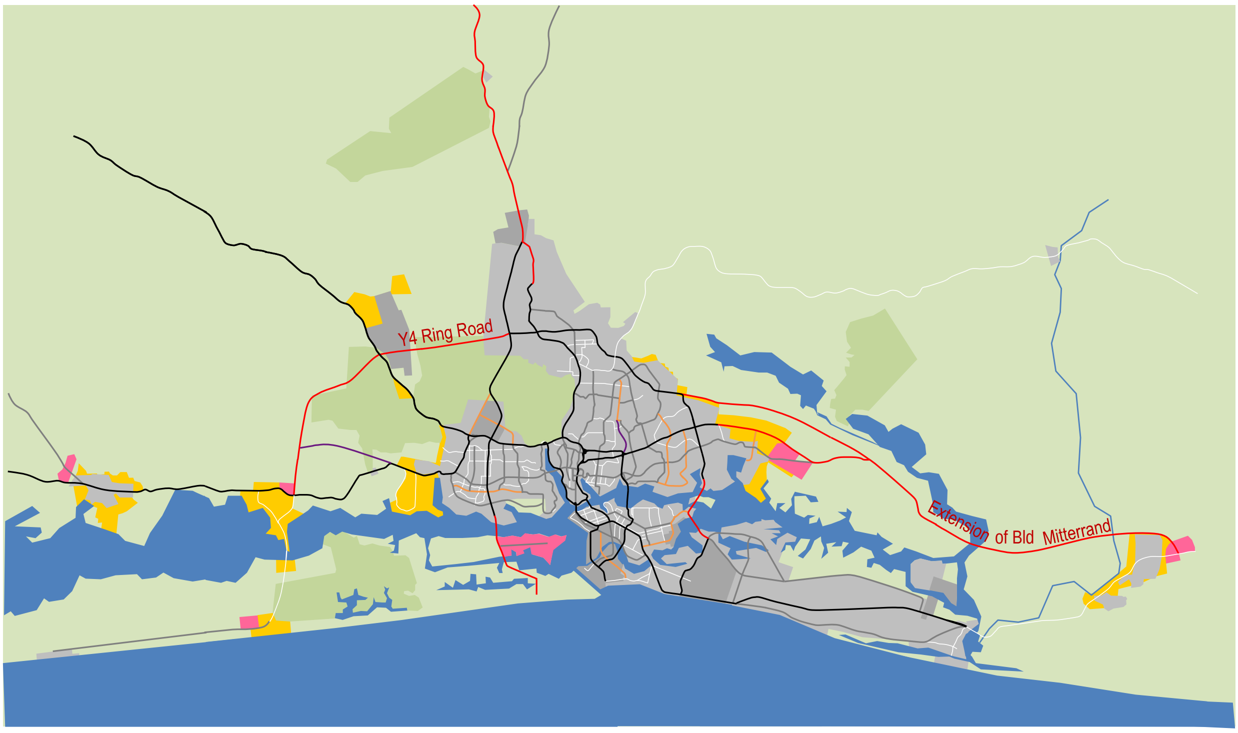
Priority should be put on the implementation of the Voie V23 and the Fifth Bridge connecting Yopougon to Plateau. This project is crucial for the development of the western part of Greater Abidjan, which is currently connected by a lone link that goes through the Autoroute du Nord.

The other priority project is the northeast section of the Y4 Ring Road. The ROW has been secured but urban sprawl is starting to reduce its width. Its implementation should be accelerated before the ROW is completely occupied, as is now the case for the Voie V23.

3.6.2 Medium-Term Road Development Plan (2020-2025)

During this five-year period, urban growth should be concentrated along the Bingerville corridor in the East and the Songon corridor in the West, as illustrated in Figure 3.31. Urbanization is also expected to take place in the surrounding area of the industrial area of Attinguie. Other urban developments are also projected, such as:

- The urban renewal to Abobo, Marcory, Koumassi and Bingerville
- The creation of industrial zones in Dabou, Bingerville, Bonoua, and the expansion of the Abidjan Port
- The provision of public transit: urban rail extended to Grand-Bassam, BRT to link Cocody with Koumassi and provision of the western freight rail route to Abidjan Port expansion.



Primary road (existing)
Primary road (planned)
Secondary road (existing)
Secondary road (planned)
Additional road (planned)
Urban/Industrial area (existing)
Urban/Industrial area (planned)

Source: JICA Study Team

Figure 3.31 Road Network in 2025

To organize the urban development of the Bingerville corridor, two major roads are planned: the extension of the Boulevard de Francois Mitterrand and the Bingerville Area Northern Bypass. The latest is expected to define a clear limit to urbanization and protect the water catchment around the Lagoon Anguien. The Boulevard Francois Mitterrand will also be implemented during the same period, becoming the main arterial road inside the newly developed corridor and providing direct access to Bonoua.

Road projects that will be implemented during the 2020 to 2025 period are listed in Table 3.20.

Table 3.20 List of Road Projects to be Implemented before 2025

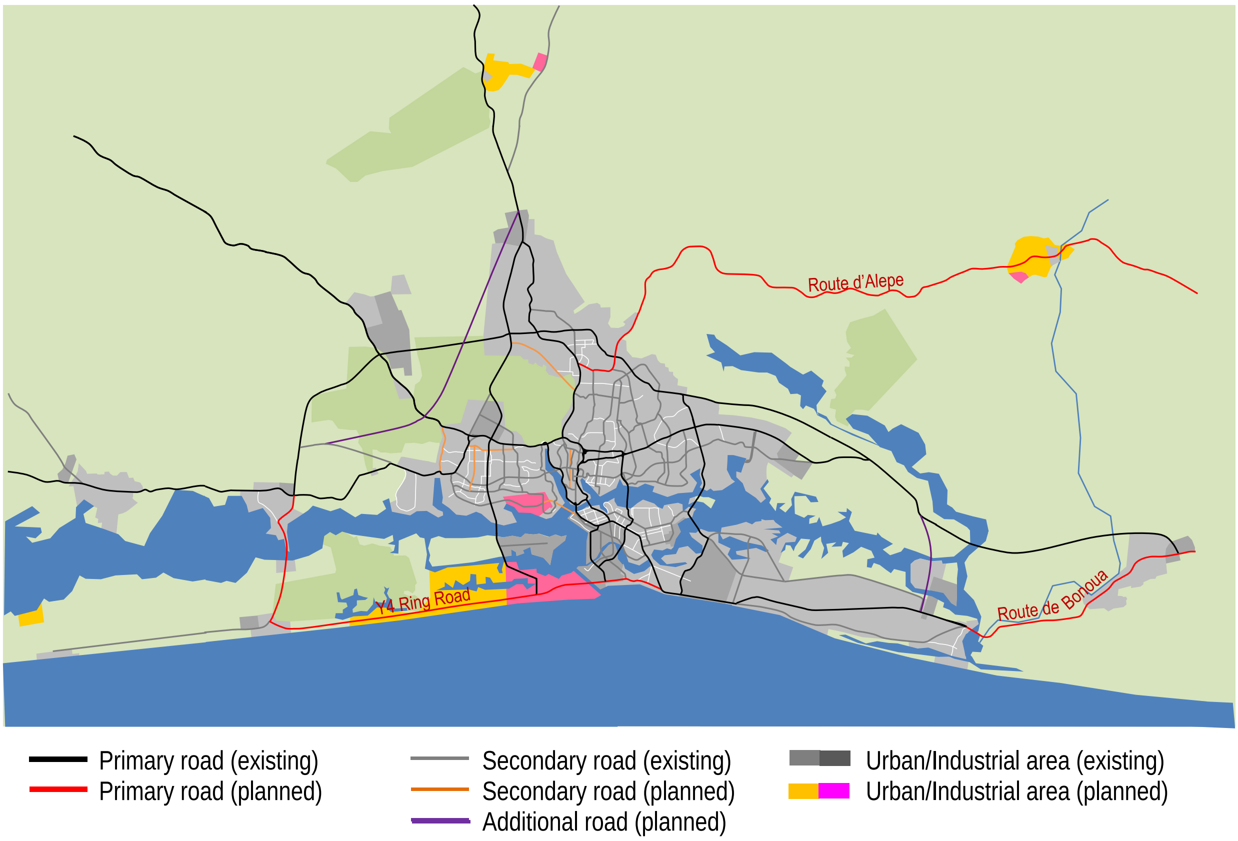
Code	Project Name	Implementation Schedule															
		Short-Term						Mid-Term					Long-Term				
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section					■	■	■									
V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section		■	■	■	■	■	■									
V-2-1	Development of BiARN - Bingerville Northern Bypass								■	■	■						
V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand						■	■	■	■	■						
V-2-4	Development of BiARN - Bingerville BRT Road									■	■						
V-4-3	Development of YoARN - Voie V2							■	■	■	■						
V-4-5	Development of YoARN - Voie V9						■	■	■								
V-4-6	Development of YoARN - Yopougon Industrial Zone Arterial Road									■	■	■					
V-4-8	Development of YoARN - Voie V28 - 4th Bridge				■	■	■	■									
V-4-9	Development of YoARN - Voie V28 - Southern Section									■	■	■					
V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo						■	■	■	■							
V-6-3	Development of CoARN - Old Y4 Alignment								■	■	■						
V-6-4	Development of CoARN - Extension of the Boulevard de France					■	■	■	■								
V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche							■	■	■							
V-7-5	Development of CeARN - Vridi Northern Bypass					■	■	■	■								
V-7-6	Development of CeARN - Grand-Campement Arterial Road										■	■					
V-7-8	Development of CeARN - Upgrade of General de Gaulle Bridge							■	■	■	■	■					
V-9-1	Development of an Alternative Road to the Route de Dabou								■	■	■						
V-9-4	Development of a Northern Extension of the 3rd Bridge									■	■	■					

Source: JICA Study Team

3.6.3 Long-Term Road Development Plan (2025-2030)

During the 2025 to 2030 periods, the focus of growth will be concentrated at the satellite towns of Alepe, Azaguie, Jacqueville and a new area west of the Abidjan Port extension, as shown in Figure 3.32. In addition, the following projects are expected to be implemented:

- The urban renewal of Yopougon center
- The creation of industrial zones in Ako-Brake, Alepe, Azaguie and Abreby/Ambroise
- The provision of public transit: urban rail west-east line, Yopougon to Bingerville; BHLS lines Dabou-Yopougon and Bingerville-Bonoua.



Source: JICA Study Team

Figure 3.32 Road Network in 2030

The missing western link of the Y4 Ring Road between the Vridi Industrial Zone and Songon will be completed during this period and the Voie V28 will be extended to provide southern access to the port expansion on Ile Boulay.

As urban development will focus on satellite towns such as Dabou, Alepe and Azaguie, roads connecting those satellite towns with the District of Abidjan will have to be widened to provide reliable and fast access to those areas and to reduce transportation time so as to allow industries to establish themselves without having to worry about being located too far from the center of Greater Abidjan.

Road projects that will be implemented during the 2025 to 2030 period are listed in Table 3.21.

Table 3.21 List of Road Projects to be Implemented before 2030

Code	Project Name	Implementation Schedule															
		Short-Term						Mid-Term					Long-Term				
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
V-1-8	Development of Y4 Ring Road - Canal du Vridi Section										■	■	■	■	■	■	■
V-1-9	Development of Y4 Ring Road - Jacqueville Section													■	■	■	■
V-3-4	Development of BaARN - Widening of the Route de Bonoua															■	■
V-4-11	Development of YoARN - Yopougon Western Bypass															■	■
V-4-12	Development of YoARN - Widening of the Voie V1											■	■	■			
V-4-14	Development of YoARN - Widening of Siporex-Sable Link														■	■	■
V-5-2	Development of AbARN - Western Abobo Bypass															■	■
V-5-4	Development of AbARN - Widening of the Route d'Alépé															■	■
V-7-1	Development of CeARN - Voie Triomphale									■	■	■	■	■			
V-7-10	Development of CeARN - Yopougon-Treichville Tunnel												■	■	■	■	■
V-9-2	Development of an Alternative Connection between Autoroute du Nord - Carrefour Thomasset											■	■	■	■		
V-9-5	Development of a Connection Road between Boulevard Mitterand and Grand Bassam												■	■	■		

Source: JICA Study Team

4.0 Traffic Control and Management Development Plan

In order to make the most of the existing capacity of the transport infrastructure as well as to achieve a better transportation environment in the study area, the following transportation control measures (TCMs) have been proposed:

- Traffic control system, including development of area traffic control system and traffic information system,
- Parking system development, including development of parking facilities and parking information system,
- Introduction of a pricing policy in the CBD,
- Public transport support system including development of dedicated bus lanes,
- Development of pedestrian facilities, and
- Other traffic and road management.

All the above TCMs should be prioritized as short-term projects as they are designed to optimize utilization of the existing transport infrastructure at a relatively lower cost. Among others, a pricing policy in the CBD, which is listed in the third item, can be considered as one of the transportation demand management (TDM) policies because it will decrease excessive vehicular traffic concentration and will shift private vehicle users to public transport.

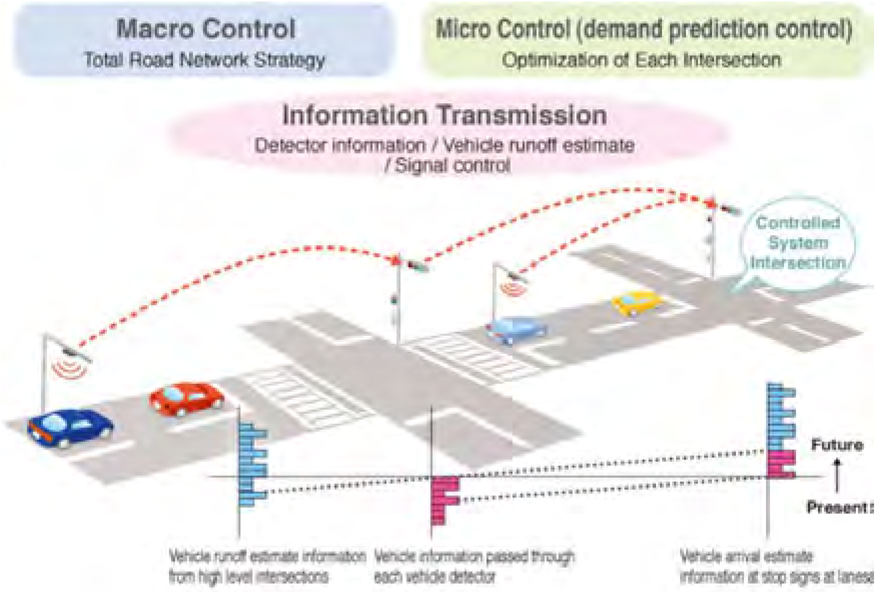
4.1 Traffic Control System

4.1.1 Area Traffic Control (ATC) System

As the number of automobiles is rapidly increasing in Abidjan, traffic congestion is also getting more and more serious. In light of this situation, it has become important to identify the bottlenecks responsible for traffic congestion using intelligent transportation systems (ITS), and to disperse traffic through optimal traffic signal control and the provision of traffic information.

The ATC system will perform precise signal phase control for safety and smooth traffic both for pedestrians and vehicles at intersections on the arterial roads in a certain area. It will also perform real-time measurement of traffic demand as well as appropriate signal control corresponding to traffic conditions.

The existing systems adopt time-of-day control, which must be upgraded to at least traffic-responsive control. For this purpose, vehicle detectors must be installed at intersection approaches, detector-data-processing functionality must be added to the central control system, and traffic-responsive signal-control software must be introduced, as shown in Figure 4.1.



Source: http://global-sei.com/its/systems/itcs.html

Figure 4.1 Image of the ATC System

Traffic conditions of the urban roads in Abidjan should be comprehensively monitored as well. A comparison of the three major traffic signal control systems is presented in Table 4.1.

Table 4.1 Comparison of the Three Major Traffic Signal Control Systems

System	Strategy	Demand Prediction	Vehicle Detection
SCATS (Sydney Coordinated Adapted Traffic System)	Green time adjustment	No	Near stop lines at intersections
SCOOT (Split Cycle Offset Optimization Technique)	Delay minimization	Yes	At exits of intersections in the upper stream
MODERATO (Management by Origin-DEstination Related Adaptation for Traffic Optimization)	Queue length minimization in heavy traffic	Yes (focusing on major intersections)	At 150 m, 300 m, 500 m, 1 km upstream from stop lines at major intersections

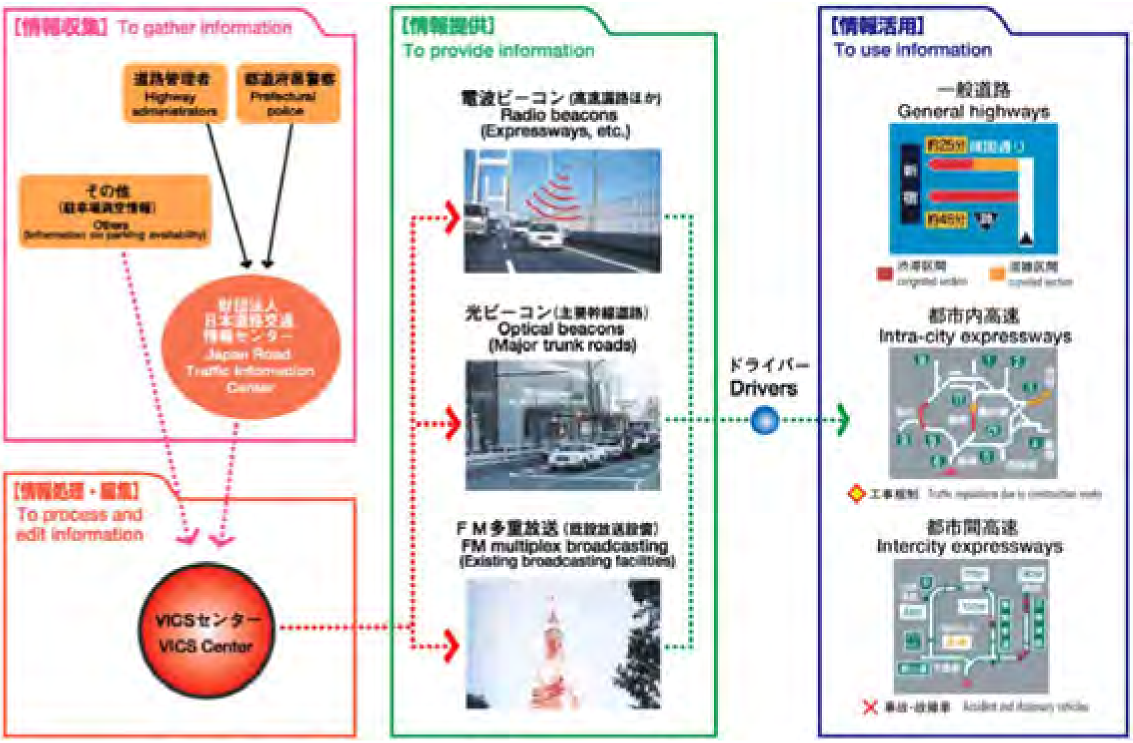
Source: Institute of Industrial Science, the University of Tokyo

Moreover, bus priority signal should be introduced in order to support bus operation. The system detects a bus approaching an intersection and adjusts signal timing to minimize the delay of the bus by either extending the green time or shortening the red time. Control function can be performed either by the central system or by a local controller.

A reliable communication system is a prerequisite condition for an ATC system to exhibit its functions. More effort should be directed to improve the quality of the communication cable network.

4.1.2 Development of Urban Traffic Information System

Although TCMs cannot entirely eliminate traffic congestion, they will surely help to reduce it if properly implemented. Introduction of a comprehensive traffic information system is most highly recommended as illustrated in Figure 4.2. Effective use of traffic information is increasingly becoming more important for heavily congested road networks. Most traffic data is collected through vehicle detectors installed by the government (traffic/road administrators). On the other hand, dissemination of traffic information has become easy with the proliferation of ICT (Information & Communication Technology).



Source: ITS Handbook, Highway Industry Development Organization

Figure 4.2 Framework of the Traffic Information System in Japan

Furthermore, GPS-based technology has been established to acquire information from mobile objects, enabling the acquisition of rich traffic data in parallel with the traditional data-collection methods. GPS-based mobile object traffic data can be precisely detailed and enables the identification of the movement of individual vehicles. Detailed data improves the accuracy of traffic simulation and therefore enhances information provision and traffic operations/management as well.

Without reliable and detailed traffic information, a traffic information system is not effective to prevent or minimize traffic congestion. A plan for developing a traffic information collection system, which would use vehicle detectors and CCTV (closed-circuit television) cameras as sensors, should be studied and formulated.

4.1.3 Application to Expressways

The above-mentioned traffic information and control system should be applied to the expressway network in Greater Abidjan. The highway traffic control center, as illustrated in Figure 4.3, also consists of various sophisticated equipment for traffic surveillance, information processing, and information dissemination. The system collects, processes and dispatches real-time traffic information to expressway users. An organization staffed with trained personnel is also essential to effectively operate the system.

Source: Ministère de l'Ecologie, du Développement durable, des Transport et du Logement
http://www.developpement-durable.gouv.fr

Figure 4.3 Highway Control Center in France

Construction of the system requires a substantial capital investment. To reduce the initial cost, system construction may be divided into phases, and the facility and system can be developed gradually. Installing equipment in a piecemeal way without a master plan must be avoided.

The first step will include installation of CCTV cameras and variable-message signboards (VMS) as well as development of a traffic control room. Meanwhile, the second step will include development of an en-route real-time travel-time information system to assist in route choice, including alternative ordinary roads.

4.1.4 Electronic Toll Collection

Many countries have introduced ETC (Electronic Toll Collection) systems for expressways and toll roads. The advantage of shorter travel time on expressways is negated by the wasted time at tollgates. ETC automatically collects tolls from moving vehicles passing through the gate so that they will not need to stop at the gate for payment. Thus, the transaction time is much shorter and turnover is much higher than manual collection.

It should be noted that, prior to the implementation of ETC, most of the proposed expressway network, including interchanges and additional toll bridges, must be completed. Furthermore, verification with an electronic vehicle-registration database, along with a bank payment system, will be necessary for ETC and to deal with violating vehicles. Hence, it should be scheduled in the long term (2026 to 2030). ETC used for expressways and toll roads has various forms in terms of how the system is introduced rather than in terms of choice of technology.

4.1.5 Overloaded Truck Control System

Damage to road structures and serious incidents due to overloaded vehicles are serious problems all over the world, and ITS is utilized to enhance the control of overloaded vehicles.

In France, the Ministry of Transport (Department for Sea and Transport, DGMT) began to implement WIM (Weigh-In-Motion) for national roads and expressways in 2007, based on the detail specifications defined by Laboratoire Central des Ponts et Chaussees (LCPC), etc. The WIM systems, which are supplied by Sterela (http://www.sterela.fr/), a French company which won the call for tender, utilize two piezo-ceramic strip sensors, an inductive loop, CCTV, and, in some cases, an additional Automatic Number Plate Recognition (ANPR) system per lane.

Moreover, enhancements are being made to the activities to identify illegitimate road use by overloaded vehicles, specialized vehicles and hazmat vehicles based on floating car data and vehicle registration information. Also under development is Bridge Weigh-In-Motion (B-WIM) to measure vehicle weight based on the amount of strain on the bridge, etc., caused by vehicle passage.

4.2 Parking System Development

4.2.1 Additional Parking Facilities/Parking Information System

Under the situation of increasing automobiles and continuing reliance on private vehicles, it is essential to increase parking capacity in Abidjan, especially in the CBD (i.e., Plateau). Some parking inside buildings is managed by the private sector and public parking is managed by Abidjan Autonomous District (AAD).

Problems of “overflowing” parking vehicles are observed everywhere in the CBD. As for on-street parking, establishments along the street pay tax for the parking space to AAD. Thus, on-street parking becomes legal private parking unless the road space is occupied. However, parking is not efficiently enforced. Illegal on-street parking outside the designated parking area is reducing the number of available driving lanes. This causes traffic disorder, consequently reducing road capacity and increasing travel time and eventually traffic pollution.

On-street parking should be removed or tightly controlled, to be replaced by the space for the ROW of public transport, private vehicles, and pedestrians. A rough analysis of the total parking demand and supply in Plateau, particularly in the most intensively developed zones (TAZs 75, 79 and 82, as indicated in Figure 4.4), was made based on the findings from the Parking Facility Survey and additional building survey, and the result is presented in Table 4.2, which reports the total daily parking demand of around 52,000 vehicle-hours in Plateau, as of 2013.

Source: JICA Study Team

Figure 4.4 TAZs in Plateau for Parking Demand/Supply Analysis

Table 4.2 Estimation of Daily Parking Demand in Plateau

Building Type	Total Floor Area (m^2)	Daily Parking Vehicle Trip Rate (veh/m^2)	Average Duration (hours)	Total Daily Parking Demand (veh-hour)
Government Office Buildings	303,900	0.013	3.6	14,100
Private Office Buildings	759,400	0.014	2.8	29,800
Commercial Buildings	138,800	0.018	3.3	8,200
Total	1,202,100	-	3.3	52,000

Source: JICA Study Team, based on Parking Facility Survey

Based on this demand, Table 4.3 shows a simulation of the daily parking demand-to-supply ratio in Plateau. The current ratio of the demand to the supply of off-street parking is well below 1.0, based on the assumption of either 12-hour operation (e.g., 6:00-18:00) or 8-hour operation (e.g., 8:00-16:00). However, it should be noted that the parking demand often concentrates on a certain period of the day, causing oversaturation. According to the Parking Survey result, such an oversaturation period is generally observed in the period of 8:00-12:00 and 13:00-16:00 in government office buildings, 9:00-14:00 in private office buildings and from 7:00-17:00 in commercial buildings. If parking is to be controlled as explained later, it should be applied in those hours.

Table 4.3 Simulation of Parking Demand/Supply Ratio in Plateau

Parking Type	Total Capacity (Vehicles)	Total Supply: 8-hour Operation Case* (Veh-Hour)	Total Supply: 12-Hour Operation Case** (Veh-Hour)
(1) Off-Street Parking (Inside Buildings)	7,664	61,300	92,000
(2) Off-Street Parking (Open Air)	4,288	34,300	51,500
(3) On-Street Parking	5,111	40,900	61,300
(4) Total Off-Street Parking Supply: (1)+(2)	11,952	95,600	143,400
(5) Total Off-Street Parking Demand	-	52,000	52,000
(6) Total Demand if On-Street Parking*** is Removed to Off-Street: (3)+(5)	-	92,900	113,300
Off-street Parking Demand/Supply Ratio: (5)/(4)	-	0.54	0.36
Demand/Supply Ratio if On-Street Parking is Removed to Off-Street: (6)/(4)	-	0.97	0.79

Note: *Assuming 8-hour operation from 8:00 to 16:00.
** Assuming 12-hour operation from 6:00 to 18:00.
*** On-street parking demand is assumed to be equal to the current capacity of on-street parking.
Source: Estimation by JICA Study Team, based on Parking Facility Survey (for parking duration) and data from AGETU (for parking capacity)

Furthermore, if all the on-street parking is to be removed from the roads in Plateau to off-street parking, the total off-street parking demand will increase by 5,100 vehicles and, consequently, the ratio of the demand to the supply will increase close to 1.0, especially in the case of 8-hour parking operation. Furthermore, taking various conditions into account, such as the above-mentioned hourly concentration of parking demand, countless parking vehicles overflowing from the designated on-street parking spaces and a continuous increase in the private vehicle trips, construction of additional parking facilities is urgently necessary in Plateau to clear away the current on-street parking from the roads to utilize the road space for public transport and private vehicle traffic.

Moreover, for the long term, local planning authorities should stipulate the requirement of supply of parking spaces for development on private land. In addition, control guidelines for development, such as a building code, should be prepared.

As proposed by AAD[12], additional parking facilities are planned in Plateau and the locations are presented in Figure 4.5. Some busy streets are proposed to be converted to pedestrian streets that are closed to private vehicles except for public transport. Furthermore, a planned road-widening project on Voie Triomphale (currently Boulevard Carde) should also be implemented, along with development of

[12] Direction des Transports, *Proposition de Decongestion du Traffic Urbain*, District d'Abidjan, August 2011.

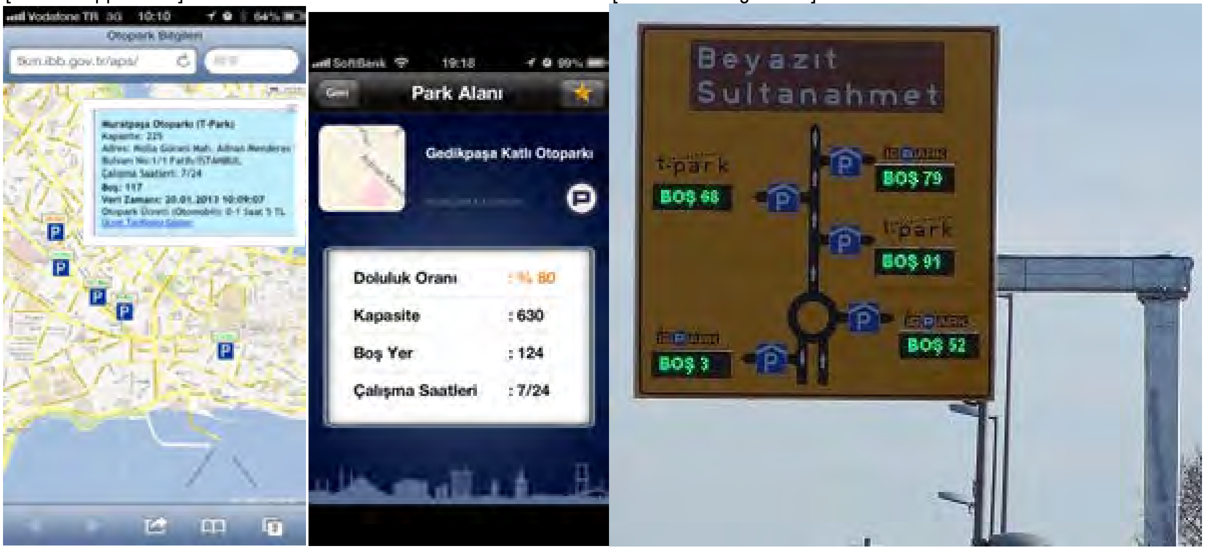
parking facilities. Thus, the total additional capacity of those parking facilities should add to the existing parking capacity in order to take away parking vehicles from the roadside in Plateau.

Source: JICA Study Team, based on data from AAD

Figure 4.5 Additional Parking Facility Development in Plateau

When those additional parking facilities have been developed, a parking information system will be necessary, guiding car users to the most appropriate public and private parking lots along with providing parking availability information through information devices such as parking information signboards (Figure 4.6). It will also help to reduce on-street parking vehicles and queues waiting to enter parking facilities in the central area.

[Internet Application] [Information Signboard]



Source: Traffic Demand Management of Historical Area in Istanbul (iSTDM) by JICA

Figure 4.6 Examples of a Parking Information System (Istanbul)

4.2.2 Park & Ride System

Construction of fringe parking facilities is also critical for facilitating intermodality between private vehicles and public transport systems throughout Greater Abidjan. New parking facilities should be developed in the major intermodal nodes, namely, the transfer points between arterial roads and high-capacity corridor (i.e., BRT, railway, or lagoon transport) stations to promote Park & Ride, which provides parking lots for private car users to transfer to public transport, especially at the proposed intermodal transportation terminals outside the urban area.

While a further study is necessary to estimate the scale of the parking facilities to be used for the Park & Ride system, Figure 4.7 shows the expected number of passengers at each high-capacity corridor terminal that is described later. The potential demand of parking facilities for Park & Ride will be proportional to the number of passengers. That is, it is assumed that a certain percentage of mass transit users will utilize the Park & Ride system.

Source: JICA Study Team

Figure 4.7 Proposed Park-and-Ride Facilities and Projected Daily Number of Passengers (2030)

4.2.3 Other Measures for Parking Problems

Current parking regulations, especially for on-street parking, need to be reassessed drastically to guarantee a more efficient use of roads and to secure the rightful capacity of the proposed road network. Longer term, parking problems should be solved through regulations related to parking. Local planning authorities should stipulate the requirement of supply of parking spaces for the development on private land.

First, control guidelines for development—such as a building code in which new high-rise buildings of five stories or more, for example, must be constructed with sufficient parking space to accommodate parking vehicles—should be prepared. Another regulation would require residents in the city to secure an off-street parking space before obtaining a car. This regulation would be directly effective in reducing on-street parking, and it has been applied in some cities in the world.

Meanwhile, in the shorter term, there are some intermediate measures for parking on existing arterial roads in commercial areas where there seems to be no clue for solving the parking problems, such as:

- (Metered) on-street parking on nearby local streets instead of the arterial roads with high traffic demand
- Utilization/sharing of backyard parking space, or wherever there is some space available

- Provision of common loading/unloading area for commercial trucks
- (Metered) on-street parking allowed only in daytime, off-peak hours, if the above measures seem to be insufficient for solving the parking problems

However, it should be noted that the above measures are just temporary solutions. That is, customers coming to such commercial areas by private car should eventually shift to public transport to create a transit-oriented urban environment.

4.3 Introduction of a Pricing Policy in the CBD

4.3.1 Road Pricing

It is obvious that future transport demand in Abidjan cannot be satisfied by private cars. To curb the growth of private car use and encourage the shift to public transport, direct traffic demand control, through some kind of a pricing policy in the CBD, is required. In Europe, after Norway became the first country in the world to introduce automatic toll collection for road usage in 1986, many countries implemented traffic demand control through road pricing.

Road pricing is one of the main road transportation control measures to alleviate traffic congestion and reduce air pollution. It mainly charges passenger car users passing through designated roads, in order to minimize unnecessary utilization of passenger cars and divert users to public transport. It also has an important objective to specify the revenues collected from road pricing as the funds for transportation system improvement.

In the case of Abidjan, it is relatively easy to apply road pricing in the CBD (i.e., Plateau) as it is surrounded by the lagoon and there are a limited number of entry roads. The target area for pricing is presented in Figure 4.8 along with the proposed tollgates. Taking the entire area of Plateau as a restricted area, entering vehicles are charged a fee. The existing two bridges connecting Plateau and Treichville will also be charged for road pricing.

Road pricing can also help to reduce the volume of heavy vehicles by charging those who are passing Plateau and diverting them to other routes to/from the Port of Abidjan such as the Third Bridge, and other planned bridges crossing the lagoon. Above all, after the Third Bridge and Vridi Bridge (project code: V-7-4) have been constructed in the short term (i.e., by 2020), there will be another primary arterial access to the port via these two bridges in addition to the existing route through Felix Houphouet Boigny Bridge. By adjusting tolls and road pricing charges on these two routes, it will be possible to motivate heavy vehicles to avoid passing through Plateau even if the route via Plateau is the shortest to the destination. Furthermore, Abidjan Autonomous District currently intends to propose a regulation that heavy vehicles must not pass the General de Gaulle Bridge and Boulevard in order to control the volume of heavy vehicles to/from the port. Thus, it should also be noted that traffic monitoring equipment for road pricing may also help to exercise control the entry of heavy vehicles on the General de Gaulle Bridge.

Source: JICA Study Team

Figure 4.8 Proposed Target Area and Toll Gates for Road Pricing

However, it should be noted that, for implementation of road pricing, alternative routes to avoid the road pricing charge must be provided for automobiles. In other words, most of the proposed road network, including the ring road and additional bridges, must be completed prior to the implementation of road pricing. Furthermore, verification with an electronic vehicle registration database, along with a bank payment system, will be necessary for toll collection and to deal with violating vehicles. Hence, implementation of the road pricing is suggested for the long term (2026 to 2030).

4.3.2 Parking Pricing

As an alternative to the above-mentioned road pricing, parking vehicles, whether they may be located on- or off-street, should be charged a fee, which is also expected to bring about considerable revenue for infrastructure investment. Furthermore, as the parking fees become higher, it will eventually deter private vehicles from entering the CBD and prompt them to shift to public transportation. Thus, this situation can be relatively easily controlled. This concept is called parking pricing and is often utilized as an effective TDM policy. However, consideration must be given to the fact that business and commercial activities along the roads, especially in the CBD, may also benefit or suffer from any action or decision. Providing sufficient nearby off-street parking facilities (as mentioned above), as well as common on-street loading/unloading zones, should also be the basis for this system.

4.3.3 Impact on the Travel Demand

Total future daily trips to/from Plateau by purpose and by mode in the cases with and without a pricing system, whether it is road pricing or parking pricing, are presented in Table 4.4. A fee of 1,000 FCFA per trip (based on the maximum daily parking fee that is assumed by AAD[13]) was assumed for this estimation and applied to all auto trips to/from Plateau. For all purposes, total trips by transit will be gaining a significant share; whereas the auto mode will be losing share accordingly. Thus, the pricing scheme is expected to have a direct effect in shifting auto users to public transport.

Table 4.4 Comparison of Total Future Trips to/from Plateau: Cases With and Without a Pricing Scheme

Trip Purpose	Future Person Trips (2030): Master Plan Case (Without Pricing)				Future Person Trips (2030): Master Plan Case (With Pricing)			
	Auto	Transit	Walk	All Modes	Auto	Transit	Walk	All Modes
Home-To-Work	356,000 (23%)	1,060,000 (68%)	137,000 (9%)	1,553,000 (100%)	291,000 (19%)	1,136,000 (73%)	137,000 (9%)	1,564,000 (100%)
Home-To-School	150,000 (21%)	505,000 (70%)	68,000 (9%)	723,000 (100%)	113,000 (16%)	547,000 (75%)	69,000 (9%)	729,000 (100%)
Home-To-Other	488,000 (65%)	203,000 (27%)	56,000 (7%)	747,000 (100%)	401,000 (53%)	297,000 (39%)	56,000 (7%)	754,000 (100%)
Total	994,000 (33%)	1,768,000 (58%)	261,000 (9%)	3,023,000 (100%)	805,000 (26%)	1,980,000 (65%)	262,000 (9%)	3,047,000 (100%)

Note: Unit: trips per day.
An additional fee of 1,000 FCFA per trip is charged for auto trips.
Source: JICA Study Team

Focusing on the trips to/from Plateau, based on the Household Interview Survey conducted in 2013, approximately 58,000 vehicles travel to/from Plateau per day. In the future, for example in 2030, if no pricing is applied, the Study team forecasts that about 994,000 person trips, or, assuming the same average occupancy ratio of 2.41 persons per passenger car, 412,000 vehicle trips per day, which is over seven times as many as the current level, will travel to/from Plateau. On the other hand, the Study team forecasts that, with a pricing scheme of 1,000 FCFA per trip, the total vehicles that will be traveling to/from Plateau will be 805,000 person trips or 334,000 vehicle trips per day, which will lead to about 19% reduction of the vehicle trips to/from Plateau.

4.4 Public Transport Support System

4.4.1 Dedicated Bus Lanes

In the context of urban transportation, public transport should be given priority over private vehicles to secure smoother travel for those who use public transport within the limited road space. Hence, the current partial dedicated bus lanes should be extended more continuously on the urban arterial roads to form a continuous, smooth network for buses, thereby serving like a BHLS, as presented in Figure 4.9. It should be noted that the dedicated bus lane development is mainly for the feeder-type bus lines serving the high-capacity corridor stations (including high-speed ferry stations), while some line-haul

[13] ibid.

type bus lines will also utilize dedicated bus lanes along the radial roads. By securing a relatively high operating speed, the time schedule can also be foreseen, consequently reducing the waiting time and thereby attracting more passengers. It should also be noted that the dedicated bus line network would be a prototype of BHLS or other mass transit by expanding the fleet size and frequency, along with designated platforms, when the demand grows in the longer term.

Source: JICA Study Team

Figure 4.9 Development of Dedicated Bus Lanes in Abidjan

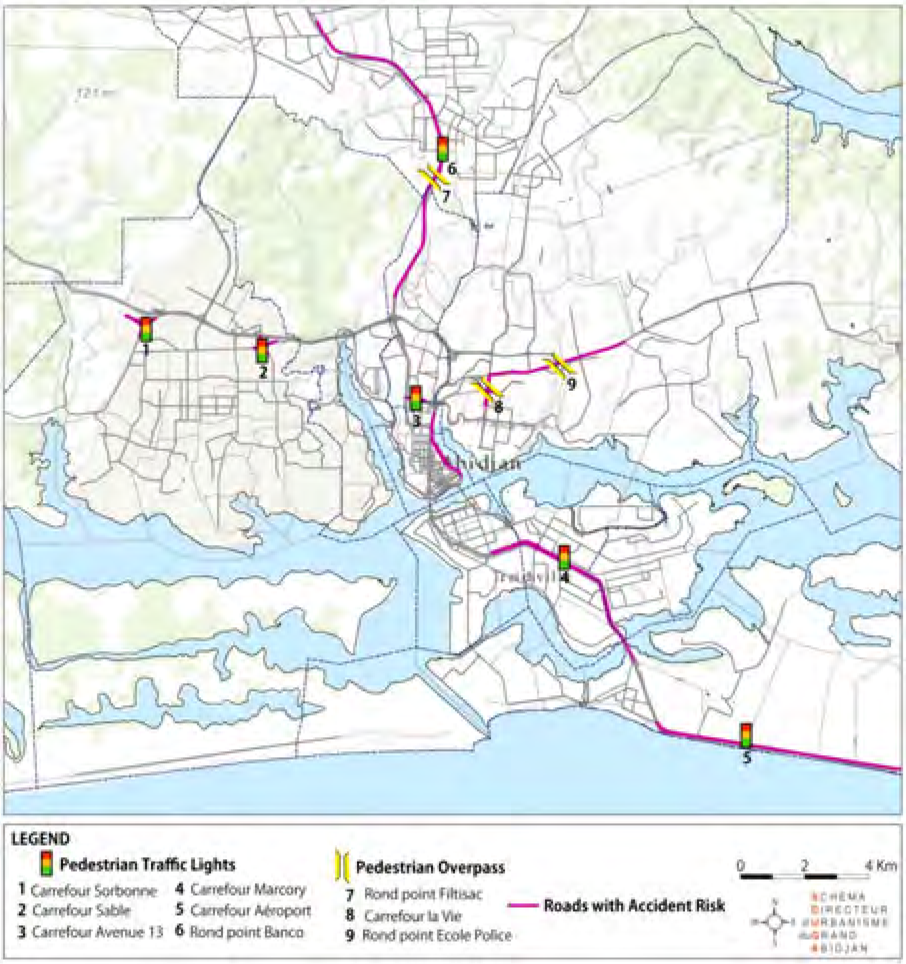
4.4.2 Other Public Transport Support Measures

The public transport system is a key element in providing good and affordable mobility to the majority of people. However, the existing bus system is not receiving favorable treatment in the road-based transport system, and the current bus service may not attract more passengers because it is substandard in many aspects.

There are various bus priority measures that can make bus service more attractive. In addition to the above-mentioned dedicated bus lanes and bus priority signals, bus contra-flow lanes, exemption of buses from turning restrictions and sheltered bus stops are examples of hardware improvement. Meanwhile, punctuality and adherence to timetables, public transport location (or operation monitoring and control) system, various discounted fares across different public transport modes, automated fare collection (or transportation IC-card) system and longer operating hours are operational improvement measures for better public transport service.

4.5 Pedestrian Facilities for Better Environment

According to the Household Interview Survey (HIS), the most preferred mode of transport by the citizens in Greater Abidjan is "on foot". However, pedestrian facilities, especially along the busy main roads in the city, are insufficient in number. In order to reduce accidents involving pedestrians and to ensure safety, more pedestrian facilities such as crosswalks, pelican crossings, and pedestrian bridges/underpasses should be provided. Proposed intersections that need improvement for pedestrians, especially for safe crossing, are presented in Figure 4.10. In addition, narrow or poorly maintained sidewalks along the urban roads need to be improved, since sidewalks of good quality will enhance not only pedestrian safety but also the urban amenity and environment.



Source: JICA Study Team

Figure 4.10 Proposed Locations for Pedestrian Facility Improvement

4.6 Other Traffic and Road Management

Although many works have been planned, geometric improvement is still an effective method for alleviating congestion at intersections or bottlenecks. With the change in traffic demand and pattern over time, modification of the existing geometry may be necessary. Traffic regulation, including a one-way system, may need review, and modification and additional installation of traffic control devices may be effective.

The capability of the staff in charge of traffic management in AGEROUTE should be strengthened. The program will consist of the following three parts:

- Preparation of standard manual for traffic signs, signal design, pavement markings and other traffic control devices,
- A series of workshops on the basics of traffic engineering, and
- On-the-job training of traffic engineering improvement.

Furthermore, for management of the roads, the following programs are proposed by utilizing advanced technologies, including ITS:

- Development of a road-surface-condition survey system, to collect information on road surface conditions, such as abrasions, pot holes, falling obstacles, etc.;
- Development of road management system of information on maintenance works, to disseminate the information about traffic restriction caused by road works to reduce traffic congestions; and
- Development of asset management system, to perform high-level, cost-efficient maintenance of the road assets, including bridges, tunnels and pavements.

4.7 Traffic Control and Management Projects

As discussed in Part 6 of this report, traffic control and management projects are proposed along with the project profiles, and overall evaluation of the projects was made along with quantitative and qualitative evaluation criteria such as coherence with visions, urgency, necessity, implicit feasibility, and social acceptance, to sort them into projects to be implemented in the short term (i.e., 2015 to 2020), medium term (i.e., 2021 to 2025), and long term (i.e., 2026 to 2030). The final traffic control and management development projects proposed by the Study team are listed in Table 4.5.

Table 4.5 List of Traffic Control and Management Projects

G	Traffic Control and Management Plan																
G-1	Development of Traffic Control System																
G-1-1	Development of Area Traffic Control System	■	■														
G-1-2	Development of Public Transport Priority System				■	■											
G-1-3	Development of Urban Traffic Information System	■	■														
G-2	Development of Public Transportation System																
G-2-1	Development of Dedicated Bus Lanes		■	■	■												
G-2-2	Implementation of Transportation IC-Card System											■	■	■			
G-2-3	Development of Bus Operation Monitoring and Control System								■	■							
G-2-4	Development of Public Transportation Operation Information Provision System										■	■					
G-3	Parking System Development																
G-3-1	Development of Parking Facilities/Parking Information System		■	■	■												
G-4	Development of Expressway System																
G-4-1	Development of Highway Traffic Control System					■	■	■									
G-4-2	Development of Electronic Toll Collection System												■	■	■		
G-5	Traffic Enforcement Assistance																
G-5-1	Development of Overloaded Truck Control System		■	■	■												
G-5-2	Development of Road Pricing System														■	■	■
G-5-3	Supporting System for Control of Illegal Parking									■	■	■					
G-6	Traffic Safety Assistance																
G-6-1	Pedestrian Facility Development for Better Environment	■	■	■													
G-7	Road Management																
G-7-1	Development of Road Surface Condition Survey System							■	■	■							
G-7-2	Management System of Information on Road Maintenance Works										■	■	■				
G-7-3	Development of Asset Management System															■	■

Source: JICA Study Team

4.7.1 Short Term (2015 to 2020)

For the short term, most of the traffic control and management projects that are considered as priority and could be relatively easily implemented, such as those for development of a traffic control system, have been proposed. Other urgent transportation control measures, such as development of dedicated bus lanes, parking facilities, pedestrian safety facilities and an overloaded truck control system, have also been prioritized as short-term projects.

4.7.2 Medium Term (2021 to 2025)

There are several traffic control and management projects that are expected to bring about full benefit only after completion of the road or public transport infrastructures, such as bus location and information systems, a common fare system for public transport, illegal parking control support and road management and maintenance systems. Thus, those projects are scheduled in the medium term. Development of some projects also has a prerequisite of an "advanced" system in the society, such as cooperation with a bank payment system and legislation for penalties regarding traffic violations, including illegal parking.

4.7.3 Long Term (2026 to 2030)

Though most of the traffic control and management projects in Abidjan will be developed in the medium term, the remaining projects such as development of electronic toll collection and road pricing systems have been scheduled in the long term. Since they are considered to bring about significant impact on people's travel behavior, completion of all the transport projects will be necessary before implementation of these projects. Moreover, a comprehensive electronic vehicle registration database is also essential not only for Abidjan but also for the entire country. Thus, these projects should be studied and planned well in advance for smooth implementation.

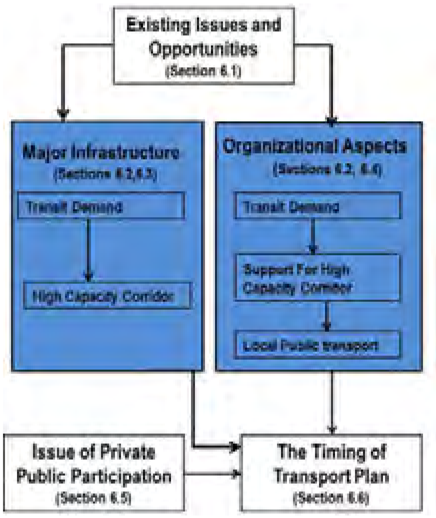
5.0 Public Transport Development Plan

5.1 Issues and Opportunities

5.1.1 An Overview

This chapter sets forth recommendations regarding public transport services until the year 2030. The adopted approach synthesizes policy (software, humanware) with fleet and infrastructure (hardware) aspects of public transport services. These are developed initially on a sectorial basis, and then integrated with the overall Transport Master Plan. The adopted approach consists of a series of linked and cascading work patterns, as depicted in Figure 5.1.

The section includes first an overview summary of the existing modal perspective together with an insight into issues, opportunities and constraints representative of recent operating conditions of the major public transport modes. The next section focuses on transit demand with particular reference to the high-capacity corridors. The third section of this chapter provides a detailed description of the high-capacity transit corridors and their associated hardware or infrastructure. The next section discusses the upgrade of local transport and the realignment of existing local services to support the high-capacity corridors, an issue related to both software and humanware. This section includes a discussion on the overall organizational structure of public transport in Abidjan. The penultimate section addresses the relevance of the private sector in the promotion of public transport infrastructure in Abidjan. The last section of this chapter is a review of the necessity of transport projects within the framework of the implementation timeline.



Source: JICA Study Team

Figure 5.1 Public Transport Analytical Framework

5.1.2 Issues and Opportunities

Over the last 10 years, there has been a continuous decrease in the usage of the formal public transport system in Abidjan. This is clearly shown in earlier chapters that trace the declining number of passenger boardings on the public SOTRA bus services. In 1998[14], the modal share of public transport trips for SOTRA buses was 24%, with the informal sector of Gbaka and Woro-Woro accounting for a further 25% and 17% of trips, respectively. By 2013, the modal proportion of bus and Woro-Woro had reversed in a significant shift away from the formal transport sector. Woro-Woro accounted for 52% of person trips in 2013 with SOTRA buses accounting for a mode share of only 12% among all public transport modes. This modal shift from the formal sector has occurred because of several possible reasons, with the most likely being:

- Lack of proper infrastructure (i.e., bus exclusive lanes), which would separate the bus operation from traffic congestion;
- Decrease in size of the bus fleet, due in part to the financial constraints, causing an overcrowding situation on buses and impairing the quality of service, such as frequency and coverage;
- Flexibility of the informal sector; and
- Increase in vehicle ownership.

At present, there are few policies in place to support the goal of access to enhanced mobility for all in Greater Abidjan, especially in relation to a shift from the informal sector to the formal sector. The polices that need adoption must be guided to provide a comprehensive and integrated public transport network that is convenient, user-friendly and accessible to all income groups to serve all urban centers, both district and neighborhood, whilst providing access to local community facilities, employment centers, leisure and potential tourism sites such as Grand Bassam. The SDUGA public transportation proposals will promote the following key initiatives in relation to public transport, namely:

- Promotion of High-Capacity Transit Corridors;
- An enhanced bus system; and
- A review of the informal public transport sector.

The recommendations contained in this chapter prescribe a series of logical and needed enhancements to public transport. However, as a master plan document, it cannot (and should not) address detailed matters pertaining to, for example, route-by-route analyses. These must be a topic of further, follow-on work once the policy and political ramifications of the proposed Transport Master Plan are in place. Recommended priority projects, in particular those related to public transport, whose implementation is seen as being of the highest priority and for whom more detailed feasibility studies will follow immediately after completion of the Master Plan phase, take full account of this consideration. Priority projects are, along with other elements of the integrated Master Plan, presented in Part 5 of this report.

In terms of urban transportation, priority must be given to the mobility of people, not cars. In that context, public transportation will have priority over private vehicles to secure smoother travel for those who use public transportation. The capacity of a car is five to six people whereas the capacity of a bus is 50 or more people. The road system is a limited resource that one must use efficiently.

[14] Source: World Bank

5.2 Transit Demand in 2030

5.2.1 An Overview

By 2030, the anticipated population growth of Greater Abidjan will result in an increase of nearly 60% over the 17-year period from 2013. The number of motorized person trips[15] will almost double in number over the same period. This will place a significant strain on the existing transport infrastructure, including public transport. This, then, is a catalyst for improvements in both the formal and informal sector of public transport. As part of the solution, SDUGA has proposed the creation of high-capacity transit corridors with the appropriate hardware. The introduction of these high-quality routes will require, initially, consideration for an appropriate fare structure. The current fare structure of public transport cannot be readily applicable to these high-capacity routes.

5.2.2 Appropriate Fare Structure for High-Capacity Transit Corridors

For these high-capacity transit corridors there is a need for a reference fare. The initial setting of such a reference fare for the transport infrastructure within the high-capacity transit corridors is not without difficulties. The team understands the importance of this issue. If the reference fare is too low, the infrastructure will attract too high a number of passengers. This will require a high level of infrastructure whilst possibly not collecting sufficient revenue for maintenance. Alternatively, with a high reference fare, the infrastructure will attract a low number of passengers. These two alternatives at the end of the spectrum suggest that the public transport fare structure needs to be in balance with the economic situation of the people within Greater Abidjan.

The Transportation Opinion Survey (TOS)[16] undertaken by SDUGA enabled the Study team to gauge an appreciation of fare sensitivity. In particular, interviewees were asked the question of would you pay a certain amount of money to travel between Anyama and Plateau or, alternatively, between Abobo and Plateau. In both cases, 30% of the respondents indicated that they were prepared to pay 700 FCFA and 500 FCFA respectively for the specified journey. This is equivalent to a distance-based fare with a boarding fare of 300 FCFA plus 20 FCFA per kilometer. With the understanding that there is an underreporting of propensity to travel on new systems, a reference fare for initial analysis was set at a boarding fare of 300 FCFA plus 30 FCFA per kilometer.

In comparison from the HIS, it is estimated that the average fare to travel by Woro-Woro between Anyama and Plateau or, alternatively, between Abobo and Plateau is estimated on average at 550 and 450 FCFA, respectively, if a SOTRA non-express bus is used for the last segment of the trip. On the stipulation that a SOTRA express bus is used for the last leg of the trip, then, this fare would increase by 300 FCFA to 850 and 750 FCFA respectively. Alternatively, the cost of taxi fare is estimated between Anyama and Plateau or, alternatively, between Abobo and Plateau at 2,900 and 1,500, respectively.

The average cost of the ticket at the reference fare on the new rail system is estimated between Anyama and Plateau or, alternatively, between Abobo and Plateau at 1,000 and 750, respectively. This fare has been set as the reference fare on all high-capacity corridors. Currently, the informal sector sets its own fee that is often temporally dependent, whereas the government controls the existing public transport

[15] Mechanized person trips include all person trips except walk trips.
[18] Fare estimated via a linear regression analysis of modal trips from the SDUGA Home Interview Survey.

sector fare. Currently in Abidjan, residents of Abidjan spend significant money on public transport with those from non-vehicle-owning households spending up to 15% of their monthly income, whilst those from vehicle-owning households are observed to spend only around 7% of their monthly income on public transport[17].

Equity means that a certain minimum level of mobility should be assured and provided for all members of the society. Not only automobiles but also all modes of transport should have a right to share the public space and travel around the city freely and safely in order.

On the other hand, some low-income people cannot afford to pay expensive transportation cost. Some socially vulnerable people, including the aged and the handicapped, have difficulties in their mobility. An affordable and sufficient level of transportation services should be provided for those people, especially by improving the existing public transport system. This implies that, even with the introduction of the high-quality service, the existing SOTRA bus service needs maintaining. However, from the above discussion, it is apparent that the proposed fare structure for the high-capacity corridors is not unreasonable. For reference, the estimated fares for other transport infrastructure services are provided in in comparison with the proposed high-capacity corridor fare structure.

Table 5.1 Fare Structure of Major Modes[18]

Mode	Boarding Fare (FCFA)	Additional Fare per km (FCFA)
SOTRA Standard (Bus and Water Bus)	200	-
Informal Lagoon Transport	100	-
SOTRA Express	500	-
Gbaka	200	16
Woro-Woro	150	25
High-Capacity Corridors - Reference Fare	300	30

Source: JICA Study Team

5.2.3 Demand on High-Capacity Corridors

The number of passengers expected to be attracted to the transit modes in 2030 is around15 million[19], a doubling of the existing public transport passengers. It is unnecessary to state the obvious that the public transit structure could not cope with this level of increase in demand, as stated earlier. Public transport supply must increase in line with the demand. A road-centric public transit system with the existing supply of hardware reliant on bus, Gbaka and Woro-Woro could not meet this demand. This forms the logic for the development of high-capacity transit corridors. The infrastructure on these corridors will move people around the city quickly, efficiently and safely. These high-capacity transit corridors will contribute to the development of Abidjan encouraging dense compact land use whilst linking Anyama, Grand Bassam, West Yopougon and Bingerville by direct and circumferential routes as well as the two outlying centers of Bonoua and Dabou.

[18] Fare estimated via a linear regression analysis of modal trips from the SDUGA Home Interview Survey.
[18] Fare estimated via a linear regression analysis of modal trips from the SDUGA Home Interview Survey.
[19] All future demand analysis mentioned in this chapter of the report refers to the demand results from the SDUA transport model.

The high populations along the three heaviest such high-capacity transit corridors, described in detail in the next section and as seen in Figure 5.2, are tabulated in Table 5.2. The north-south corridor, henceforth known as the Blue Line[20], will have in 2030 around one and a half million people within one kilometer and more than two and half million people within two kilometers of the alignment.

The southern ferry west-east corridor, henceforth known as the Purple Line, will have in 2030 around a half million people within one kilometer and more than one million people within two kilometers of the alignment. This is a one-sided catchment, as the other side of the catchment is the lagoon. The northern west-east corridor, henceforth known as the Red Line, will have in 2030 around a million people within one kilometer and nearly two million people within two kilometers of the alignment.

Table 5.2 Population Adjacent to the Alignment of Selected Lines[21]

Transit Line	Brief Description of Corridor	Radius (Distance from Alignment)	Population (Thousands)	
			Year: 2013	Year: 2030
Blue Line	Anyama to Grand Bassam	Within 1 kilometer	1,159	1,339
		Within 2 kilometer	2,186	2,535
Purple Line	Songon to Bingerville	Within 1 kilometer from Waterfront	465	573
		Within 2 kilometer from Waterfront	834	1,023
Red Line	Western Yopougon to Bingerville	Within 1 kilometer	832	928
		Within 2 kilometer	1,500	1,704

Source: JICA Study Team

With these high levels of population adjacent to the corridor, any planned high-capacity transport infrastructure should attract significant passengers. Table 5.3 provides passenger forecasts attracted to these corridors and the other remaining five high-capacity transit corridors, including the high-capacity transit bus routes.

As one might expect, the highest demand is on Phase one of the Blue Line, which is expected to attract in excess of 2,371,000 passenger boardings per day by the year 2030. The second phase of the Blue Line will attract a further 382,000 passengers in 2030, totaling more than six million passengers per day on the completed Blue Line. The maximum line loading on the Blue Line in 2030 is 72,000 passengers per hour per direction[22].

The Red Line is expected to attract around 1,836,000 passenger boardings per day in 2030, whilst the Purple Line, including its planned extension, will attract 921,000 passengers per day in 2030. In 2030, the maximum line loading on the Red and Purple Lines are 51,000 and 26,000 passengers per hour per direction in 2030.

In 2030, the combined BRT routes planned from Abobo to and Brake Industrial estate to Adjame will attract a combined patronage of nearly 534,000 passengers. The two proposed BHLS[23] routes attract a patronage of 364,000 in 2030.

[20] The Blue Line is also referred to as the Urban Railway Project. This project was also incorporated in earlier proposals by two consortia, namely, SCET-TUNISIE, in collaboration with SYSTRA & CECOTID, and Dongsan Engineering Korea Consortium.
[21] The population within the alignment of the corridors is sourced from the SDUGA transport-modeling database.
[22] The volume of passengers per hour per direction determines the rolling stock requirements, commonly referred to as the system sizing.
[23] The BHLS, a bus concept, is described in the next section.

Table 5.3 Estimated Passenger Boardings on the High-Capacity Corridors[24,25]

Transit Line	Brief Description of Corridor	Project Code	Year	Daily Passenger Boardings	Maximum Load (Passengers per Hour per Direction-pphpd)
Blue Line Phase 1	Rail - Anyama to Grand Bassam	T-1-1	2025	1,835,600	51,000
			2030	2,371,300	72,200
Blue Line Phase 2	Rail - Airport to Grand Bassam	T-1-2	2030	382,200	25,100
Red Line	Rail - Western Yopougon to Bingerville	T-1-3	2025	1,404,400	55,900
			2030	1,864,400	68,600
Purple Line	High-Speed Ferry- Songon to Bingerville	T-4-1	2020	437,000	15,000
			2025	598,000	23,000
			2030	622,000	26,000
	High-Speed Ferry- Bingerville to Airport and Grand Bassam	T-4-1	2020	60,100	2,600
			2025	186,200	10,400
			2030	299,100	16,800
Green Line	Water Bus - Attecoube to Treichville	T-4-2	2020	407,600	20,200
			2025	461,300	24,000
			2030	430,400	21,800
BRT	Brake Industrial Estate to Adjame	T-2-1	2025	95,700	10,500
			2030	97,800	9,400
	Abobo to Koumassi Phase 1	T-2-2	2020	26,700	2,200
			2025	133,300	6,500
			2030	147,700	6,800
	Abobo to Koumassi Phase 2	T-2-3	2025	173,000	5,300
			2030	288,600	11,500
BHLS	Bonoua to Bingerville	T-2-4	2030	121,700	7,700
	Dabou to Western Yopougon	T-2-5	2030	242,500	11,300

Source: JICA Study Team

[24] These passenger forecasts also include the impact of "Ramp Up" phenomena. "Ramp Up" is the phenomena whereby transport models tend to overestimate new high-order transport, especially in the early years of operation. The passenger boardings include interchange passengers. At present, only the forecast for Blue Line Phase 1 is available for any year other than the year 2030.

[25] The volume of passengers per hour per direction is an estimation of the peak hour load determined from the maximum daily load.

5.2.4 Fare Sensitivity Analysis

Consideration is given to the sensitivity of the reference fare. The fare sensitivity analysis is undertaken for the Blue Line, as this will likely be one of the earliest operational high-capacity transit corridors. This fare sensitivity analysis for the Blue Line is presented in Table 5.4.

Table 5.4 Fare Sensitivity Analysis of Blue Line

Option	Designated Fare (FCFA)		Fare for a 5 km Trip (FCFA)	Daily Passenger Boardings	% Difference to Reference Fare
	Boarding	Fare per km			
Reference Fare	300	30	450	2,753,000	-
Option 1	300	20	400	2,785,000	1.2
Option 2	400	20	500	2,502,000	-9.1
Option 3	400	30	550	2,504,000	-9.0
Option 4	400	50	650	2,455,000	-10.8

Source: JICA Study Team

Four sensitivity test options are shown in the aforementioned table. The first is for the same boarding fare as the reference case, whilst for the other three options the boarding fare is set at a higher level, at 400 FCFA. The average fare for a 5-kilometer trip is shown as an orientation of the relative fare structure.

The results are sensitive to the initial or boarding fare. If the distance portion of the fare remains constant at 20 or 30 FCFA per kilometer but the boarding fare increases from 300 FCFA to 400 FCFA, then the expected ridership will decrease by around 9%. This is the comparison between Option 1 and Option 2 and then between the reference case and Option 3 respectively.

In comparison, for a 5-kilometer trip, when the fare increase from 450 FCFA, the reference case, to 650 FCFA, Option 4, an increase of some 40% in the number of passengers will decrease by some 11%.

When detailed feasibility studies are undertaken for these high-capacity transit corridors, consideration will no doubt be given for the introduction of an electronic ticketing scheme to make travel between different modes seamless.

5.3 High-Capacity Transit Corridors

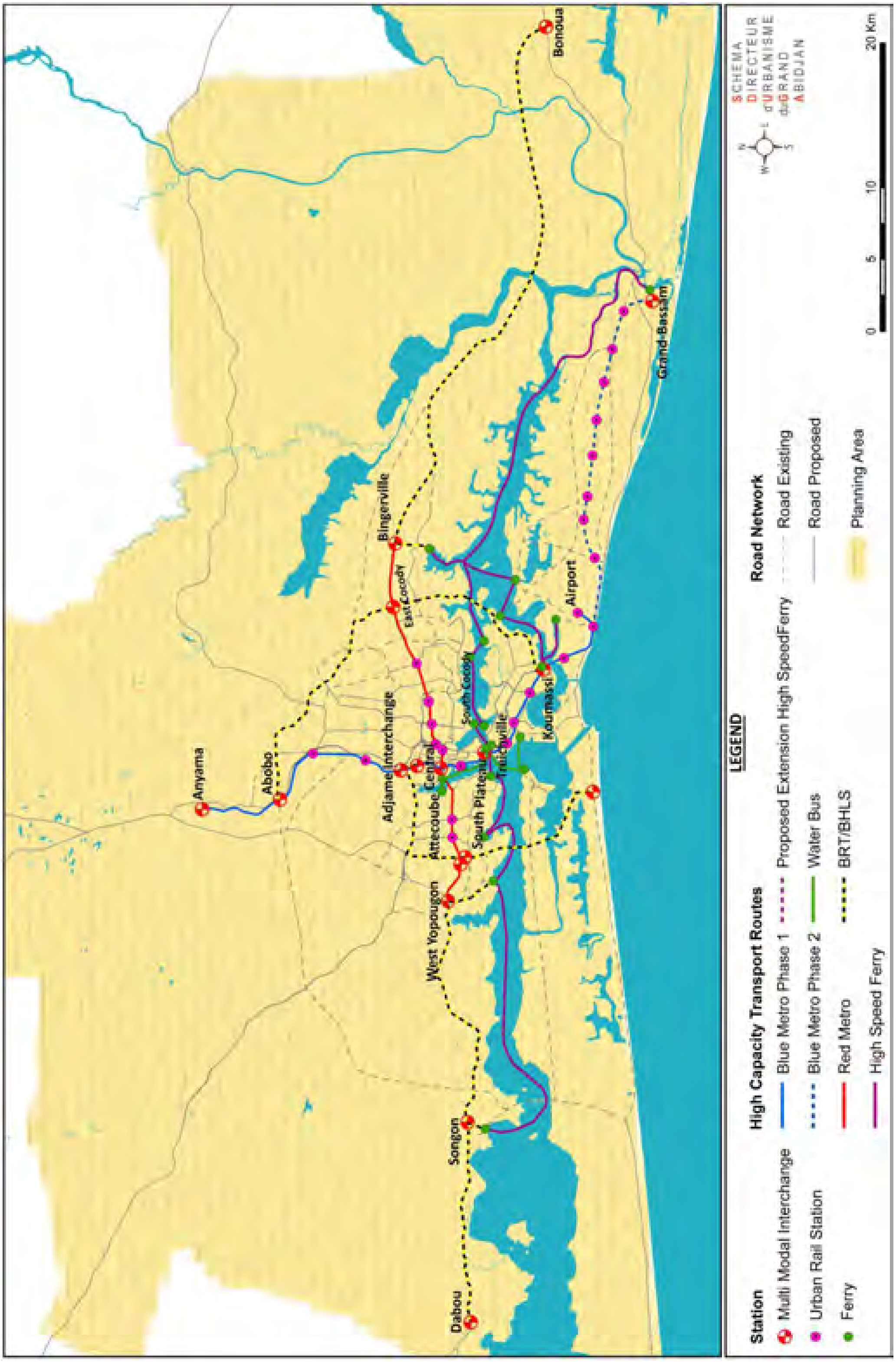
5.3.1 An Overview

There are eight proposed high-capacity corridors, as stated earlier. These corridors are depicted in Figure 5.2 for the Planning Area and in detail in Figure 5.3. The eight proposed corridors are now designated as follows:

- Blue Line - Anyama to Grand Bassam;
- Red Line - Western Yopougon to Bingerville;
- Purple Line- Songon to Bingerville;
- Green Line - Attécoubé to Treichville;
- BRT
  - Brake Industrial Estate to Adjame;
  - Abobo to Koumassi; and
- BHLS
  - Bonoua to Bingerville;
  - Dabou to Western Yopougon.

Rail is the designated technology for the Blue and Red Lines, whilst a high-end ferry will run on the Green and Purple Lines. BRT[26] is the preferred option on the two high-capacity bus routes starting from Abobo, whilst BHLS is the preferred route on the outer city connections from Bonoua and Dabou that are planned to link to the eastern and western termini of the Red Line, respectively. This section includes a discussion on the confirmation choice of the technology hardware.

[26] BRT is Bus Rapid Transit, whereas BHLS is Bus with High Level of Service.



Source: JICA Study Team

Figure 5.2 Public Transport High-Capacity Corridors

Source: JICA Study Team

Figure 5.3 Detail of Abidjan High-Capacity Corridors

5.3.2 Detailed Description of the Corridors

The high-capacity transit corridors are described below, although all stations are intermodal in some form. The locations of the more significant intermodal and park-and-ride stations form highlights within the following discussion.

(1) Blue Metro Line

The first phase of this line commencing from Anyama includes six stations north of Central[27], the intersect station of the two metro lines and a further nine stations to the south, terminating at the airport. The stations on average are spaced at approximately every two kilometers.

The second phase of the Blue Line includes an extension from the airport to Grand Bassam with further nine stations along the intermediate axis between the northern coast and the Abidjan – Bassam Highway. While the detailed route selection for the extension of the Blue Line should be studied in the Detailed Urban Master Plan (PUd) of the region or in the subsequent feasibility studies, the following constraints have been taken into account:

- Each station on the route should have a large enough catchment area of residents who are prospective users of the Blue Line. For this, it is also better to place the route away from the Abidjan – Bassam Highway, which may divide the residents' daily zone of life;
- A route along the northern or southern coast would cause traffic congestion on the east-west parallel road with a mixture of the through traffic and the traffic accessing the stations. It might further cause other problems such as coastal erosion, depression, and impairment of the landscape; and
- A route along the northern coast, in particular, would cost more for development of the area along the route to make it more viable, due to the currently existing low population.

The Blue Line intersects with other corridors of high-capacity transit, namely:

- Rail – At Central Rail Station with the Red Metro Line;
- BRT – At Abobo, Adjamé, and Koumassi;
- Water Bus – At Central and South Plateau stations;
- High-Speed Ferry – At South Plateau Interchange and the extension of the High-speed Ferry at Koumassi.

Besides the Central Railway Station, there are seven major multi-modal stations. The two terminal points at Anyama and Grand Bassam are designated as multi-modal stations. These two stations will also have park-and-ride facilities. The next station south of the northern terminal at Abobo is designated as an intermodal station as it is also the terminal of two proposed BRT services and there is a planned international bus station at this location. It is essential that good connectivity be established between the rail, BRT and the international terminal as well as local transit services.

Adjamé Interchange station is also designated as a multi-modal station as there is currently present at this location both a Gbaka and a SOTRA terminal. The station immediately north of this station will host the new, planned international bus station and likewise has the designation of a multi-modal station.

[27] Central is the designation of the interchange station between the Blue and Red metro lines. It is in this respect a location of potential major regional development. The Urban Master Plan, Part 2 of this report includes further discussion on this topic.

To the west of Central Station is the Green water bus station. An urban environmentally planned walk link between Central and the Green Line[28] will exist by 2030. Central station is planned for extensive urban rejuvenation.

Two stations further south is South Plateau, a major interchange station. This is the location where both water routes and Green and Purple Lines come together, as well as being a major existing SOTRA bus terminal. An international terminal[29] for trips from Ghana is under consideration at this location, provided authorities address security concerns. This site has significant advantage as a redevelopment site.

Further south on this line, a park-and-ride station is planned at Koumassi where the Blue Line meets the BRT route and the extension of the Purple Line, the high-speed ferry service.

(2) Red Metro Line

This line commencing from West Yopougon includes four stations west of Central and a further seven stations to the east of Central terminating at Bingerville. The stations on average are spaced at approximately every two kilometers.

The Red Line intersects with other forms of high-capacity transit, namely:

- Rail – At Central with the Blue Metro Line;
- BRT -At East Cocody and Central Yopougon Stations;
- Water Bus – At Central Station;
- High-Speed Ferry – Bingerville and West Yopougon terminal stations are close to the terminals of the high-speed ferry Purple Line;
- BHLS – At Bingerville and West Yopougon.

Besides the Central Railway Station, there are four major multi-modal stations. The two terminal points at West Yopougon and Bingerville are designated as multi-modal stations. These two stations will also have park-and-ride facilities. The station east of Central at East Cocody is designated as an intermodal station as there is a common station with BRT. In addition, a park-and-ride facility is planned for East Cocody.

(3) Purple High-Speed Ferry

In the future, high-speed ferry will operate at 22 knots (40 km/h) on this Purple Line. This line commences at Songon and terminates at Bingerville. There is also a spur line from Bingerville terminating at the northern part of the airport reserve via Koumassi. In addition there is a proposed extension of the service from Bingerville to Grand Bassam. There are four stations on the main service west of the South Plateau interchange station and a further four stations to the east. The spur line from Bingerville has four stations including the terminal stations, whilst the proposed extension has only a single final station at Grand Bassam.

The principal Purple Line intersects with other forms of high-capacity transit, namely:

[28] The urban plan allows for the development of a pleasant precinct to encourage walking between Central and the water bus station.
[29] The Ministry of Transport, Directorate of Marine Affairs and Ports initially considered this location for the international terminal for a boat service from Ghana. They were concerned about the security at this location so other sites are under investigation.

- Rail – At the South Plateau interchange;
- Green Water Bus – At the South Plateau interchange: and
- BHLS – At Bingerville and West Yopougon.

The spur line also intersects the BRT and the Blue Metro Line in Koumassi.

(4) Green Water Bus

The north-south water bus corridor is designated as the Green Line. This line commences at Treichville and ends at Attecoube. There are three stations north of the South Plateau Interchange station and a further three stations to the south.

The Green line intersects with other forms of high-capacity transit, namely:

- Rail – At the South Plateau Interchange and Central; and
- Purple Line – At the South Plateau Interchange.

In the case of the services on the lagoon, the Purple and Green Line, preliminary investigations undertaken by government agencies[30] on the physical characteristics of the locations of ferry stations or piers suggest that there are no engineering problems. However, this would need confirmation in an engineering feasibility study. The Ministry of Transport has developed a series of ToRs for strengthening the water/lagoon sector transport in 2013 but these have not proceeded further at this time due to a lack of resources.

(5) BHLS and BRT

There are four proposed bus corridors. A bus with high level of service (BHLS) will connect Dabou and Bonoua to the Red Line Metro at West Yopougon and Bingerville, respectively. Although the route between Bonoua and Bingerville will attract a high number of passengers, BHLS technology is preferred as there will be only limited stops and there is thus no need for the additional technology of BRT.

There are currently two planned BRT routes, the first commencing in Abobo and terminating in Koumassi. The second is from Brake Industrial Estate to Adjame. Park-and-ride stations are planned at Abobo, East Cocody and Koumassi.

The BRT line between Abobo and Koumassi is divided into two phases with the first phase finishing at Abobo. The station spacing along the BRT is between one and one and half kilometers at appropriate centers.

In summary, the key modal features associated with each corridor are shown in Table 5.5.

[30] The locations of some stations on the Purple line were modified to take account of preliminary investigation.

Table 5.5 Key Multi-Modal Locations

Transit Line		Multi-Modal Stations	International Terminals	Park-and-Ride Locations
Blue Metro		Anyama, Abobo, North Adjamé, Adjamé, Central, South Plateau, Koumassi and Grand Bassam	Abobo, North Adjamé and South Plateau	Anyama, Abobo, Koumassi and Grand Bassam
Red Metro		West Yopougon, Central Yopougon, East Cocody and Bingerville	-	West Yopougon, East Cocody and Bingerville
Purple High-Speed Ferry		Songon, South Plateau and Koumassi	South Plateau	Songon
Green Water Bus		Central and South Plateau	South Plateau	-
BRT	Brake Industrial Estate to Adjamé	Adjamé, Central Yopougon	-	Adjame
	Abobo to Koumassi	Abobo, East Cocody and Koumassi	Abobo	Abobo, East Cocody and Koumassi
BHLS	Bonoua to Bingerville	Bonoua and Bingerville	-	Bonoua and Bingerville
	Dabou to West Yopougon	Dabou, Songon and West Yopougon	-	Dabou, Songon and West Yopougon

Source: JICA Study Team

5.3.3 The Appropriate Technology

(1) Railway

Both the Blue and Red metro lines will attract passenger volumes in excess of 72,000 passengers per hour per direction (pphpd) by 2030 so that rail technology of some form is appropriate for these two lines[31]. The characteristics of land transport technologies are shown in Table 5.6.

Both the alignments of the Blue and Red Lines identified with the highest number of passengers require a high level of investment so it is therefore important that these two lines in particular are compatible with the urban development plan as seen in Figure 5.4.

There are certain technical issues associated with these two rail alignments, namely:

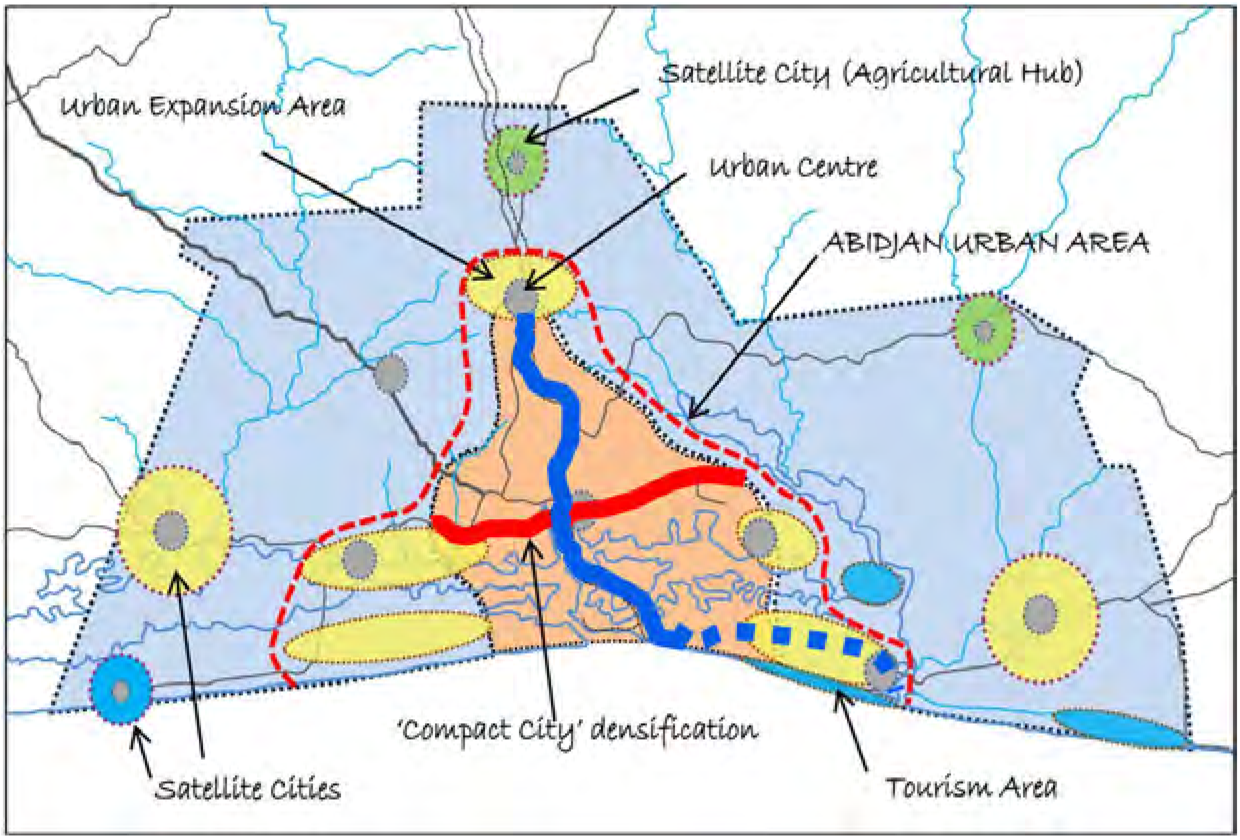
- The rail corridor routes assume that its ROW (Right of Way) is secured on either existing road space or existing rail alignment. This study assumes that the area currently occupied by the road median separator will be allocated for transit routes, in principle.
- Because of the required transport capacity and high frequency train service, a double track system should be applied.
- A critical issue for the Red Line is the route passing over Banco bay.
- For the parking of and maintenance work on rolling stock, a train depot is needed. The required area depends on the number of train sets. However, the minimum requirement is approximately 3 to 5 hectares. The location of either one or two depots has not been designated at this point.

[31] Although rail-based transport is considered appropriate for this corridor, due to its rolling topography, including some sections with a gradient of more than 6%, rubber-tired new transport, which can share the same bridge with roads or linear-motor, etc. could be considered more appropriate. Only a feasibility study can address this issue in proper perspective.

Table 5.6 Land Transport Technology Comparison

Topic of Comparison	Subway/Metro	Monorail/Elevated	Tramway	Classic Bus Rapid Transit (BRT)	Exclusive Bus Lane Network or BHLS
					
System	Closed with possible connection to suburban railway	Closed	Closed but easy to extend	Closed but easy to extend	Open
Level	Underground/Elevated	Elevated	On the road	On the road	On the road
Track Condition	Rails	Rails/Guide way	Rails	Road (closed system)	Road (open system)
Lane Specialty	Designated	Designated	Designated lanes or sharing	Designated	Designated lanes or sharing
Max. Carriage Capacity	30,000 persons per hour	15,000 persons per hour	10,000 persons per hour	30,000 persons per hour	10,000 persons per hour
Surface Space	Metro entrance	4 m wide for pillar + station access shafts + sidewalk space	2 lanes (8.5 m) + station (2.5 m both sides)	2 lanes (8.5 m) + station (2.5 m both sides)	2 lanes (8.5 m) + station (2.5 m both sides)
Cost	300 million USD per km	60-150 million USD per km	20-30 million USD per km	5-20 million USD per km	2-15 million USD per km
Justification for introduction	High cost / Over 1 million people in the city	High Cost / Over 700,000 people in the city	Good for specific area for cityscape emphasis and friendly town community	Rather good for immediate implementation and as secondary transit connection	Rather good for immediate implementation and as secondary transit connection

Source: JICA Study Team



Source: JICA Study Team

Figure 5.4 Rail Corridors and Future Urban Development

(2) Tramway Option

An alternative, or perhaps complimentary to the Blue Line, is a tramway whose proposed alignment is shown in the Figure 5.5. It is unlikely, even in the long term, that both technologies are necessary. When such a tramway is tested in conjunction, instead of the Blue Line, the tramway attracts 1,712,000 passengers with 37,000 passengers per hour per direction (pphpd) in 2030. The number is significantly lower than the proposed Blue Rail Line that the Blue Rail Line is the best option for 2030. The Blue Rail Line has a higher operational speed as it has its own right of way with fewer stations.

Source: JICA Study Team

Figure 5.5 The Tramway Alignment

(3) Water-Based Transport

With the two water-based transit lines, the Green Line is a candidate for high-capacity boat service that would operate at a lower speed because of the close proximity of stations (see Figure 5.3). Meanwhile, the Purple Line is a candidate for a high-speed ferry. The lagoon is currently an under-utilized resource. These upgraded ferry services, different from the existing SOTRA water bus, will make an extensive difference to the operation of water-based public transport in Abidjan. The introduction of such a quality service will impact both the existing formal and informal water sector. Like the "Woro-Woro" in land transport, the informal water transport, the "Pinasse" will not decrease in its attractiveness to potential passengers without an alternative superior cost-effective transport service. This can be achieved with the introduction of the superior service[32] on the Lagoon. Once there is an alternative to

[32] Consideration should be given for inclusion in the Feasibility Study of the Purple Line, an analysis of the "Future of the Pinasse" as a result of Improved Lagoon transit service.

the "Pinasse," the government can also move to enforce higher safety standards on any remaining "Pinasse" service.

It is practical to develop such a high-capacity east-west transit corridor as the Purple Line early in the timeframe of the Master Plan. On this southern alignment for the east-west corridor, the service between Songon and Bingerville, with intermediate ferry stations at all significant urban centers, will attract a high number of passengers, as discussed earlier. The technology proposal is for a ferry similar to those operating in cities that have major harbors such as Hong Kong, Sydney or Istanbul (see Figure 5.6) with a capacity in excess of 200 people and with operating speeds of 22 knots or 40 km/h. The exact form of technology can only be confirmed at the stage of a feasibility study.

Figure 5.6 An Example of a High-Speed Ferry

(4) BRT and BHLS

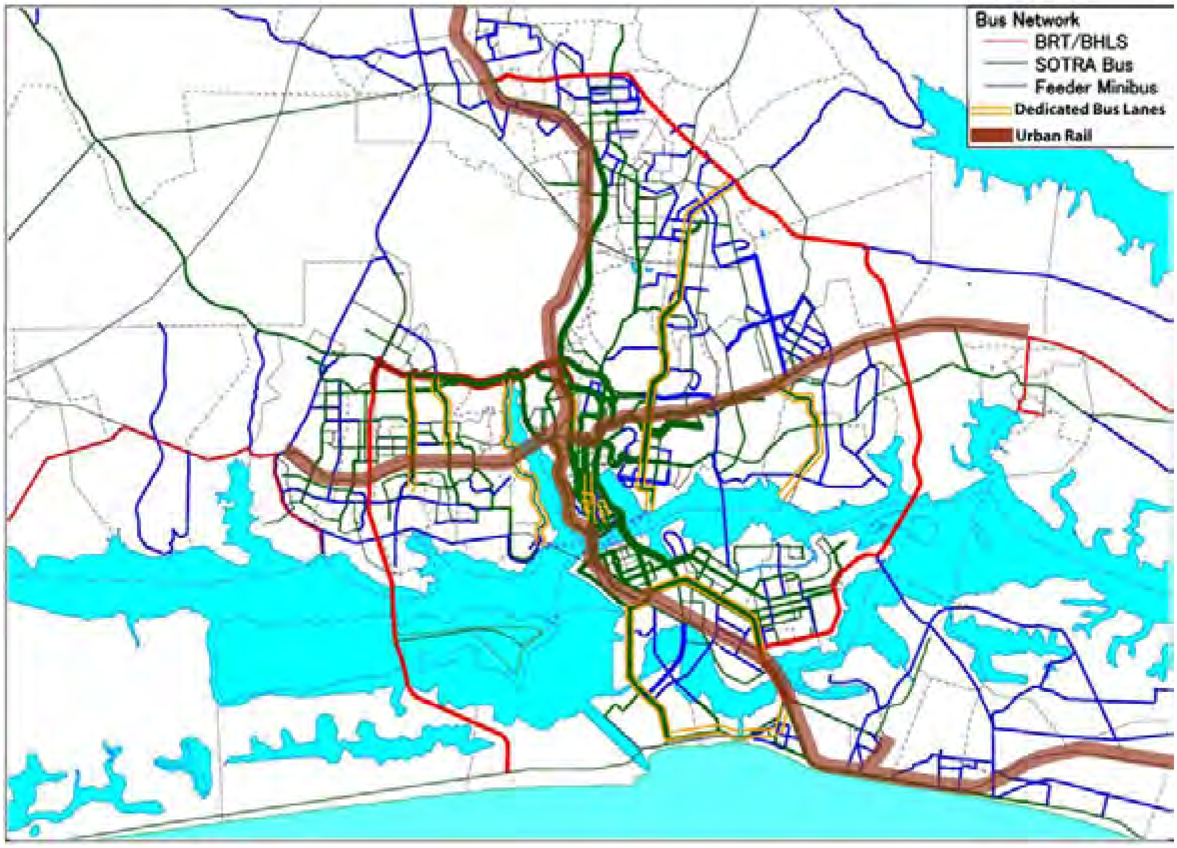
Features of BRT and BHLS[33] (bus with high level of service) are indicated in Table 5.6. Among several BRT systems, the BRT of Bogota, TransMilenio is the largest in scale, transporting as many as 380,000 passengers for one direction per day which corresponds to a Metro system. However, construction cost is rather high (i.e., 5.0 million USD per km) and the system needs four BRT lanes as well as the elevated BRT stop platforms that are 3 meters wide and over 100 meters long at certain terminals for 5 to 6 vehicles to operate in tandem.

In France, BHLS is often used because of the importance of high quality service, convenience, and city image in addition to the commercial speed and carriage capacity. Under the concept of BHLS, SOTRA is also studying the "BRT" development plan in Abidjan, which is based on an open system "BRT" network where various normal bus lines could also utilize the dedicated lanes. Development of the dedicated bus lanes, which are described below, may be useful for this purpose.

[33] BHLS is often referred to as a lower level of the classic BRT system. An example is the case of CHRONOBUS in Nantes. Its main objective is to provide a better quality of urban mobility. Traffic priority is to the bus over the individual use of cars. A dedicated traffic lane is not always required.

(5) Dedicated Bus Lanes

Roads in Abidjan are able to cope with the introduction of dedicated lanes for public transport but at the expense of the private car. The decision must be to give public transit priority over the private car because, as stated earlier, this mode of transport is more energy efficient. The primary crossing axes of the trunk route corridors of the public transport, as seen earlier will be rail- and water-based but in combination with the existing public buses, which extend beyond the existing services to the newly developing areas, as seen in Figure 5.7. The bus will still consist of primary corridors that focus on Plateau; there will be service consideration for some high-capacity transit corridors of lower demand. As seen in the maps of high-capacity corridors, additional surface transport resources, namely, dedicated bus lanes are included in the corridors, which attract a lower level of patronage.



Source: JICA Study Team

Figure 5.7 Bus Network Extensions

As described in Section 4.4.1, the current partial dedicated bus lanes should be extended more continuously on the urban arterial roads to form a continuous, smooth network for buses, serving like a BHLS, as presented in Figure 5.7. Those dedicated bus lanes have been proposed on the roads that have enough ROW and are utilized by many bus lines. By securing a relatively high operating speed, the time schedule can also be foreseen, consequently reducing the waiting time and thereby attracting more passengers. It should also be noted that the dedicated bus line network would be a prototype of BHLS or other mass transit by expanding the fleet size and frequency, along with designated platforms, when the demand grows in the longer term. In 2030, the urban transport master plan forecasts that the necessary fleet of conventional buses will be around 500 buses.

5.4 Transportation Upgrade

5.4.1 An Overview

The key planning issue for public transport services at present is that the public transport is provided largely by the informal sector, as discussed earlier. Bus services are currently concentrated on routes originating from suburban areas and ending in several city terminals such as Adjamé or the South Plateau terminal. Both of these terminals become intermodal stations on the Blue Line with the implementation of the high-capacity transit corridors. The focus of the bus system will evolve from that of a primary line haul system to a combination of line haul and the provision of feeders or access to the high-capacity corridors.

5.4.2 Local Transportation

It is possible to categorize bus routes into four types from a planning point of view, namely, line-haul bus services on high-capacity corridors, circulator bus services within major centers such as the CBD, circumferential routes and suburban feeder bus services. The circumferential routes[34] would provide linkages between major activity hubs without the need for coming into the center to access an adjacent hub. This is in fact the role of the two proposed BRT routes.

With the introduction of the high-capacity public transport, line haul routes will become the prerogative of the formal public transport structure. The role of the informal sector, such as Gbaka, intra-communal taxis or Woro-Woro will then need to focus on circulator and feeder routes. This consideration forms part of the discussion on the demonstration project in the next section. Whilst it is common to have a circular route in a CBD, in Abidjan consideration should be given as well for the need of such routes within the individual communes.

In fact, a majority of public transport users residing in suburban areas would desire the improvement of feeder minibus services in terms of accessibility, frequency and punctuality. This is the most vital point to strengthen the intermodal system of the overall public transport network delivery. Ideally, all the residential areas should be served and covered by feeder public transport within about 250 meters from the nearest bus stop. Consequently, as shown in Figure 5.8, interval of parallel bus routes should be about 500 meters at maximum, and intervals of bus stops should also be 500 meters at maximum. For this, even the informal sector, such as Gbaka could take on this role to develop into "formal" feeder minibus services.

Such internal communal routes would change the role of the currently dominant informal sector. For example, a circular route feeding the central Plateau would originate from the existing intermodal bus and ferry SOTRA center at the base of Plateau.

The informal services are currently an integral part of the transportation system of Abidjan. It is possible for all of these services to be re-engineered to support the line haul high-capacity corridors as feeders. The urban transport master plan proposes to stimulate the conversion of the informal sector to the formal one. The introduction of the high-capacity corridors will result in a shift to the formal sector. By 2025, this means that the informal sector, represented by Woro-Woro and Gbaka, will be replaced by

[34] Alternatively, one may consider three levels of public transport, namely, a primary, secondary and tertiary level, with both the circulator and feeder services set into the latter category.

a feeder minibus service to provide access to high-capacity corridors, namely, urban rail or BRT/BHLS. Public transport passenger boarding is expected to increase nearly 1.9 times with the introduction of the transport master plan as seen in Table 5.7.

The number of passengers using formal public transport is estimated at about 3.3 million, 9.5 million and 12.3 million per day in 2020, 2025 and 2030 respectively, which means a growth of more than 14% per annum between 2020 and 2030. By 2020, the share of the formal sector to all public transport trips will grow by some 27% from 16% in 2013, which is composed of 12% of SOTRA bus, 2% of SOTRA water bus and 2% of other buses, respectively. By 2030, with the improvement of the bus system, which is composed of SOTRA bus, feeder minibus and BRT/BHLS, the number of anticipated passengers will increase by 1.3 times.

On the other hand, the number of informal public transport passengers estimated at about 4.4 million in 2020, which takes 57% of all public transport passengers, are expected to be shifted to the formal sector in 2025. Urban rail will greatly attract passengers, accounting for about 4.6 million (38% of all public transport passengers) in year 2030; the result indicates that urban rail will play an important role to form the backbone of major corridors in Abidjan in the future. In addition, water transport and BRT/BHLS can support those corridors as supplemental transport modes in the peripheral areas or the areas divided by the lagoon, which cannot be served by the railway service due to the limitation of its catchment area.

Table 5.7 Estimated Number of Passengers and Modal Shares of Public Transport

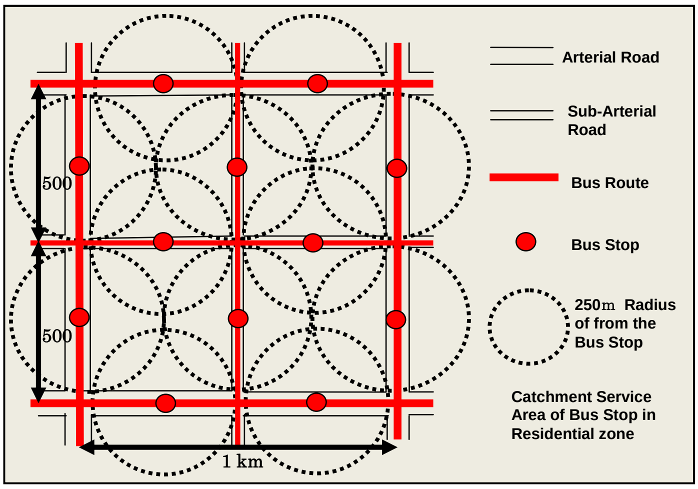
Unit: thousand passengers/day

Mode		2013	2020	2025	2030
Informal Sector	Gbaka	2,313 (36.3%)	736 (9.5%)	-	-
	Woro-Woro	3,045 (47.8%)	3,665 (47.3%)	-	-
	Sub Total	5,357 (84.1%)	4,401 (56.8%)	-	-
Formal Sector	SOTRA Bus	744 (11.7%)	2,393 (30.9%)	2,612 (27.6%)	3,096 (25.2%)
	SOTRA Water Bus	125 (2.0%)	433 (5.6%)	461 (4.9%)	430 (3.5%)
	Other Bus	144 (2.3%)	-	-	-
	High Speed Ferry	-	497 (6.4%)	784 (8.3%)	921 (7.5%)
	Feeder Minibus	-	-	1,832 (19.4%)	2,227 (18.1%)
	BRT/BHLS	-	27 (0.3%)	529 (5.6%)	1,018 (8.3%)
	Urban Rail Blue	-	-	1,836 (19.4%)	2,753 (22.4%)
	Urban Rail Red	-	-	1,404 (14.8%)	1,864 (15.1%)
	Sub Total	1,013 (15.9%)	3,350 (43.2%)	9,458 (100.0%)	12,310 (100.0%)
Total		6,370 (100.0%)	7,751 (100.0%)	9,458 (100.0%)	12,309 (100.0%)

Note: Figures in 2013 are from HIS where only representative modes were counted as passengers. Other bus contains school, company and private bus.
Source: JICA Study Team

This is only the beginning of the shift to the formal sector as the result of the introduction of the high-capacity corridors without consideration for the impact of the demonstration project.

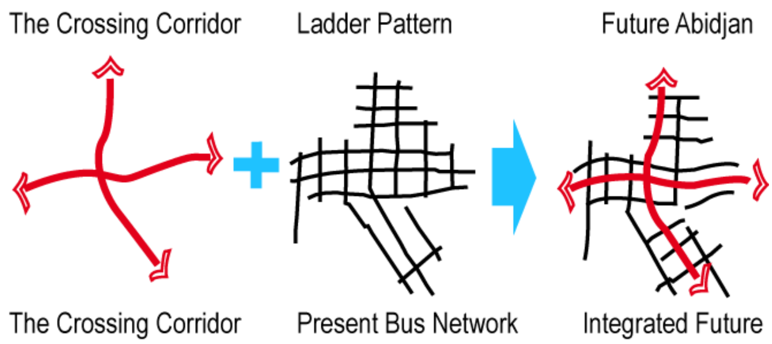
Likewise for the informal water sector, "Pinasse" will be reduced in attractiveness with the introduction of the high-capacity water transit service.



Source: JICA Study Team

Figure 5.8 Conceptual Structure of Bus Service Network

The development of a feeder minibus service to high-capacity public transport corridors could incorporate the use of the existing Gbaka fleet whilst the development of the circular routes, especially within communes, is also a likely use of the Gbaka fleet. However, for the demonstration project, the proposal is that this service will in fact be a new SOTRA service. The missing element in this system is the future role of the Woro-Woro which currently provide an important local role. Once the feeder minibus service becomes fully operational, Woro-Woro will not continue operation because it is inefficient as a transit system and it will simply worsen the traffic congestion. In Figure 5.9, it is seen how, even once the existing bus network is linked with the corridors and the Blue, Red and Purple lines, there is an integrated future for Abidjan. In 2030, the urban transport master plan forecasts that the necessary fleet of feeder minibuses will be around 2,000 vehicles.



Source: JICA Study Team

Figure 5.9 Future Potential Bus Pattern

Meanwhile, to tackle the problem of the informal sector, an example project currently undertaken in Dakar, Senegal is introduced. It is a project by CETUD (Executive Council of the Urban Transport of Dakar) to replace old, so-called Car Rapide vehicles with higher-capacity AFTU (Association for Financing of Professionals of Dakar Urban Transport) buses, as shown in Figure 5.10. Since there was no route data for Car Rapide operation, a survey was conducted to determine the size of the fleet that would be necessary. As part of this renovation process, the project also included capacity building for the existing individual car rapid drivers to professionalize and recruit them as not only AFTU bus drivers but also bus conductors and line supervisors. Furthermore, 2400 additional jobs are to be created. This way the informal sector is becoming formalized under one operational body, which will soon be merged with the operators of the conventional buses and the commuter rail. This reform of the informal sector is to be completed by 2017.

[Car Rapide] [AFTU Bus]

Source: JICA Study Team

Figure 5.10 Car Rapide and AFTU Buses

5.4.3 Modal Integration

Developing an intermodal public transport system reliant upon a public and private sector requires the efficient integration and interconnection of the different public transport elements. Real intermodal public transport can only be approached with a rational vision whose foundation lies upon an assessment of the capabilities of the different public transport modes and their interconnectivity with each other. This interconnectivity relates on the one hand to the (important) role of terminals and on the other hand to the hierarchy of public transport systems, as discussed in the previous section.

Under such an approach, one may argue that fixed-route and high-capacity systems should, on one hand, be given priority in the scheme, while other more flexible public transport systems should be superimposed to create an integrated network. An example of modal integration from Japan showing the layout associated with a station is depicted in Figure 5.11.

Source: JICA Study Team

Figure 5.11 Example of Modal Integration

Since the high-capacity public transport is a network utility, the intermodal transfer system at stations should be improved to ensure the convenience of the riders when they transfer from one public transport mode to another with less impedance on the passengers. The following measures deserve to be implemented for this purpose:

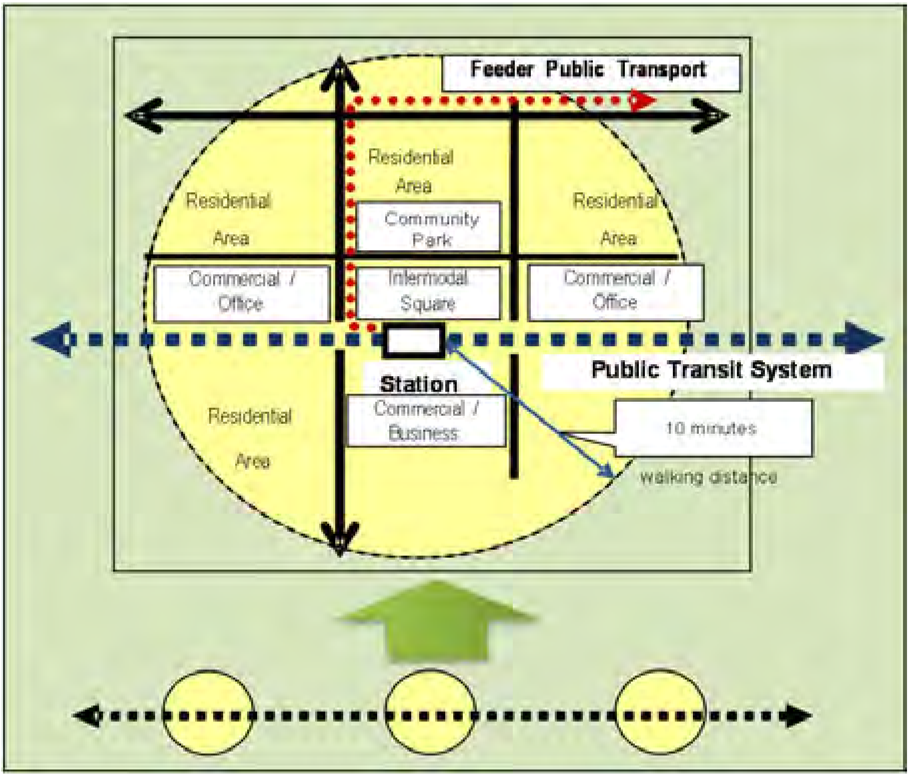
- To improve the user-friendliness of the transport facilities, by providing pedestrian walks, car parking lots, and other transport services;
- To upgrade the convenience level for transferring activities, by improving physical conditions such as shortening the walking distance for transferring from the station to another mode and provision of Information on timetables and operational conditions; and
- To prepare safe and comfortable waiting space for transferring passengers.

Conversely, low-capacity but highly demand-responsive and flexible systems such as Gbaka could be considered end-line service providers and should not necessarily be constrained by a fixed route network. But the radius of operations should be geographically limited to a specifically defined sector as with current Woro-Woro operation, therewith avoiding long-haul travel or predatory practices by this mode. An important element is the allocation of public transport resources into an integrated, intermodal system within which service duplication is largely avoided. This means that whenever possible, the service of an area by more than one main public transport system is only acceptable when this is based upon a capacity need.

5.4.4 Transit-Oriented Development

While at present, many large business, commercial, and housing development projects are sprouting all over Abidjan and its vicinity, it is of great importance to make the urban structure convenient for public transportation users through appropriate land-use plans. That is, since office buildings and shopping malls are large trip generators, they should not only be provided with enough parking spaces but also be located within walking distances from the high-capacity public transport stations or bus stops. Setting high floor area ratios in areas around existing and planned stations will also induce a large amount of generated trips which can easily be served by high-capacity public transport systems.

As illustrated in Figure 5.12, both public transport and land use should be integrated under a concept of transit-oriented development (TOD), and the promotion of high-density commercial land use around stations will benefit both the urban economy and the business of the public transport operator. Corridor areas that are served by the high-capacity public transport system will be endowed with great potentials for urban development such as housing and industrial and commercial facilities, thereby bringing a significant impact on the urban structure. Thus, the high-capacity public transport system is expected to bring a wide variety of opportunities for the suburban development with new housing areas and shopping malls.



Source: JICA Study Team

Figure 5.12 Concept of TOD along High-Capacity Public Transport

5.4.5 Transport Administration

The situation, in terms of public transport management and administration, is that AGETU was currently responsible for all public transport in Abidjan Autonomous District (AAD) as well as in the surrounding communes of Anyama, Bingerville, Grand Bassam, Dabou, Songon and Jacqueville. However, AGETU had little control over the informal sector. Early in 2013, AAD[35] established the Abidjan Urban Planning Agency (AUPA). There is a significant potential for overlap in their responsibilities. The other key player outside of the informal sector is SOTRA.

There are thus three government agencies that will initially want to take a role in the management of the transportation system of Greater Abidjan and that do not include the Ministry of Transport or SITARAIL[36]. It is often apparent that a local organization, such as AUPA, responsible to the local government, is sometimes better than a national agency. Thus AUPA could take a future planning role. In the case where the high-capacity public transport routes extend beyond AAD, the mandate of AUPA would need to be extended beyond AAD by the central government.

All of the routes on the high-capacity corridors will have an operator. This operator will either be public or private or some combination of the public and private sector. The concept of the public/private sector is discussed in the next section. There will need to be a single regulator. This regulator will not be

[35] AAD currently has an independent budget and the position of governor is a presidential appointment.
[36] SITARAIL is the current rail operator with limited passenger service within Abidjan. The Blue Line will operate on the SITARAIL right of way.

SOTRA for even if SOTRA fails to become an operator on a high-capacity transport corridor, SOTRA will remain the bus operator in Abidjan. Thus, the proposal is for a Planning Agency, AUPA and a regulator. The introduction of high-capacity transit corridors will also lead to electronic ticketing. In this case, the regulator could also take the role of the Clearing House that will distribute revenue to the various operators.

5.4.6 A Demonstration Project

Within any commune, the informal Woro-Woro and Gbaka dominate public transport. An exception is Plateau where neither class of informal transport has a license for operation. The results from the future demand forecast suggest that bus passengers other than those on BRT and BHLS will remain stagnant whilst the informal sector of Gbaka and Woro-Woro will, at least initially, increase, as these services will provide access to high-capacity transit corridors[37]. Without positive intervention, as stated earlier, the growth in the informal sector will decelerate but it will still remain in a growth mode rather than in declination.

A demonstration project is suggested in the commune of Yopougon. The purpose of this project is to focus travelers away from the informal sector. The access from Yopougon at present to the eastern part of the city is via a single narrow corridor. The reason for a demonstration project to focus on Yopougon is two-fold, namely, it will continue to hold a high proportion of the population of the AAD growing to 25% in 2030, whilst at the same time it will be beneficial due to the most likely first high-capacity transit corridor, the Purple Line. SOTRA services will focus on this Purple Line Corridor as an alternative to taking people to the eastern part of the city via the narrow northern corridor.

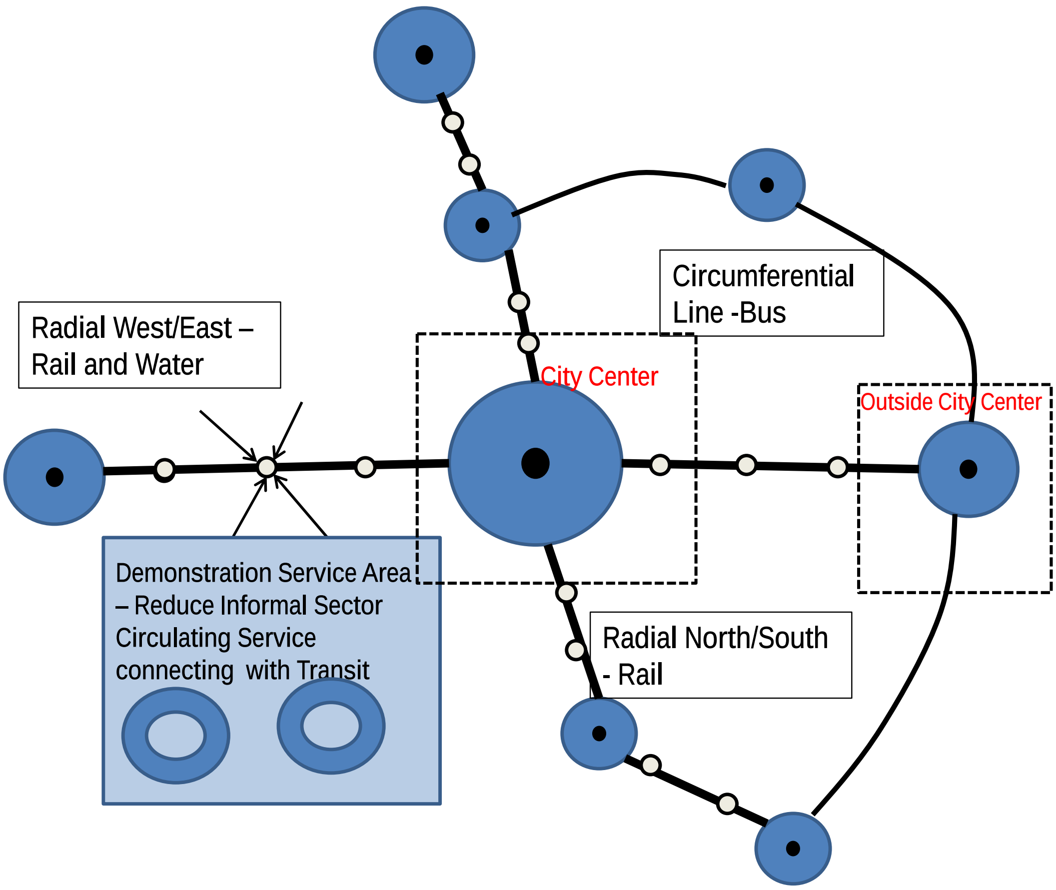
In the case of the local trips within Yopougon, the average trip length by Woro-Woro is 7.2 km. This is a mean fare of around 210 FCFA. Users of a new local SOTRA service would not be financially disadvantaged. The intention is to introduce a feeder minibus service that is circulating on a frequent schedule along the road system currently serviced by Woro-Woro with connections to the proposed Purple Line. This will need positive intervention by government to ensure that the alternative to Woro-Woro will proceed effectively[38] .

The impact of such a service will see the beginning of change from the informal sector with a forecast increase of around 15% in bus passengers and a subsequent decline in Woro-Woro of nearly 10%. The success of this service, if then implemented in other communes, would begin to see a significant shift to the formal public transport sector.

Although Plateau is not initially nominated for inclusion in the demonstration project, the team would like to include Plateau in the demonstration. Plateau would have a hop-on/hop-off circulating bus system using the major roads of Plateau, circulating between Central and South Plateau stations.

For the success of this demonstration project, it requires an integration of service. Such an integration procedure is shown in Figure 5.13.

[37] The informal sector of Gbaka and Woro-Woro is forecast to increase by around 45 % between 2013 and 2030 without intervention from transport administrators.
[38] This is the proposal for a detailed feasibility of such an introduction of the local SOTRA service.



Source: JICA Study Team

Figure 5.13 Service Integration

5.5 Private Sector Participation Development

5.5.1 An Overview

Is there a case for the private sector to operate public transport in Abidjan with particular reference to the high-capacity public transport corridors? The answer is of course "yes" provided the right conditions are met for the introduction of the private sector. The reported number of passengers on the Blue Line as stated earlier is 471,800 passengers per day with the reference fare. This number of passengers will result in fare-box revenue of around 80 billion FCFA per year or 120 million Euros per year. So there are substantial sums of money available but of course there is no detailed financial case study at this point in time.

5.5.2 Private Sector Participation in Perspective

In perspective, privatization of fully government functions or in partnership is not a new concept. There is a long history of privatization that dates from Ancient Greece, when governments contracted out almost everything to the private sector. In the Roman Republic, private individuals and companies performed the majority of services, including tax collection (tax farming), army supplies (military contractors) and construction. However, the Roman Empire also created state-owned enterprises, for example, much of the grain was eventually produced on estates owned by the Emperor. Some scholars suggest that the cost of bureaucracy was one of the reasons for the fall of the Roman Empire[39]. So the involvement of the private sector in public enterprise is not new.

Today, many definitions exist related to the cooperation between private and public partners. In the USA, the World Bank in particular uses, since the middle of the nineties, the term Private Sector Participation (PSP) to refer to all possible forms of collaboration between the private and public sectors. Within more recent years, Private Participation in Infrastructure development (PPI) has become frequent in documents when discussing infrastructure development projects. In the case of the management of transport assets in Abidjan, this will likely be in the form of the PPP option.

The use of the Private Sector Participation (PSP) and Private Participation in Infrastructure development (PPI) expressions seem specific to the World Bank and related organizations while other American authorities and private experts also frequently use the expression Public-Private Partnership (PPP) intertwined with Private Sector Participation (PSP). In Europe, the relationship between the private and public sectors in setting up joint projects was, from the beginning, referred to as “Public-Private Partnership.” In 2004, the European Commission formalized its point of view by publishing a “Green Paper on Public-Private Partnerships and Community Law on Public Contracts and Concessions”.

A closer review of the 2003 Guidelines and the 2004 Green Paper suggests that the targets, context and structure of the Public-Private Partnership (PPP) expression are equivalent to the Private Sector Participation (PSP) concept. In the United Kingdom the “Private Finance Initiative” or “PFI” is the preferred cooperation method, which is defined as a Public-Private Partnership for funding major capital investments, without immediate recourse to the public purse. The British “Private Finance Initiative (PFI)” concept is similar to Australia’s idea on “Privately Financed Projects” or “PFP” which is part of the broader spectrum of Public-Private Partnerships (PPP) and is a general term covering any contracted relationship between the public and private sectors to produce an asset or deliver a service. Finally, the ADB uses both the terms “Public Private Partnership” (PPP) and “Private Sector Participation” (PSP) without a real distinction, albeit with a slight preference for the latter.

The establishment of a PPP is not without risk. One can distinguish among the risks that can be borne by the private sector:

- The technical risk: using new techniques: applying existing methodologies at a larger scale or under different conditions, etc.
- The scheduler risk: delays in execution; unrealistic development schemes, etc.
- The commercial risk: failing or lack of financial resources; cost escalation; failing budget control; lower-than-expected incomes, etc.

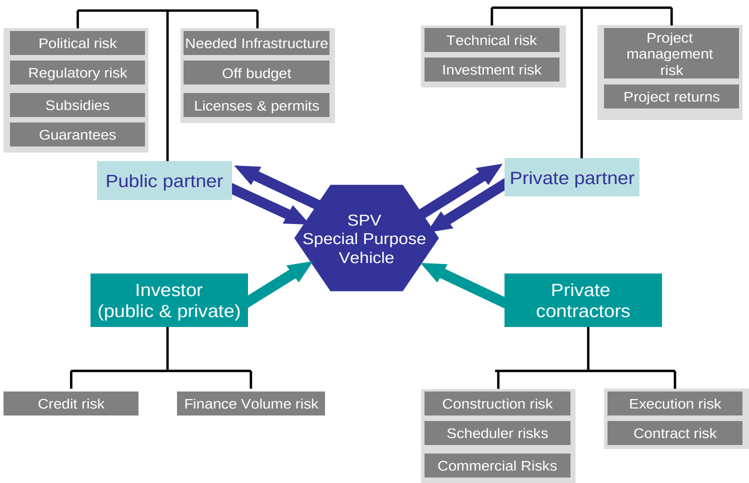
There are other categories of risk or uncertainty that fall outside the control of the private sector and should be covered by the public sector:

- Planning and permits risk: delays in planning procedures and required permits, etc.
- Political risk: interventions by lower-level decision makers; delays or cancellation of promised interconnected investments that are imperative for the project’s success

[39] *International Handbook on Privatization* by David Parker, David S. Saal

- Regulatory risk: changes in design rules; new technical requirements; new safety and environmental rules and regulations; changes in the "rules of engagement," etc.

The Public-Private Participation should anticipate this divergence in objectives and ensure a guaranteed commitment of all partners to balance the entire set of project risks between partners in an equitable way and according to the guiding principle that risks are allocated to the partner(s) which is (are) the most capable of efficiently dealing with the risk, see Figure 5.14 for an allocation of the various risks to the different stakeholders.



Source: JICA Study Team

Figure 5.14 Risk Distributions of PPP Shareholders

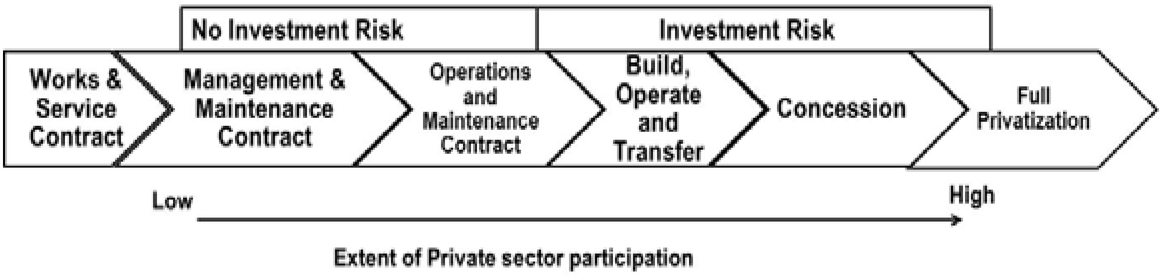
PPPs fall into two broad categories with respect to transport, with many transport projects located under the first category.

- Financially self-standing concessions: these comprise tolled roads and river crossings where the traffic volumes and toll charges are sufficient to finance the investment and ongoing services and support. For such concessions, which can take many of the features of privatization, it is essential that user charges should be regulated but set at economic levels to pay for the investment required as well as the ongoing maintenance; and

- Hybrid PPPs: these cover areas of service where user charges are made, but for political and/or social reasons are maintained at levels that are insufficient to sustain the required outlays of capital and operational expense, such as public transport projects. In these cases user charges have to be supplemented by subsidy from the public authority.

The nature of the partnership between the private and the public sector can range from fairly simple contractual arrangements to supply a specific service (e.g., garbage collection), to complex arrangements to design, construct, operate, maintain, finance, and provide an infrastructure service (e.g., a new airport). In other words, there are many variants of PPPs, including management contracts, leasing investment concessions, build-operate-transfer (BOT) and related versions, such as Rehabilitate-Operate-Transfer (ROT), Build-Own-Operate (BOO) and Build-Own-Operate-Transfer (BOOT). In return for agreeing to provide the service, the private sponsor receives a fee (in payment for specific services rendered, or a tariff or user charge depending on the type of the PPP used) according to certain standards of service and other criteria as specified in the contract.

Figure 5.15 illustrates the broad spectrum of private sector participation in service delivery. As more equity and control is transferred to the private sector, so is more risk. PPPs, in which the private sector can provide significant amounts of finance for the project, provide relief to the government budget. With these savings the government can invest in those projects that are less amenable to PPPs.



Source: JICA Study Team

Figure 5.15 Full Spectrum of Private-Public Participation in Project Delivery

The PPP Partner selection process should be fair, transparent and accord with the general principles of good public procurement practice. A two-step or three-step process can be followed that should be decided from the outset, depending on whether the client expects too many tenderers to join the procedure. A two-stage process will involve choosing a shortlist of prospective tenderers directly from the responses to the initial advertisement.

5.5.3 Selected Examples, What of Abidjan?

In Abidjan, four major new passenger modes, namely, Metro, Ferry, BRT and BHLS are proposed for inclusion in the Master Plan. Each of these new modes has at least two lines and they will all operate on the high-capacity transit corridors. The question for Abidjan is what is the form of operation and ownership? Key operational requirements for these new modes in Abidjan are:

- Land Requirements;
  - Stations and Depots; and
  - Right of Way.
- Affordability;
- Rolling Stock (train, bus or ferry).

It is unlikely that the private sector can provide all and also meet the affordability requirement without the support of the government. Table 5.8 presents some European examples of public funding in different types of private- public partnerships. Here the most common contract has been DBFM (Design Build Finance Maintain), where the government minimizes their risk at the expense of the private sector.

The project capital cost of these selected examples range from the low, 100 million Euros to the high 7.8 billion Euros. The private sector may not necessarily bring significant savings, as the finances needed for said project must be raised on the capital market. It is also seen that the concept of non-government involvement is a myth as all these selected projects require significant government capital[40].

What is improved by private sector involvement in the implementation of a project is likely the quality aspect of said project. For instance, there is a possibility of project cost reduction for the long term by applying maintenance know-how of the private sector, so called LCC (Life Cycle Cost). In addition to this, it is considered that project implementation time will be shortened by participation of private sector at an early stage.

The project implementation scheme should be selected by various factors concerning the project situation. There is no guarantee that private sector involvement will bring cost reduction more frequently than pure public project. One reason private-sector participation was done often, for example in railway projects, is that it could reduce the LCC of project cost through maintenance skill of the private sector. Also, there is no other choice for the governments, which are often faced with fiscal deficit due to the growing social cost spending.

DBFM is recommended for consideration in the delivery of project implementation in Abidjan as part of the preparation of any feasibility study.

Table 5.8 Overview of Selected Rail PPP in Europe

Project	Time from Design to Completion	Contract Duration (years)	Route Length (km)	Capital Expenditure (billion)	Public Co-Funding (grants) (billion)	Type
Stockholm-Arlanda Airport	1993-1999	41	39	4.1 SEK	22.4 SEK	BOT
HS1 Channel Tunnel rail link	1996-2003	90	109	5.8 GBP	2.1 GBP	DBFM
Oresund road-rail link	1991-2000	25-30	38	2.0 EUR	Not applicable	DBFM
HSL-Zuid	2000-2007	25	100	6.0 EUR	0.11 EUR/year	DBFM
Perpignan-Figueras HS	2005-2009	50	45	1.1 EUR	0.6 EUR	BOT
Diabolo rail link Brussels	2007-2012	35	3	0.54 EUR	0.25 EUR	DBF
Liekenshoek rail link Antwerp	2008-2013	38	16	0.84 EUR	0.05 EUR/year	DBFM
Tours-Bordeaux HS	2011-2016	50	340	7.8 EUR	4.0 EUR	BOT
GSM-R France	2010-2015	15	14,000	1.5 EUR	0.16 EUR	DBFM
Lisbon-Madrid HS	2009-2013	40	165	7.8 EUR	Not applicable	DBFM
Nimes-Montpellier HS	2012-2017	25	80	1.8 EUR	Not applicable	DBFM
Montpellier Odysseum station	2012-2017	30	-	0.100/0.120 EUR	50%	DBFM
Bretagne-Pays de la Loire HS	2011-2017	25	214	3.4 EUR	1.85 EUR	DBFM

Source: United Nations, 2012

At present SOTRA is the principal supplier of services in the formal transport sector. SOTRA in itself already has a private sector partner[41]. An increase in the private sector participation of SOTRA may provide a springboard for government to encourage the development of DBFM investment in the development of the new high-capacity transit corridors.

[40] A notable mass transit case often put forward as a success without government involvement is the elevated Skytrain of Bangkok. However this is a myth as the government supplied the land for the depot and the right of way. In addition, international banks wrote off substantial debt in making the project financially viable.

[41] In 2009, Irisbus/IVECO, now a division of CNH Industrial had a 35% share in SOTRA.

5.6 Project Development Timeline

5.6.1 An Overview

The nature of the improvement in public transport in Abidjan is that it will be driven by the introduction of the high-capacity transit corridors. Without the introduction of these corridors, there will be little change in the mixture of increased vehicle traffic and informal transport needed to move people, congestion will simply continue to increase and the mobility of people in Abidjan will decline along with economic prosperity. Increased mobility of ordinary people via the usage of the high-capacity transit corridors will encourage commerce and lead to the development of prosperity.

5.6.2 The Timeline

As stated at the beginning of this chapter, the development of improved public transport and hence mobility for all is linked to humanware, software and hardware. Besides the providing of the hardware, for the operation of improved public transport, a part of each project is the training of staff and the implementation of upgraded systems.

The short-term projects or projects for immediate action are those that are scheduled for operation up to 2020. These are shown in the implementation schedule of Table 5.9 under short-term implementation. The hardware infrastructure projects for short-term implementation are shown in Figure 5.16.

Source: JICA Study Team

Figure 5.16 Short-Term Corridor Projects

Table 5.9 Proposed Implementation Schedule[42]

Project		Category	Project Code	Implementation Period
Rail	Blue Line Phase 1 (Anyama to Airport)	Infrastructure	T-1-1	2017 to 2021
	Blue Line Phase 2 (Airport to Grand Bassam)	Infrastructure	T-1-2	2026 to 2029
	Red Line (West Yopougon to Bingerville)	Infrastructure	T-1-3	2021 to 2023
Water	Purple Line (Songon to Bingerville, Airport and Grand Bassam)	Infrastructure	T-4-1	2017 to 2019
	Green Line (Attecoubé to Treichville)	Infrastructure	T-4-2	2017 to 2019
BRT	Brake Industrial Estate to Adjame	Infrastructure	T-2-1	2022 to 2025
	Abobo to Koumassi Phase 1	Infrastructure	T-2-2	2018 to 2020
	Abobo to Koumassi Phase 2	Infrastructure	T-2-3	2022 to 2025
BHLS	Bonoua to Bingerville	Infrastructure	T-2-4	2026 to 2029
	Dabou to West Yopougon	Infrastructure	T-2-5	2026 to 2029
Purchase of Additional SOTRA Buses		Infrastructure	T-2-6	2016 to 2018
Pilot Project of Communal Transport		Humanware	T-2-7	2016 to 2018
Development/Improvement of Intermodal Centers		Humanware	T-3-1	2019 to 2021
Reorganization of SOTRA Bus Services		Humanware/Software	O-2-1	2017 to 2021

Source: JICA Study Team

These projects are the Purple Line and the first phase of BRT. The BRT routes will provide an alternative to the heavily trafficked existing bus routes and will link Abobo and Cocody to the lagoon and the Purple Line, the high-speed ferry. The other part of the upgraded ferry service, the Green Line links Attécoubé to Treichville via South Plateau. At the very least, it will be important to have the section of the Purple Line between Songon and Bingerville operational by 2020. However, there is no reason why all of the Purple and Green Lines cannot be operational by 2020.

The commencement of services will change the city. In conjunction with the commencement of transit services on the lagoon, SOTRA bus routes can be re-oriented to serve the first high-speed transit corridor. Instead of people travelling north from the center of Yopougon and then east and south to Plateau and Treichville, people will travel south on the redeveloped SOTRA bus services including the SOTRA[43] service replacing Woro-Woro and then east directly to Plateau.

The introduction of the Purple Line can trigger a package of projects linked to humanware, hardware and software, namely:

- Purple Line;
- BRT ~ Brake Industrial Estate to Adjame;
- BRT ~ Abobo to Koumassi Phase 1;
- Purchase of additional SOTRA buses; and
- Reorganization of SOTRA bus services.

The other short-term projects are the improvement of intermodality at key existing public transport interchange locations of Adjamé and South Plateau.

[42] Preliminary costs of these projects are included in the project profile sheet of which there is one for each project.
[43] This is the demonstration project that has the objective of refocusing local transport in Yopougon towards buses and away from Woro-Woro.

Once limited to Treichville and Plateau, Abidjan has been quickly expanding around the Ebrie Lagoon and now stands on several converging peninsulas and islands in the lagoon. Once the six high-capacity transit corridors of the Blue, Red, Green, Purple and two BRT Lines are operational, the mobility of people in Abidjan will be enhanced significantly. For the completion of the public transport master plan, extension of the Blue Line from the airport to Grand Bassam and the BHLS services to Dabou and Bonoua are scheduled for completion in 2029 and 2030, respectively. This will then link the outlying centers with central Abidjan. By 2030, there will be nearly five million trips per day being undertaken along the high-capacity transit corridors thus forming the backbone of urban public transport in Abidjan.

Source: JICA Study Team

Figure 5.17 Medium-Term Corridor Projects

5.6.3 Conclusion and Recommendation

The trigger for the upgrading of public transport services in Abidjan is the introduction of high-capacity transit corridors. Without these services there will be little incentive for public transport improvement.

At the same time, the introduction of BRT and BHLS and the purchase of additional SOTRA buses will improve the status of SOTRA. The purchase of additional SOTRA buses will enable additional services on their existing line haul routes in the short term. Whilst at later stages of the public transport timeline, when buses are released from this role, as the high-capacity transit corridors come online, SOTRA will then use buses to access these high-capacity transit corridors. SOTRA will also provide new services to access outlying centers not served by BRT or BHLS.

The regulatory authority discussed earlier will not only be responsible for the standard of operational service; it must also have a role in the insurance of the safety and maintenance of public transport in Abidjan. The future will demand a high level of training of staff of the new services in Abidjan. It is thus recommended that the new operators and relevant agencies provide a high level of in-house training.

The involvement of the private sector is highly likely in, as a minimum, the operation of the high-capacity transit corridors. This issue is subject to final confirmation during the respective detailed feasibility studies of said projects.

6.0 Freight Transport Development Plan

6.1 Major Truck Routes

The efficient movement of goods is vital to the economic development and growth of not only Greater Abidjan but also to Cote d'Ivoire as a whole. Trucks traveling to and from the port and industrial areas transport raw materials for manufacturing and finished goods for consumption; thus, many jobs are related to and dependent on the freight industry. An effective transportation system that optimizes freight capacity must exist if Abidjan is to enhance its economic strength and maintain its leadership in Western Africa.

6.1.1 Current Situation

Based on the results of the traffic count surveys carried out at the beginning of this project, major truck routes have been identified as shown in Figure 6.1. The two main heavy-vehicle corridors are oriented in the northwest direction along the Autoroute du Nord, heading towards the northern part of the country, and in the west direction with the Route de Dabou.

Main Truck Generator/Attractor Main Road Truck Route Existing Logistic Center

Source: JICA Study Team

Figure 6.1 Major Truck Routes in Greater Abidjan

Inside the district, all truck traffic going to and from Abidjan Port and the related industrial area must funnel through the Plateau and the two bridges crossing the lagoon. If these facilities are closed down, there are no alternative routes for cargo transport.

Adding additional capacity to the lagoon crossings would solve just part of the problem, as the road network around the Plateau is highly congested throughout most of the day and is located in densely developed areas, making expansion very difficult. In addition, the increase in capacity would possibly attract commuters and other travelers from public transportation into cars, which would compete with trucks. Furthermore, as most of the cargo transport is currently transiting through the Plateau, many negative impacts can be observed on the traffic, the road conditions and the surrounding areas:

(1) Air pollution in the Plateau area

The Plateau is the economic center of Abidjan and the symbol of its political power. Although heavy trucks are banned from entering the central business district (CBD), they are still allowed to use the Boulevard Lagunaire surrounding it (except during morning and evening peak hours: i.e., 6:00 to 9:00 a.m. and 4:30 to 8:00 p.m.).

(2) Slowdown of traffic on urban roads

While the truck routes are essential to serving the port and industrial areas, they create slowdown of traffic on urban roads commonly used by private cars and public transport. Thus, truck traffic should be alleviated by providing alternative roads for trucks.

(3) Increase the risk of accidents

The percentage volume of trucks on the road is closely related to the severity of crash, even to the extent that lower traffic volume with higher truck percentage increases risk of fatal accident.

(4) Damage to the road pavement

Heavy trucks cause noteworthy damage to pavement, which in turn leads to more frequent maintenance actions and, ultimately, more traffic delays and congestion.

(5) Noise

Areas surrounding major truck routes will experience truck traffic and associated noises. As a result, measures have to be taken to reduce noise exposure from trucks through transportation planning and land use policies.

Considering the above, it is necessary to establish appropriate truck routes to facilitate safe and efficient trucking inside the Greater Abidjan area, ensuring that mobility for all roadway users is preserved, that freight and goods can move safely and efficiently and that the economy of Abidjan continues to grow.

6.1.2 Objective of the Future Truck Route System

The future truck route system will have to:

- Minimize the impacts of trucks on sensitive land uses such as residential areas

- Minimize widespread deterioration of the local road system as a result of heavy truck traffic
- Minimize traffic hazards

A balance should be found between the needs of commerce and manufacturers and the protection of sensitive land uses. As such, a truck route system should not prohibit trucks from using any road within residential areas, but require that they use the roads most suitable roads to the greatest extent possible, and limit their intrusion into the sensitive areas as much as possible.

Existing roads with sufficient capacity and adequate design features to accommodate the anticipated volume, size and weight of vehicles should be selected as truck routes and new road infrastructure should be planned to deviate cargo transport from the commonly used road network.

6.1.3 Truck Route Design Considerations

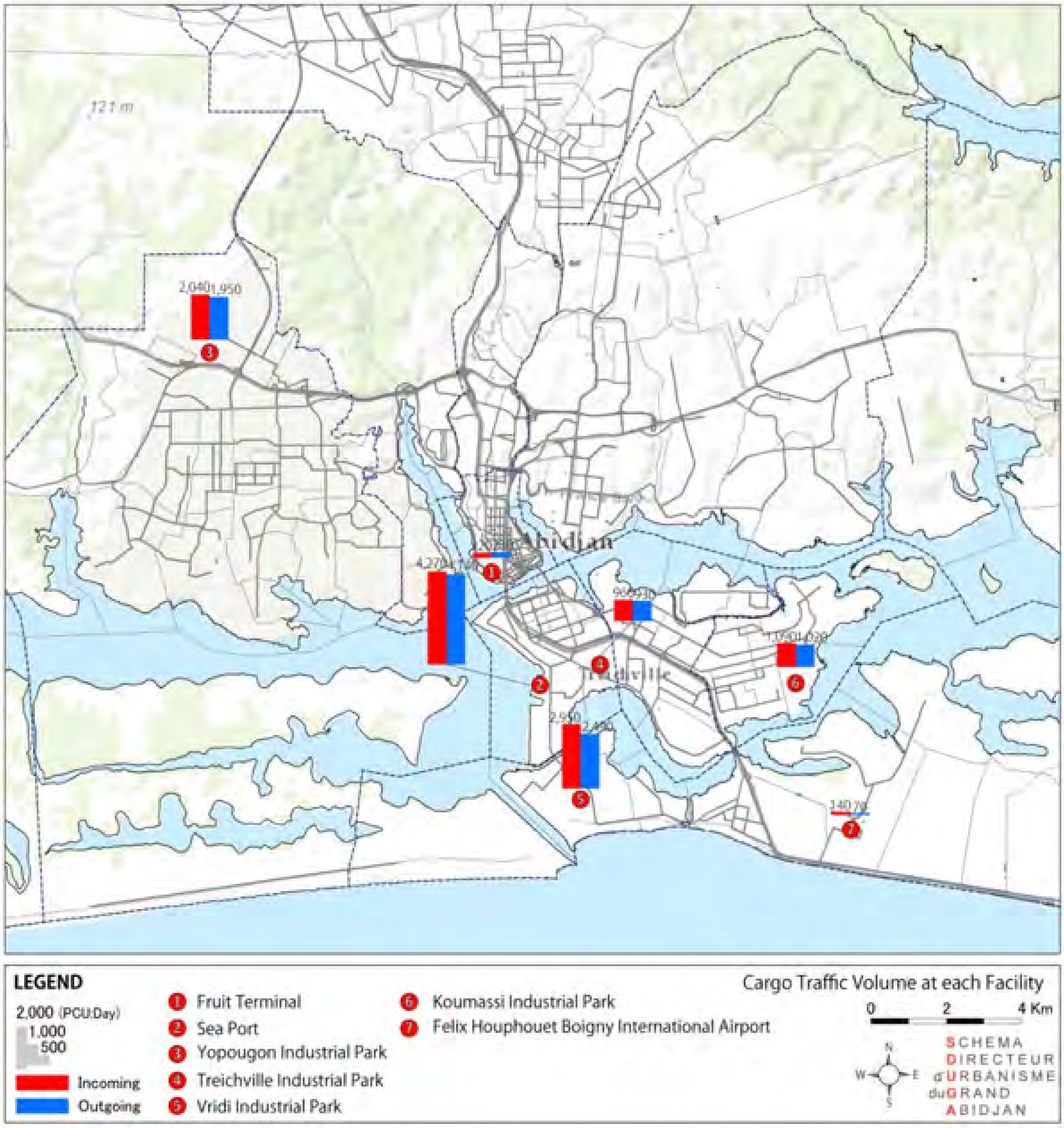
In order for a truck route to properly facilitate the transport of goods and services, roadways, intersections, pavement, crossings, lane width, turning radii, etc., must be designed to accommodate trucks. The types of trucks using the network must also be recognized as a major determinant of truck route facility design. Also, it is important to recognize the locations of truck generator areas.

In determining appropriate truck routes, physical design features of the roadways are important considerations that significantly affect traffic operation and safety. Critical geometric design factors that directly influence truck-routing guidelines include vertical clearance, lateral clearance, sign placement, weight limits, turning radii and intersection and interchange design. A thorough review of any proposed route must include these basic factors and should also consider the standard design vehicle requirements for the most prevalent trucks being driven on the route.

6.2 Truck Traffic To/From the Ports

6.2.1 Truck Traffic Volume from the Port

Truck traffic volume at major facilities, such as industrial parks and the port, is shown in Figure 6.2. The biggest traffic generator is the Autonomous Port of Abidjan, followed by the Vridi and Yopougon industrial parks. It should be noted that some portion of traffic observed at Vridi industrial park includes through traffic due to its location.



Source: JICA Study Team

Figure 6.2 Truck Traffic Volume

6.2.2 Traffic at the Port

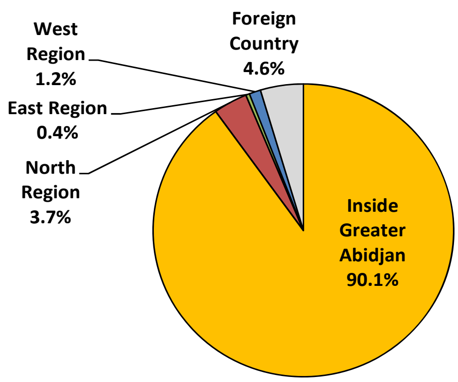
Recent composition of annual traffic recorded at the Port of Abidjan is shown in Figure 6.3. The national economy was impacted strongly in 2011 by the post-election crisis of Cote d'Ivoire, which put a check on the economic activities in all sectors, particularly on port activities with the closing down of banks and the embargo on ships making a stopover in Cote d'Ivoire. However, the Port of Abidjan is considered to be extremely important to ensure the efficiency and economic viability of national and international transportation of goods. The traffic at the port is expected to grow rapidly in accordance with the recovery and growth of the economy of the country.

Note: Fisheries and transshipment are excluded.
Source: Abidjan Autonomous Port

Figure 6.3 Composition of Annual Traffic Recorded at Abidjan Port

6.2.3 Origin / Destination of Trucks

A large portion of the origins and destinations of trucks are inside Greater Abidjan, as illustrated in Figure 6.4. To integrate a large volume of freight from other regions or foreign countries into a logistics center in the region, close connection, provided not only by road but also by rail, will be necessary.

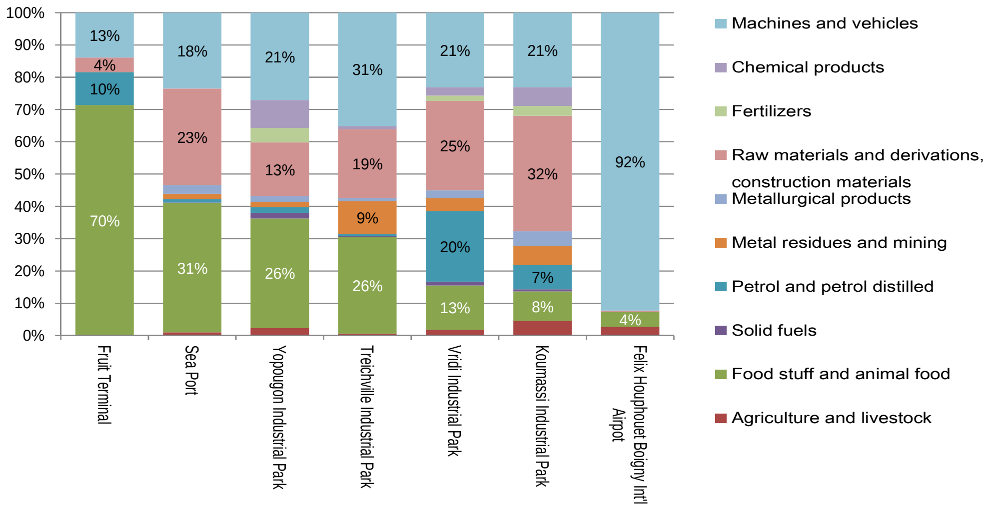


Source: JICA Study Team

Figure 6.4 Origin/Destination of Trucks from/ to Ports

6.2.4 Characteristics of Road Freight Transport

The trucks leaving the port are mainly carrying machines and vehicles, raw materials and derivations, construction materials and fertilizers, as shown in Figure 6.5.



Source: JICA Study Team

Figure 6.5 Composition of Commodities at each Surveyed Facility

Besides fertilizers, which are mainly for the rural areas, most of the commodities are being distributed inside Greater Abidjan.

6.2.5 Existing and Future Road Accesses to the Port

(1) Overview

The activities of the Port are expected to expand in the next 15 years, requiring the construction of new transport infrastructures. Currently, the Port is connected to the rest of the country by two bridges crossing the lagoon: the Houphouet Boigny Bridge and the General de Gaulle Bridge. The Third Bridge that is currently being built across the lagoon will not be directly connected to the Port facilities and it is expected that the truck traffic generated by the Port will not be using this new link.

Inside the Port area, the Boulevard du Vridi is supporting most of the traffic, as it is the only arterial road connecting all industrial areas. Furthermore, the capacity of this road is reduced by trucks parked on both sides of the road (see section 6.4.1(4)). Thus, the closure of this road could have a huge economic impact on the Ivorian economy.

Based on the above, new access roads will have to be built to ameliorate the efficiency of road cargo transport and reduce traffic congestion inside the industrial areas. In this section, various scenarios will be studied to evaluate the impact of each new infrastructure on the traffic entering or leaving the Port. In particular, focus will be put on the two new bridges that are planned to cross the Vridi Bay, namely the Vridi Bridge and the Vidri-Bietry Bridge. The impact of truck access restriction to the Plateau will also be studied to see if it has a real effect on the traffic condition around the Port area.

(2) New Road Infrastructures in the Vicinity of the Port

Several road projects have been planned in the Port area to relieve the pressure on the boulevard du Vridi. They are:

<u>The Vridi-Bietry Bridge</u>

This bridge will be part of a road connecting the Vridi Industrial Zone with the Boulevard du Canal. The purpose of this road is to provide local access between the two sides of the lagoon. Both sides of the lagoon have port associated activities. This bridge is associated with a committed land reclamation activity. However if the bridge is built without restraint then the road will act as an arterial road simply as a result of the continuing growth in congestion in Abidjan. This bridge will likely attract traffic from further afield then just the vicinity of Vridi.

<u>The Vridi Bridge</u>

This bridge will connect the Vridi Industrial Zone with the Third Bridge. It has been developed as part of the transport master plan. It provides a strategic crossing of the Vridi Lagoon that also links to the Third Bridge that is under construction. The Third Bridge also provides a link in the north to the existing west to east corridor of Boulevard Mitterrand. In fact this proposal forms the basis of continued network connectivity from the north of the city.

<u>The Vridi Northern Bypass</u>

The planned Vridi Northern Bypass will provide an additional link to the Port, running north of the existing Boulevard de Vridi.

(3) Context of the Detailed Analysis

The following section will concentrate on the two planned Vridi Crossings in conjunction with a variety of options including the restriction of truck movements in the vicinity of The Plateau, which is effectively the central business district of Abidjan. It is not usual to encounter the movement of especially heavy trucks in the vicinity of a central business district, especially as such a district normally also attracts a high level of the pedestrian movement.

The transport model that was used to study the impact of new access roads and truck restriction is the one presented in section (5). It follows the conventional four-stage approach (Trip End Models, Trip Distribution, Modal Split and Assignment) that has been well tried and found to be effective in many cities of the world.

(4) Descriptions of Various Options

The SDUGA transport model was developed from and calibrated against a series of surveys undertaken as part of the SDUGA project. The proposed SDUGA transport master plan consists of many additional road projects. For the analysis of the Port access options, only the above mentioned road projects[44] are

[44] The SDUGA public transport plan is included where it is not proposed on new roads to ensure that the analysis for the future properly takes account of the modal share between private and public transport.

included in the analysis. Forecasts for this analysis have been prepared for the future time horizon years of 2020, 2025 and 2030.

The traffic volume that will be crossing the Vridi Lagoon is also linked to traffic across the existing two city bridges, Felix Houphouet Boigny and General de Gaulle, as well as the soon to open Third Bridge. An important part of the Port access is the interaction between the crossing and the above mentioned bridges. For example, it is not good long term policy to be attracting heavy truck traffic through the central business district of the city, in effect the Plateau.

Part of the logic of creating a new crossing connected to the Third Bridge is to draw traffic away from the city bridges and move the said traffic towards the suburbs of Abidjan. The various options examined for the Vridi crossing are tested with and without restricted truck access to the Plateau. This will necessarily force truck traffic to use the Third Bridge. As an encouragement for trucks to use the Third Bridge, it is proposed that the toll for trucks be reduced[45] on the Third Bridge.

The Vridi-Bietry Bridge could take two forms, namely operating simply as a local bridge or as an arterial road. Both alternatives are considered as different scenarios or options in this analysis. It could thus act as a standalone arterial road or as a local road in conjunction with the Vridi Bridge, which would be acting as the arterial road. It is also proposed that in any case both alternative crossing points on the northern side of the Vridi lagoon be linked by a new Lagoon waterfront road on the edge of the reclamation area. In addition there is a proposed improvement of the existing Pierre and Marie Curie Road so this is also considered in the mix of options under consideration for the Vridi crossing.

The detail of the eight options, A to H is included in Table 6.1.

Table 6.1 Options under Consideration in the Analysis of the Vridi Crossing

Option	Network Changes				
	Vridi-Bietry Bridge	Vridi Bridge	New Lagoon Road	Improvement to Pierre et Marie Curie Road	Restricted Access to the Plateau for Trucks together with reduced Toll on 3rd Bridge
A	Arterial Bridge	-	-	-	-
B	Local Bridge	Included	-	Included	-
C	Arterial Bridge	-	Included	Included	-
D	-	Included	Included	Included	-
E	Arterial Bridge	-	-	-	Included
F	Local Bridge	Included	-	Included	Included
G	Arterial Bridge	-	Included	Included	Included
H	-	Included	Included	Included	Included

Source: JICA Study Team

(5) Traffic Impact on the Bridges Crossing the Vridi Bay under Various Options

By 2030, the traffic on all Vridi Bay crossings will increase from around 13,000 PCU per day in 2020 to 28,000 PCU per day depending on the various combinations of road improvements. This is seen in the examination of the tabulated results for Options A to H in Table 6.2 through to Table 6.4 for the time

[45] In terms of PCU, the truck toll is reduced by 50% in this analysis.

horizons of 2020, 2025 and 2030 respectively on selected key roads. The selected link[46] results for flows across the crossings are presented in Figure 6.6 through to Figure 6.13 for Options A through to H for the year 2030[47].

Table 6.2 Traffic Projections on Associated Roads in 2020

Option	Daily Traffic Volumes(PCU)					
	Existing Bridges	Third (HKB) Bridge	Vridi-Bietry Bridge	Vridi Bridge	Pierre et Marie Curie Rd	Boulevard Marseille
A	189,100	11,200	11,800	-	4,100	17,100
B	189,100	11,200	2,400	10,300	7,300	16,200
C	189,100	11,200	12,200	-	4,100	14,400
D	188,800	11,400	-	12,100	7,300	15,900
E	184,400	15,900	11,700	-	4,100	15,900
F	183,900	16,300	2,400	10,500	7,600	16,100
G	184,300	15,900	11,600	-	4,200	14,200
H	183,900	16,300	-	11,800	7,600	15,800

Source: JICA Study Team

Table 6.3 Traffic Projections on Associated Roads in 2025

Option	Daily Traffic Volumes(PCU)					
	Existing Bridges	Third (HKB) Bridge	Vridi-Bietry Bridge	Vridi Bridge	Pierre et Marie Curie Rd	Boulevard Marseille
A	266,500	27,200	22,300	-	6,000	20,700
B	265,900	27,700	9,300	14,600	12,200	20,400
C	267,400	26,300	22,400	-	6,300	19,400
D	266,000	27,700	-	18,500	12,200	19,900
E	260,900	32,800	20,200	-	6,200	21,600
F	259,600	34,000	7,200	15,000	12,600	20,300
G	260,700	33,000	21,900	-	6,600	19,200
H	259,700	34,000	-	17,600	12,500	19,200

Source: JICA Study Team

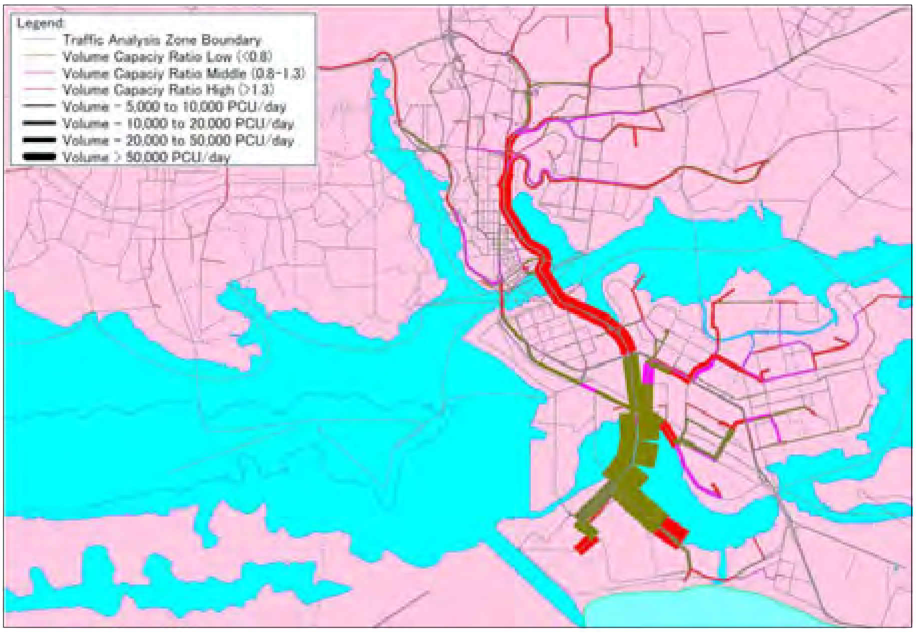
Table 6.4 Traffic Projections on Associated Roads in 2030

Option	Daily Traffic Volumes(PCU)					
	Existing Bridges	Third (HKB) Bridge	Vridi-Bietry Bridge	Vridi Bridge	Pierre et Marie Curie Rd	Boulevard Marseille
A	365,700	45,400	24,000	-	6,300	29,700
B	364,200	46,900	9,700	17,500	14,100	23,400
C	367,200	43,900	24,400	-	7,100	19,300
D	364,200	46,900	-	25,000	15,600	20,000
E	356,100	54,900	25,100	-	6,300	26,400
F	354,100	56,900	9,700	17,900	14,900	23,600
G	356,800	54,300	24,200	-	7,300	19,500
H	354,300	56,700	-	25,200	16,100	21,500

Source: JICA Study Team

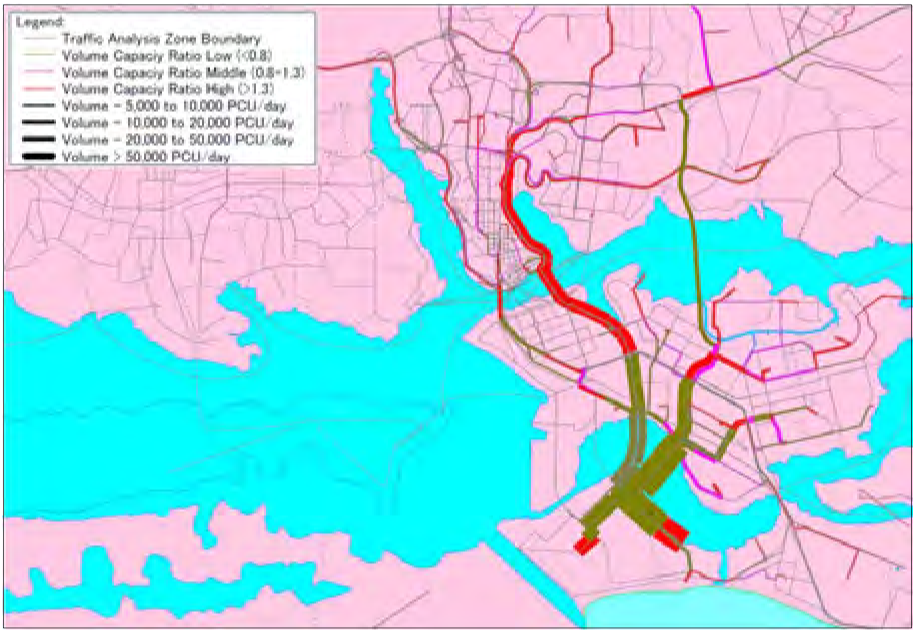
[46] A selected link analysis in this case as shown in the figures traces the pattern of flow on the links in the vicinity of the crossings. This is the flow that is using either of the crossings in the proposed options.
[47] This year is chosen for the select link analysis as it represents the year of nearing complete development of the port.

In the case of Options A and C that include Vridi-Bietry Bridge as an arterial road, traffic is drawn to this bridge from the existing General de Gaulle Bridge as shown in Figure 6.6 and Figure 6.8. The existence of this proposed bridge will draw traffic into the area of the Plateau to access the development associated with the industrial expansion in the vicinity of Vridi Lagoon; whereas, in the case of Options B and D as illustrated in Figure 6.7 and Figure 6.9, the Vridi Bridge draw a part of those traffic to the Third Bridge.



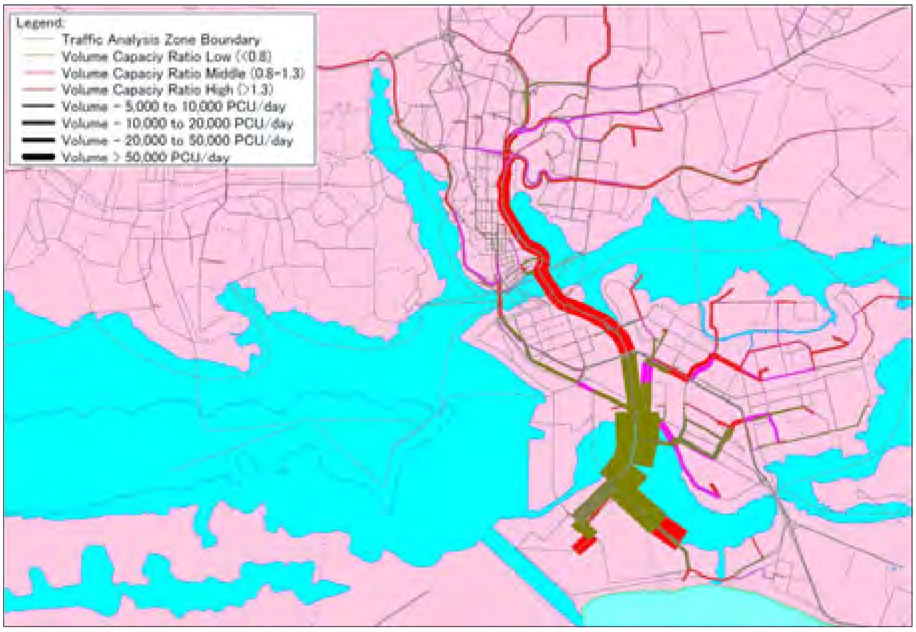
Source: JICA Study Team

Figure 6.6 Vridi Crossing Option A



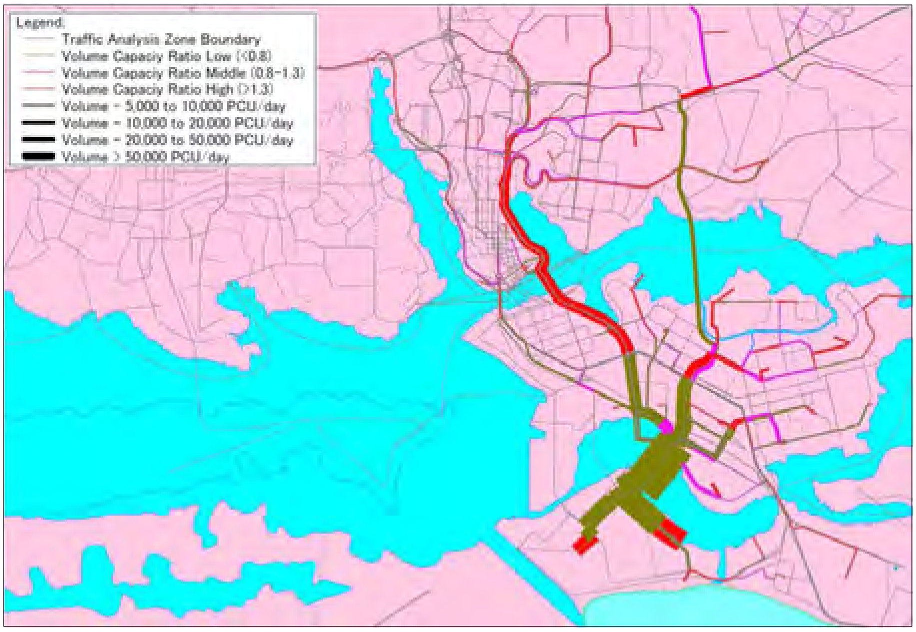
Source: JICA Study Team

Figure 6.7 Vridi Crossing Option B



Source: JICA Study Team

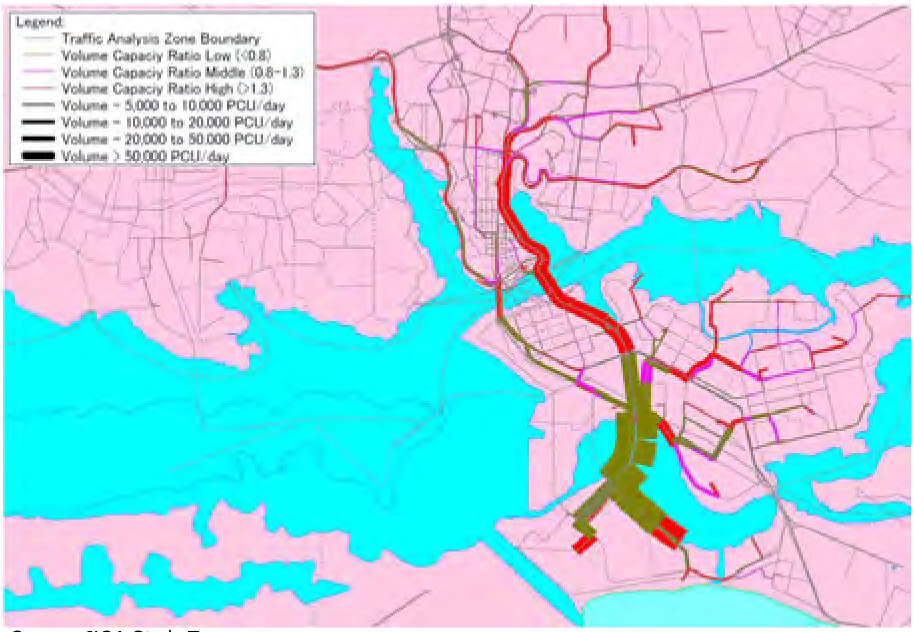
Figure 6.8 Vridi Crossing Option C



Source: JICA Study Team

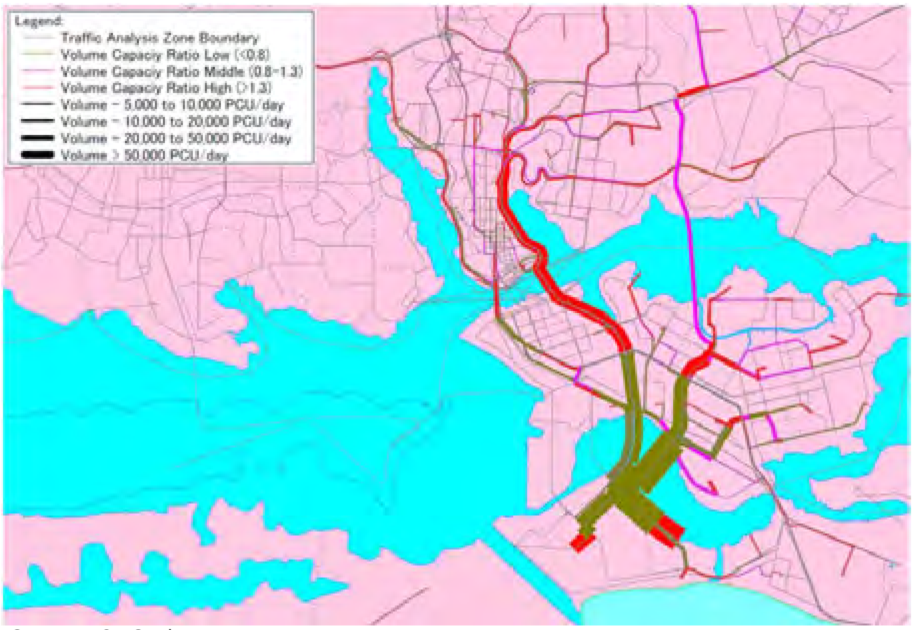
Figure 6.9 Vridi Crossing Option D

Truck traffic is drawn to the Vridi crossings away from the city bridge with the introduction of truck restrictions on the Plateau. Besides the actual traffic flows, one should consider the impact on key intersection in the vicinity namely Solibra and the intersections between Boulevard Marseille and Pierre and Marie Curie Road. In the latter case, the introduction of the new Lagoon road draws more traffic to this intersection. At the same time, the inclusion of this Lagoon road in Options C, D, G and H reduces the traffic on Boulevard Marseille by up to 35% in 2030 as seen in Table 6.4. The Pierre and Marie Curie Road is a critical part of this analysis. The inclusion of the Vridi Bridge proposal in Options B, D, F and H as seen in Table 6.2 through to Table 6.4 significantly increases traffic on this road.



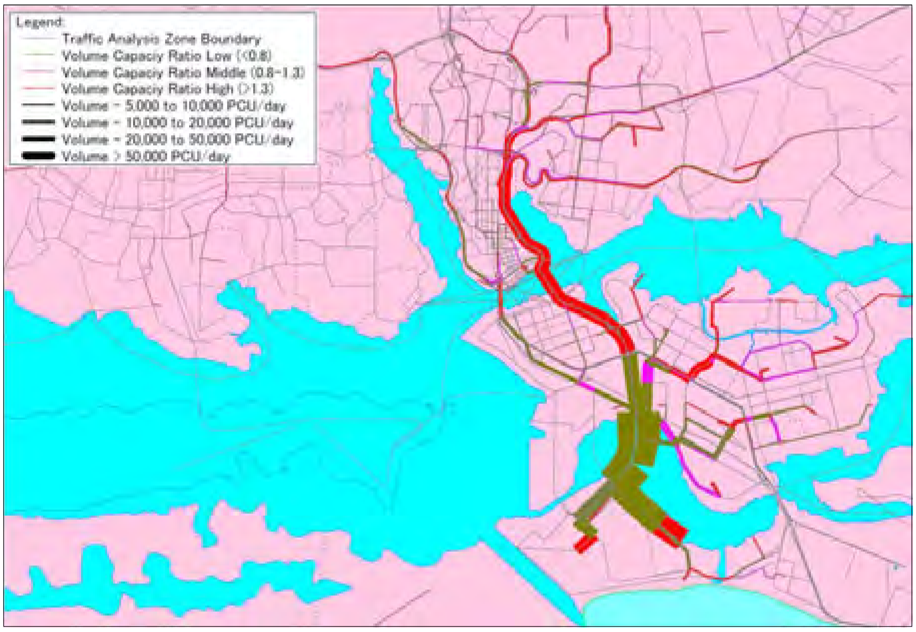
Source: JICA Study Team

Figure 6.10 Vridi Crossing Option E



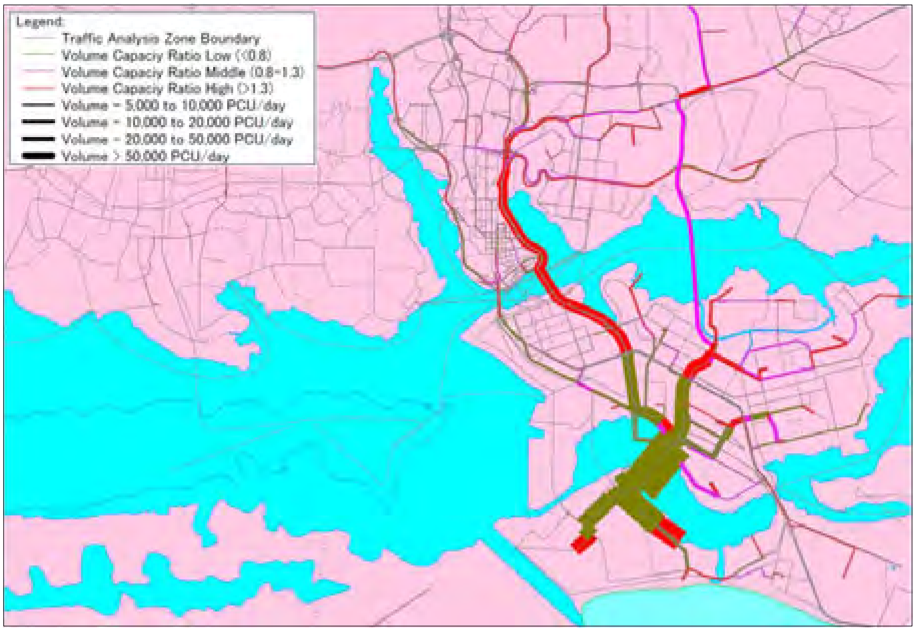
Source: JICA Study Team

Figure 6.11 Vridi Crossing Option F



Source: JICA Study Team

Figure 6.12 Vridi Crossing Option G



Source: JICA Study Team

Figure 6.13 Vridi Crossing Option H

However, at the same time, it should be seen that even with the Vridi-Bietry Bridge in Options A to C and E to G, the traffic on Pierre and Marie Curie Road will increase by up to 10,800 PCU per day between 2020 and 2030 thus likely requiring consideration for upgrading even without the Vridi Bridge.

The results are discussed in further detail for each option in the year 2030[48]. Under Option C, the highest traffic on the Vridi-Bietry Bridge is observed with a total of 24,400 PCU per day. However, in the case of option B that includes the local Vridi-Bietry Bridge and the strategic Vridi Bridge, the combined traffic is 27,200 PCU per day. In Option F again with the local Vridi-Bietry Bridge and the strategic Vridi Bridge but this time with Plateau truck restrictions, the combined traffic is 27,600 PCU per day.

In the options with and without Plateau truck restrictions but with a waterfront lagoon road namely Options C, D, G and H, there is a traffic reduction on the Boulevard Marseille. In effect, additional capacity is included in this corridor as a result of the inclusion of the new Lagoon frontage road. The options that include the Vridi Bridge proposal namely Options B, D, F and H as well as improvements to Pierre and Marie Curie Road attract significantly more traffic to this road[49]. With the introduction of Plateau truck restrictions, the proportion of truck traffic on the existing bridges decrease by 61%, from 27,600 to 6,800 PCU/day.

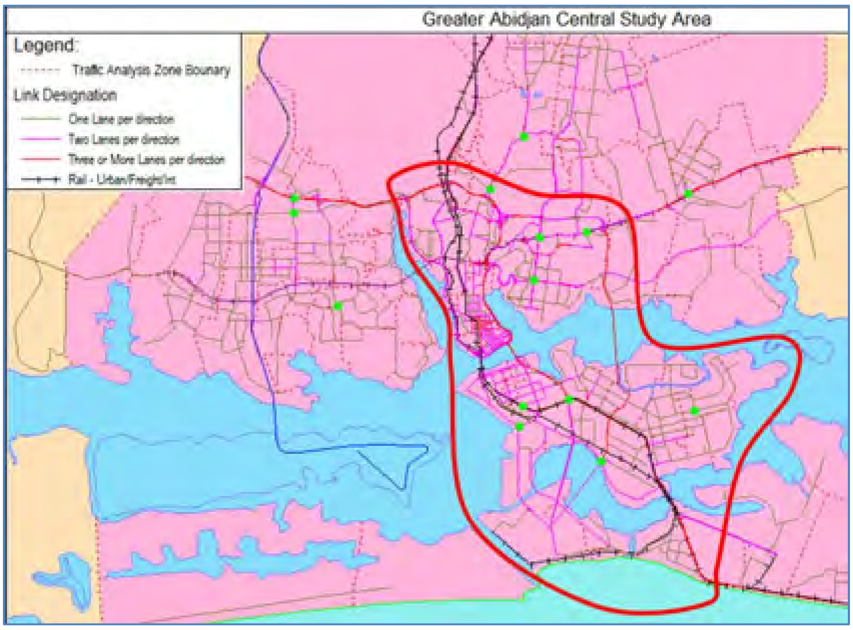
Another consideration is the economic impact of the inclusion of the Vridi crossings. The economic statistics namely PCU-km and PCU-hr of travel time were estimated across an area of influence as shown in Table 6.5 and Figure 6.14 across an area surrounding Vridi.

Table 6.5 Statistics associated with Economic Change

Option	Year:2020		Year:2025		Year:2030	
	PCU-km (thousand)	PCU-hr (thousand)	PCU-km (thousand)	PCU-hr (thousand)	PCU-km (thousand)	PCU-hr (thousand)
A	4,639.0	120.3	6,439.7	196.3	8,651.5	363.6
B	4,625.6	120.1	6,407.0	194.3	8,625.9	360.0
C	4,639.5	120.6	6,444.2	197.5	8,656.5	366.0
D	4,625.2	120.1	6,398.5	193.1	8,624.7	360.0
E	4,650.0	120.3	6,446.1	194.2	8,678.3	362.9
F	4,636.3	119.8	6,415.9	192.7	8,649.6	359.0
G	4,650.4	120.2	6,452.1	193.6	8,683.5	361.1
H	4,636.5	119.7	6,433.1	192.2	8,650.1	358.4

Source: JICA Study Team

[48] As stated earlier, the year 2030 is chosen for detailed discussion because by that year the port is expected to have undergone significant development. However the observations from the 2030 results are also evident in the results in the other time horizons.
[49] This fact will also need further considerations in further detailed evaluation.



Source: JICA Study Team

Figure 6.14 Economic Area of Influence

If Option E likewise is considered the base for those options with Plateau truck restrictions, then Option H represents the case with the lowest PCU-hr of travel in 2030 followed by Option F. However, Option F is more expensive. Thus, in both scenarios there is a strong economic case for the inclusion of the Vridi Bridge from the point of economic benefits[50].

(6) Recommendations on the Evaluation of the Bridges Crossing the Vridi Bay

It is apparent from the above discussion that there is a case for the Vridi Bridge proposal for the crossing of the Vridi Bay with or without the imposition of truck restrictions on the Plateau. Thus Options D or H are the preferences together with their associated road improvements. It seems that this is also a good time to implement a significant transport policy for removal of heavy trucks from the Plateau. Thus, the recommendation from this preliminary numerical analysis is Option H. Option H includes the following:

- The construction of the Vridi Bridge;
- The elimination of the proposed construction[51] of the Vridi-Bietry Bridge;
- The restriction of truck access to the Plateau[52];
- The Improvement of Pierre and Marie Curie Road; and
- The construction of a lagoon frontage road providing access from the new Vridi industrial area to the Vridi Bridge.

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[50] The economic benefits are indicative only as there is no consideration of the cost differentials between the two projects crossing the Vridi Lagoon.
[51] There is possibly a case for this as a local road but even that may not be in the best interest of PAA.
[52] The restricted access to the Plateau is complimented with a reduced truck toll on the Third Bridge.

(7) Traffic Impact of the Yopougon-Treichville Tunnel under various Options

The construction of the Yopougon-Treichville Tunnel is expected to reduce the traffic volume on the existing first and second bridges. Two cases, namely, cases with and without the Yopougon-Treichville Tunnel were studied with the transport model to forecast the future traffic volumes on the six existing/planned bridges crossing the lagoon. As shown in Table 6.6, with the construction of this new tunnel, the traffic on the two existing (FHB and GdG) bridges is expected to decrease from 267,000 PCU to 246,000 PCU per day. More significantly, all the truck traffic will be eliminated due to the provision of an alternative route under the truck regulation. The traffic volumes on the Fourth and Fifth Bridges are expected to decrease accordingly. Thus, this new infrastructure could have a positive impact on the traffic condition on the primary road network surrounding the Plateau area. Meanwhile, the impact of this tunnel on the public transport will be minimal, because this tunnel primarily aims at reducing the traffic burden on the existing two bridges connecting to Plateau and hence no public transport lines are planned through this tunnel.

Table 6.6 Traffic Volume with and without the Yopougon-Treichville Tunnel

[Unit: PCU / day]

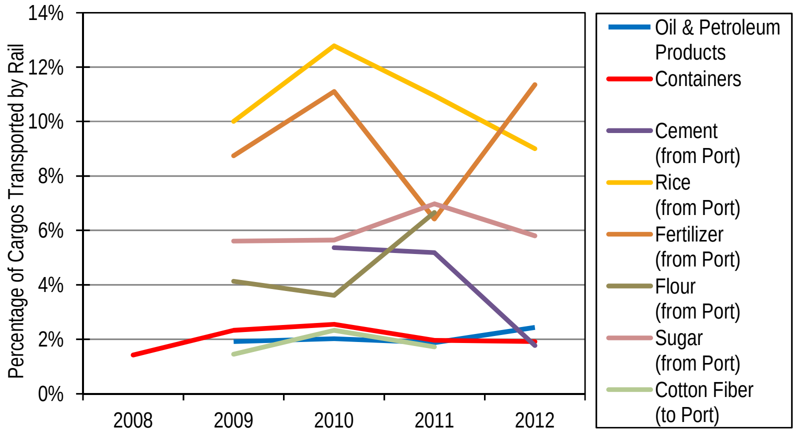
Road	Without Tunnel			With Tunnel			Difference from 'Without' Case		
	Total	Car	Truck	Total	Car	Truck	Total	Car	Truck
FHB Bridge (1st Bridge)	121,493	119,866	1,627	102,456	102,456	0	-15.7%	-14.5%	-100.0%
GdG Bridge (2nd Bridge)	145,265	145,226	40	143,260	143,260	0	-1.4%	-1.4%	-100.0%
HKB Bridge (3rd Bridge)	53,539	50,992	2,547	49,626	48,861	765	-7.3%	-4.2%	-70.0%
Jacqueville Bridge	5,768	5,679	89	5,695	5,606	89	-1.3%	-1.3%	0.0%
Fourth Bridge	71,836	64,898	6,939	59,934	59,229	705	-16.6%	-8.7%	-89.8%
Koumassi Bridge	50,661	50,199	462	50,678	50,274	404	0.0%	0.2%	-12.6%
Yopougon-Treichville Tunnel	N/A	N/A	N/A	48,204	37,797	10,407	N/A	N/A	N/A
Total Traffic Volume	448,563	436,859	11,704	459,853	447,483	12,370	11,290	10,624	666
Fifth Bridge	151,175	147,292	3,883	132,329	129,884	2,445	-12.5%	-11.8%	-37.0%
Vridi-Bietry Bridge	3,122	3,103	19	4,452	4,437	15	42.6%	43.0%	-22.8%
Vridi Bridge	22,503	21,288	1,215	20,005	19,804	201	-11.1%	-7.0%	-83.4%

Note: Option F (i.e., two bridges crossing the Vridi Bay with restricted access to Plateau for trucks together with educed toll on the Third Bridge) is applied to both cases. No toll is levied on the planned bridges and the tunnel.

Source: JICA Study Team

6.2.6 Characteristics of Rail Freight Transport

The trends of mode shares of major cargo items that were transported from/to the Port of Abidjan by rail are presented in Figure 6.15. While oil and petroleum products and containers are the major items transported by rail, as seen in Section 6.2.2, their railway mode shares are currently at a low level. Among the general cargos, rice, fertilizer, sugar, cement, and flour are holding certain railway mode shares.



Source: SITARAIL and Abidjan Autonomous Port

Figure 6.15 Trends of Mode Shares of Major Cargos Transported From/To Abidjan Port by Rail

6.3 Preliminary Investigation Report for the Grain Terminal of Abidjan Port

6.3.1 Present Situation of Abidjan Port

The Port of Abidjan is managed by Abidjan Port Authority (PAA), which is an autonomous body highly independent from the government.

Major roles and duties of the PAA are as follows:

- Planning, coordinating and management of port activities,
- Securing human safety and assets in the port area,
- Procurement of port equipment, and
- Construction of port facilities.

Many organizations are involved in port development, management and operation.

(1) Present Situation of Port Facilities

The Port of Abidjan has a water area of 1,000 ha. There are 34 quays with berths. The total area of warehouses and sheds is 140,000m^2 and that of open storage facilities is 105,000 m^2.

Almost all major port facilities were constructed by France in the 1950s. Accordingly, the port has not been able to cope with the recent trend of large vessels with deep draught. It can be said that major facilities of the port are obsolete and out-of-date.

Source: JICA Study Team

(2) Cargo Handling Volume

<u>International Trade Cargo and Container Cargo Volume</u>

At Abidjan port from 2007 to 2013. Average cargo handling volume is approx. 21,000,000 tons except in 2011, when the cargo handling volume dropped significantly due to the civil war. Imports account for 65% of the total handling volume and exports 35%. In general, imports have been increasing and exports decreasing.

Container cargo handling volume throughput of Abidjan port for export container cargo handling volume consists of 35% whilst import ration is 65%. Abidjan port was approx. 650,000 TEU except in 2010 and 2011, when the cargo handling volume fell due to the civil war. The cargo handling volume seems to have reached the handling capacity of the port.

<u>Main Grain Commodities and Handling Volume at Present Grain Wharf</u>

The largest import grain cargo is rice (1,310,000 tons), followed by wheat (670,000 tons) and sugar (300,000 tons). As to export cargo, cacao is the largest commodity (500,000 tons), followed by cashew nuts and coffee.

Transit cargo during 2007 to 2013 was to Burkina Faso, Mali and Niger of which 95% was to first two countries.

(3) Port working Facilities, Working Conditions & Warehouse

Number of bulk ships entered to Abidjan was 223 vessels where 65% was rice ship (152 vessels) and next was wheat and sugar ship (42 vessels, 29 ships).

The import ratio of Rice from year 2010 to 2013 was slow but it was seen to increase in 2012 because of the change of the rice tax system (1.77 million tons) in this year so it caused an unusual increase in import volumes.

Wheat handling using the Silo at North Wharf is attaining a higher ratio up to 3~4 times than standard 1.0 ratio, while the rice at West wharf was 120~130% just beyond 100%.

The major import cargo into Abidjan port, rice, occupies 86 % of the South wharf and it is clear that the quantities in 2014 are sharply increasing than 2012 and 2013.

(4) Entry of the Vessels

Abidjan calling grain vessels were approximately 10% of all called bulk carrier during 2010 to 2013.

Present working style is to load 50kgs rice bags into a net sling (30 to 40 bags per net) in the ships hold and lift them using the ship's gear which then swings them onto the shore side which is a standard in Abidjan.

The West wharf, there is one warehouse each (No.6 to 11).

The utilization of the warehouse during 2012-2014 second quarter, North wharf for Wheat was over 80%, West wharf for Rice, Sugar, Salt, Fertilizer etc. was 60% which is growing rapidly

We have examined the extract vessel waiting time outside the harbor and port stay time at the West wharf during 2012 and up to May 2014 the average port stay in Abidjan is increasing,

(5) Data and Information on Natural Conditions

Tide data of Abidjan port is H.W.L +1.60, M.W.L +1.10, L.W.L +0.80, C.D.L ±0.00

Rain fall and Temperature is between 24℃ and 28℃ throughout the year.

Wind Velocity and Direction Max 100km/h. Earthquake Not Applicable

Geological stratum of Abidjan is formed with clayish-sand and sandy-clay. Surface of the ground is covered by a humus layer 30cm thick.

In-situ soil condition testing has been conducted at the new grain terminal candidate area. The Menard Pressure meter test has been applied to confirm horizontal reaction force of each soil layer. Standard penetration test was not conducted.

6.3.2 Port Policy and Port Planning

(1) Abidjan Port in West Africa Zone

Transit cargo via Abidjan was over 70% before the civil war, but the most of such cargo was moved to via Cotonou, Lome and Tema transit during the war. It has been recovered via Abidjan up to 42% at present.

(2) Priority Development Projects at the Port of Abidjan

Cote d'Ivoire Port policy

Most important objective for the country is to enhance Abidjan facility and San Pedro port development, especially Abidjan logistic recovery is a target to increase transit cargo to inland countries taking off any obstacle environment at the border of each countries. San Pedro is developed more for cacao bean export and timbers and Minerals too.

Long Term Development Projects

As part of the long term future development of the Port of Abidjan, area development plans are proposed for Boulay Island and the West Bank Area of the canal where development has yet to take place.

The development of a large scale Free Trade Zone and container terminal is planned. An access highway connecting the island with the north area of Abidjan diverting cargo traffic from the urban area is also proposed. This project has also been authorized under the National Development Plan with the following budget during 2012 to 2015

- 280 billion FCFA for development of the Free Trade Zone

West Bank of the Canal Development

The development of the petrochemical complex is planned at the West Bank area of the canal with the relocation of the existing oil jetties and oil refineries that are currently on the East Bank of the canal to the West Bank, where oil jetties will not disrupt vessel transit of the canal. After the relocation of the oil jetties, the capacity of the canal will be greatly improved. The timing of the relocation of the oil refineries from the East Bank to the West Bank is not clear at present, and it may take a long time.

Those two long term development projects are still in the conceptual stage; however, some parts of these projects are recognized as urgent projects in the NDP. Although there seems to be some mismatching between maturity and priority of the projects, it is very important to implement a long term projects taking into account the limited water and land space at the Port of Abidjan.

(3) Preliminary Review for Justification of the New Grain Terminal Development Project

Consistency with high-priority plans

Many corridor plans featuring Abidjan Port are proposed by ECOWAS and other multi-national organizations. Those plans are given high priority.

In the National Development Plan, many projects concerning Abidjan Port development are highly evaluated among the projects to be carried out up to the year 2020. In particular, construction of the new grain terminal is given high priority. Accordingly, the new grain terminal project is consistent with high-priority plans and national policy.

Consistency with the overall port development plan

At present there is no comprehensive master plan for port development but there is an overall location map of all projects under consideration in the long term. In this plan, implementation priority of each individual project is not mentioned. Priority of each individual project might largely depend on the investors concerned. However, the new grain terminal is naturally given high priority equal to Vridi Canal or the second container terminal.

Accordingly, the new grain terminal project is consistent with the overall port development plan.

Consistency with policy to maximize utilization of the limited water area

A group of new container terminals are planned on Boulay Island. They are planned at the West end of Boulay Island which faces the West Quay across the water area. The new grain terminal is planned to be constructed by extending the face line of the West quay 300 meters toward Boulay Island.

The distance between the existing quay and Boulay Island is more than 1300 meters. There will still remain 1000 meters of open water after the 300 meters reclamation works to the offshore side.

It seems possible to coordinate the utilization of the water area between the new grain terminal and the container terminals, which are expected to be constructed in future on Boulay Island.

The new grain terminal project is consistent with the policy to maximize the utilization of the limited water area.

Consistency with road traffic management in the hinterland area

In the master plan study on the traffic of Greater Abidjan, the formulation of a trunk road network is proposed based on future traffic projections including cargo traffic to/from Abidjan Port, so as not to cause serious congestion in the hinterland area.

Accordingly, the new grain terminal project is consistent with the road traffic management in the hinterland area.

Coordination with other major projects in the port

The major projects which may significantly affect the implementation of the new grain terminal are Vridi Canal, the second container terminal and the new ore terminal.

6.3.3 Demand Forecast of Grain Cargo Handling Volume of Abidjan Port

(1) Target Years

Study team sets the target years as 2020, 2025 and 2030.

(2) Population Forecast in Target Years

As a population census has not been conducted in Cote d'Ivoire for a long time, the Study team refers to the data of "World Population Prospects: The 2012 Revision," which forecasts as below.

Table 6.7 Population Forecast of Cote d'Ivoire, Mali, Burkina Faso and Niger

[Unit: thousand]

Country	2013	2020	2025	2030
Cote d'Ivoire	20,316	23,675	26,414	29,035
Mali	15,302	19,077	22,319	25,698
Burkina Faso	16,935	20,463,	23,428	26,198
Niger	17,831	23,433	28,477	34,034

Source: UN + JICA Study team

(3) The Forecast for Grain Cargo Handling Volume of Abidjan Port for Cote d'Ivoire

Regarding grain cargo (Rice, wheat, cacao and coffee), Mali, and Burkina Faso (Rice, wheat and sugar) in the target years, Table 6.8 shows the grain cargo volume forecast by commodity.

Table 6.8 Result of Grain Cargo Handling Volume Forecast of Abidjan Port in Target Years

[Unit: ton]

		2020	2025	2030
Cote d'Ivoire				
Import				
	Rice	1,273,782	1,389,454	1,478,058
	Wheat	473,500	528,280	580,700
	Total	1,747,282	1,917,734	2,059,758
Export				
	Cacao	625,632	680,747	758,951
	Coffee	95,533	95,533	95,533
	Total	721,165	776,280	854,484
Total		2,468,447	2,694,014	2,913,242
Mali				
Import				
	Rice	143,078	167,393	192,735
	Wheat	88,024	105,855	124,439
	Sugar	73,662	88,900	104,781
	Total	304,763	362,147	421,955
Burkina Faso				
Import				
	Rice	217,190	246,017	266,356
	Wheat	171,662	196,795	220,063
	Sugar	108,746	128,263	146,482
	Total	497,599	571,075	632,902
Total				
Import		2,549,644	2,850,956	3,113,614
Export		721,165	776,280	854,484
Total		3,270,809	3,627,236	3,968,098

Source: JICA Study team

6.3.4 Bulk Carrier (Grain) Forecast at Port of Abidjan

(1) Vessel Size and Type

According to the Study team's investigation, vessels called at the West Wharf were in the 20,000DWT-60,000DWT range of which cargo weights loaded was not to the full capacity of the ship because West Wharf has only a 9.5 meters draft, therefore, full capacity loading is not possible for those larger sized vessels (ranged 8 to 13 meters in full draft).

There were 30% of the vessels which loaded over 12 meters draft and tend to increase more vessels in 2014.

A comparison with the other West African ports in Bulk Ship voyaging.

The number of the ports in West Africa is very limited compared with its land area and the populations. This is due to the natural conditions as the seacoast is not suitable for the establishment of ports and therefore, it is natural that the cargo volume and movements are smaller than in South Africa.

The type called Pana Max is in the 60,000 to 80,000DWT range and is often used for Wheat parcel carriage in bulk and this type usually has no ships gear.

This fact suggests that the future ships calling into Abidjan and the other West African countries will be the Handy Type and Handy Max type. Especially the Handy Max has its own ships gear and many of the same type have called at this port in the past after long haul voyages from the Rice growing areas in Asia.

6.3.5 Necessity and Development Policy for the New Grain Terminal

(1) Problems to Solve and Correspondence

<u>Quay Depth</u>

Grain vessels currently calling into Abidjan port are about 30,000DWT of Handy Size to 58,000DWT class of Handy Max type but the size of each varies.

The Handy Max type vessel has a draft of about 13 meters or more when fully loaded, therefore, at present they are adjusting to the existing West Wharf draft of -9.5 meters by only loading half of the maximum cargo of such type of vessel.

If the –depth of the water alongside the berth is increased to 15 meters, the cargo volume of Rice could be more than double at each calling so to increase the tonnage is not much of a problem.

<u>Congestion problems to solve at the Discharge yard</u>

After the rice is unloaded, some goes directly to the warehouse at the wharf, some is delivered directly to the domestic distributers, some to the cargo forwarder's warehouse for their own handling and storage purposes and a lot is transit Rice that goes to Landlocked countries such as Burkina Faso, and Mali, therefore there is congestion around the ships during the discharge operations due to the limited apron space.

In order to promote smooth delivery, we suggest creating a dedicated truck lane and having advanced meetings to preplan loading and unloading operations and truck sorting for each destination. Further we saw quite a lot of trucks in long queues on both sides of the main road that were waiting to obtain Customs approval or clearance. The New Grain terminal must solve this congestion problem together with smooth Customs clearance with ordinary truck lanes with allocated spaces.

<u>Improvement of anchor waiting time and working efficiency</u>

We need to consider to following points to improve.

i. VRIDI Canal dredging in advance

ii. Build the new Grain Terminal (Length 400 meters, Depth 15 meters)

iii. Equipment to be provided includes a Wharf Gantry crane and fork lift to handle 1 ton Flex-Bag loading onto the trucks.

iv. Implement Flex-Bag packaging for loading at the port and domestic delivery. The current Rice bags could be manually packed into Flex-Bags.

No.2 Container Terminal construction and conventional berth

As planned, the No.2 Container Terminal construction will close the South Wharf operations (No.17 to 20 with 437,683 tones in below) and those grain unloading operations must be shifted elsewhere on a permanent basis.

(2) Capacity plan to Meet Demand

Handling Capacity to meet Demand

The West Wharf shall continue handling all of the Grains (excluding Wheat) but the capacity is over 70% usage when used to the kind of discharges such cement imports.

Excluding the existing West Wharf 76,458 square meters, new grain terminal required back yard about 37,000 square meters, this equals six ware houses (on the basis of 1=6,000 square meters).

Wharf Handling Capacity

The new Grain terminal built after, the new wharf would be 400 meters in length which can accommodate two ships of the Handy Max type at one time.

However, when construction of the new No. 2 container terminal on the South Wharf started, Grain vessels were making a total of 6 berths in all.

Therefore, we have to institute economical and skilled operations by following best practices to facilitate handling 3 million tons of Grain per year.

We have forecast total Grain volume in 2025 would be 2.8 million tons and we put here two cases for examination for your reference which is capable except wheat into Silo.

We can handle 2.9 million tons using this method.

(3) Policy to Expand Handling Volume

We can propose the two following major processes.

I. Provide 15 meters depth at the quay at the new Grain Terminal to enable Handy Max type vessels to be fully loaded, consequently the discharge volume per vessel will largely increase and contribute to terminal handling volumes.

II. Working Rationalization. This way is to use a land side Gantry rail crane in addition to the ships gear, then four gangs would be workable at the peak. Furthermore, change the cargo packages from 50 kg bags to Flex-Bags (one ton) putting bags or bulk grain inside the Flex-Bags according to the domestic needs after discharge. This also shortens the ships port stay time.

We assume that an efficient truck lane for waiting, loading and unloading should be smoothly sorted out at the reclaimed new land. Cargo handling needs certain areas.

(4) Comparison of the Plans in the Request to JICA and the Proposal for the New Grain Terminal

Table 6.9 Comparison of the Plans in the Request to JICA and the Proposal for the New Grain Terminal

	Recommendation	Requested Project	Implementation
Deep Sea Berth	Depth -15m、Length 400m	Depth -15m, Length 400m	Available
Cargo Handling Equipment	Shore Cranes (Unloaders and Silos in case of handling wheat)	not included	Installation by private operator is expected
Improving cargo handling method	Introduction of large bags for cargo handling （Introduction of large folk lifts ）	not included	Consensus among shippers, consignees and shipping lines is required
Storage Facilities	Construction of more than six warehouses (around 4ha in total)	not included	Construction by private operator is expected
Alleviating congestion in the terminal	Expansion of truck lane Preparation of waiting area Sufficient cargo handling space	not included	Prepared by private operator is expected
Land space of the terminal	Further detailed estimation of required space is necessary	Reclamation of 10ha	detailed estimation in Basic Design

Source: JICA Study team

(5) Preliminary Evaluation of Feasibility of the New Grain Terminal Project

This project is very important and urgent to cope with the serious shortage of grain cargo handling capacity in the Port of Abidjan. As described in 6.3.2 (3), the new grain terminal project has been authorized in various high level plans such as the National Development Plan which describes the basic policy of the Government. It is also consistent with the overall port development plan, the policy for the maximum utilization of the limited water area in the port, and road traffic management in the hinterland.

6.3.6 Recommendations on the Further Development of the Port of Abidjan

Although there are many projects proposed for the development of the Port of Abidjan, there is no master plan for the long term overall development of the port. It is recommended to prepare a comprehensive and consistent master plan for the port development.

6.4 Future Freight Distribution Plan

The current freight distribution plan relies solely on the road network, concentrating all the cargo transport on inadequate and heavily congested roads. Furthermore, the movement of goods should not contribute to the decline in the quality of life and public safety, in particular in the CBD of Plateau but also in the residential areas of Yopougon, Abobo and Cocody. As the economy of Greater Abidjan relies heavily on the ability to move cargo effectively and efficiently, the freight distribution plan must be completely rethought.

The special issues to consider when establishing the future freight distribution plan are:

- Anticipation, planning and incorporation of future development plans, such as port expansion
- Identifying the areas currently served by trucks
- Development of the plan as part of a regional approach to moving goods

As described in Section 6.2, the main generator of cargo transport is the seaport and the Vridi industrial park. Those areas will have to be efficiently served by appropriate transport means to maintain their competitiveness and attract investment in the future. In addition, a new port and industrial area is planned on Ile Boulay and Ile Brake that will also have to be connected to the freight distribution system.

6.4.1 Freight Road Development Plan

(1) Future Truck Route System

The future truck route system is just one component of the overall freight distribution plan. As such, its elaboration must take into account other modes of freight transportation, such as rail. In this section, a brief description of the main requirements of the future truck route system and the major truck routes that should be planned and built will be described.

(2) Objective of the Truck Route System

The elaboration of the future truck road network system will have to:

- Help trucks avoid inappropriate or narrow streets
- Reduce traffic congestion inside the District of Abidjan
- Increase logistics options that will benefit businesses, transportation providers and consumers
- Improve the economic competitiveness and attractiveness of industrial sites at major distribution points
- Provide a major benefit to the District's economy

(3) Major Truck Routes

The proposed truck route system will rely on newly built roads, as illustrated in Figure 6.16. The following projects are some of the major truck routes that should be considered for the future truck route system in order to relieve the existing road network from the traffic burden caused by the trucks:

The Y4 Ring Road

The backbone of the truck route system will be the Y4 ring road planned around the urbanized area of the District of Abidjan. All the major international roads will be connected to this new ring road, allowing transit truck traffic to avoid the highly congested Plateau area and reducing the traffic on the urban road network inside the residential areas of Cocody, Yopougon and Abobo. Furthermore, the cargo delivered at the seaport will be diverted to this new Y4 ring road, and trucks will no longer have to go through the Plateau.

The Y4 ring road will not only improve the vehicular access to various industrial parks, but it will also offer better car traffic flow through the district as a whole by reducing the heavy vehicle traffic on the central road network.

The Vridi Bridge

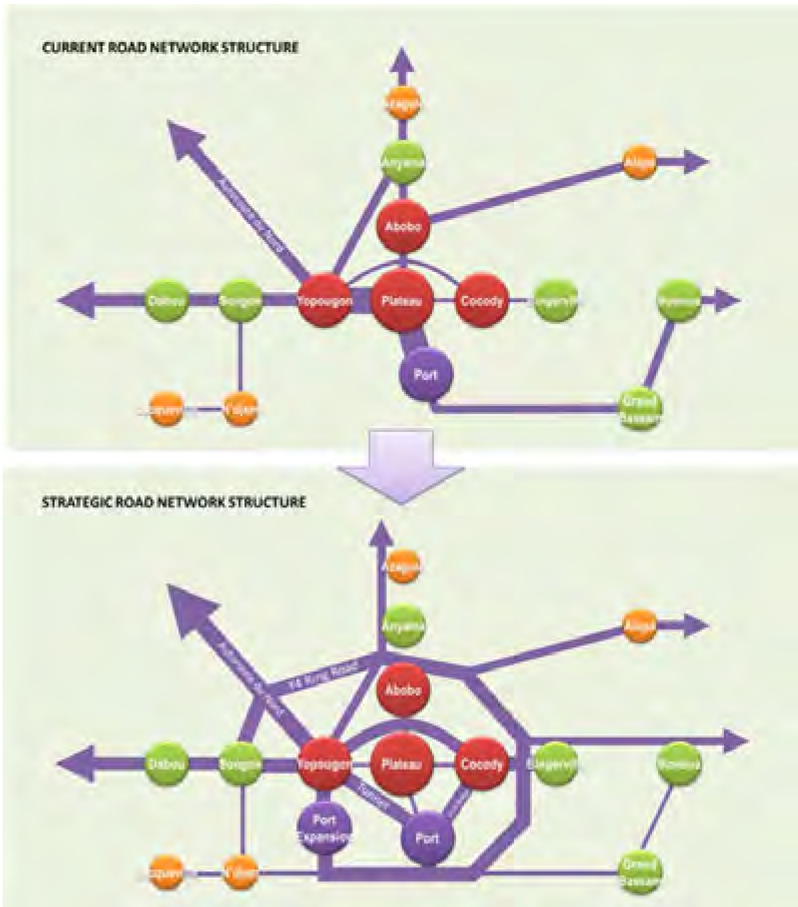
Currently, all the truck traffic generated by the port funnels through the two existing bridges, the Houphouet Boigny Bridge and the General de Gaulle Bridge, increasing traffic congestion on the boulevards surrounding the Plateau. The Third Bridge, which is currently under construction in Marcory, will not attract the truck traffic generated by the Port unless a reliable and fast link is provided between the Port industrial area, and the Third Bridge.

The Vridi Bridge has been planned to solve this issue, by connecting the Vridi Industrial Zone with the Third Bridge through the Rue Pierre et Marie road. This new infrastructure will provide a dependable alternative for truck drivers headed for the Autoroute du Nord.

The Yopougon-Treichville Tunnel and the Voie V6

The expansion of the Port to the south of Yopougon will generate important truck traffic volume between Treichville and Yopougon. In order to prevent those trucks from going inside the Plateau area, a tunnel has been considered connecting the Boulevard VGE and the planned Voie V6.

This new infrastructure will also attract traffic headed towards the Autoroute du Nord, as the Voie V6 will be connected with the Voie V28, which is also planned as a major truck route connected to the Autoroute du Nord.



Main Road Truck Route　　Main Truck Generator/Attractor

Source: JICA Study Team

Figure 6.16 Truck Routes

The Voie V28

The Voie V28 and the Fourth bridge will form the main truck routes connecting to the planned port expansion on Ile Boulay. Running through Yopougon, and connected to the Autoroute du Nord, the road will have to be designed to accommodate heavy trucks. Dedicated lanes for trucks could also be considered.

In order to relieve the Voie V28 cargo transport headed west will have a dedicated road running along the Jacqueville peninsula up to Songon, which will allow trucks to head directly to the western part of the country without having to transit through Yopougon.

The Northern Bypass of Bingerville

The Northern Bypass of Bingerville will be the main truck route towards the East. Connecting to the Y4 ring road and the Route de Bonoua, it will attract all the truck traffic from the east. The trucks will be forced to take this road instead of the Abidjan-Bassam Expressway, as the Grand-Bassam area is expected to become a major tourist area. This road will also function as a northern bypass of Bonoua.

The Northern Bypass of Bingerville with the Autoroute du Nord and the northern section of the Y4 ring road will be part of the Trans-West African Coastal Highway planned to link Dakar to Lagos. This transnational highway project is expected to link the West African coastal nations, from Mauritania to Nigeria.

(4) Development of Metropolitan Logistic Centers

In Abidjan, particularly around the Port of Abidjan, on-street parking of trucks has been causing a serious traffic problem, occupying road space and thus reducing the traffic capacity of the road. Such a situation of on-street truck parking is illustrated in Figure 6.17, focusing on the three most serious zones around the port. As analyzed in Table 6.10, in these zones, trucks are parked on both sides of the roads, including the main boulevards and local roads, occupying approximately 16% of the total road area in the Port Zone, 13% in Treichville Industrial Zone, and 6% in Vridi Industrial Zone. Those trucks staying by the roadside are impeding proper operation of the port and the industrial parks.

Source: JICA Study Team, based on the Google Earth satellite image

Figure 6.17 On-Street Parking of Trucks around Abidjan Port and Industrial Zones

Table 6.10 Number of On-Street Parking Trucks around Abidjan Port and Industrial Zones

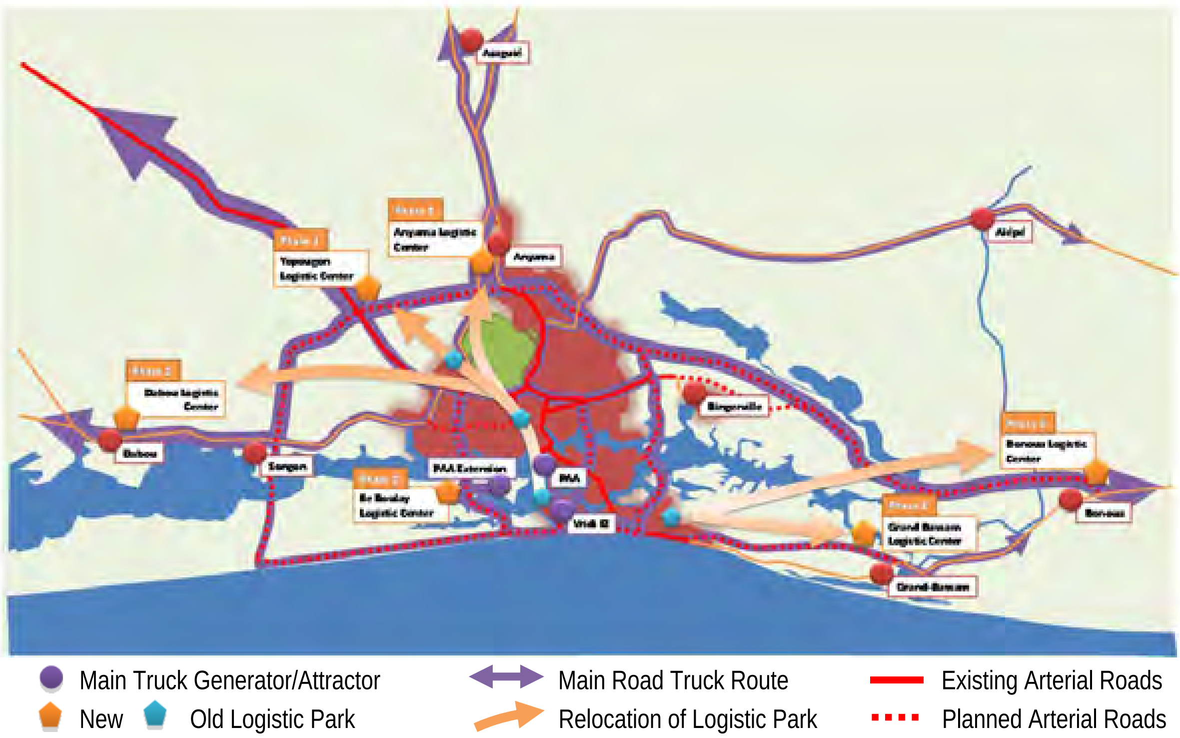
Zone	On-Street Parking Trucks	Area Occupied by Trucks (m^2)	Total Road Area (m^2)	Occupancy Ratio by Trucks (%)
Sea Port Zone	416	16,640	106,002	15.7%
Treichville Industrial Zone	258	10,320	77,096	13.4%
Vridi Industrial Zone	185	7,400	130,360	5.7%
Total	859	34,360	313,458	11.0%

Note: Area occupied by one truck is presumed to be 40 m^2.
Source: JICA Study Team, based on the Google Earth satellite image

According to OIC (Office Ivoirienne des Chargeurs / Ivorian Shippers Office), trucks are parked on the roadside around the port because trucks are overflowing from the existing truck parks whose capacity for trucks is seriously low. The only existing truck parking facility around the port is Vridi Logistic Park, where administrative customs formalities are processed for trucks loaded at the port and headed for neighboring countries. Its area is three hectares, with a capacity only 250 trucks. While there are two other locations for customs formalities outside the port area, one in Yopougon (serving trucks headed north or west) and the other in Gonzagueville (serving trucks headed east), the only free truck parking is located in Attécoube, with an area of about 1.5 hectares and a capacity of only 100 trucks, and it is not well managed.

Thus, it is obvious that more facilities for truck parking and customs procedures are needed. Under the jurisdiction of the Ministry of Transport, OIC is in charge of the facilitation of import and export by managing loading activities, especially trucks with loaded cargo transporting to and from Abidjan, including the port and industrial zones. OIC is currently planning to build a new logistic park at Akoupezedji, along Autoroute du Nord outside Yopougon (in the sous-prefecture of Anyama), to improve their operation. Fifty hectares have already been reserved for this purpose, also covering the functions of accommodation for the drivers, commodity pickup services, and so on. It is also included in the National Development Plan (PND).

Functions of the existing Yopougon and Attécoubé logistic parks will be transferred to this new metropolitan logistics center after implementation. It is also hoped that the congestion of Vridi logistic park and the surrounding industrial zone will be improved after the implementation of the project by transferring excess trucks to this new logistics center. Likewise, as shown in Figure 6.18, current parking and other ancillary facilities, such as customs for heavy goods vehicles and logistic vehicles in Gonzagueville, Yopougon and Attécoubé, shall eventually be relocated outside the urban area perimeter of towns, namely, Anyama, Grand Bassam, and Dabou. This will also help to reduce the number of heavy vehicles circulating inside the city.



Source: JICA Study Team

Figure 6.18 Development of Metropolitan Logistic Centers

Logistic centers have several functions, namely, functions of parking for trucks, customs clearance, storage, transit for through freight, transshipment to rail, distribution base, and consolidation/trading of products. Functions of the proposed logistic centers should be different from one to another depending on the conditions and locations, as presented in Table 6.11. Including Il Boulay, which will be placed just beside the new development area of the western part of the port, and Bonoua, which is expected to be a strategic integration base for agricultural produce collected from around Bonoua, there will be a total of six metropolitan logistic centers in Greater Abidjan. Development of those logistic centers and facilities will require a Traffic Impact Assessment and Environmental Impact Assessment for submission to the relevant authority and approval of the proposals by that authority.

Table 6.11 Functions of Proposed Logistic Centers

Functions	Yopougon (PK24)	Anyama	Dabou	Il Boulay	Bonoua	Grand Bassam
Truck Parking	Yes	Yes	Yes	No	Yes	Yes
Customs Clearance	Yes	No	Yes	Yes	No	Yes
Storage	Yes	Yes	Yes	Yes	Yes	Yes
Transit for Through Freight	Yes	Yes	No	No	Yes	No
Transshipment to Rail	No	Yes	No	Yes	No	No
Distribution	Yes	Yes	No	No	No	Yes
Product Integration/Trading	No	Yes	Yes	No	Yes	No

Source: JICA Study Team

(5) Future Regulations on Heavy Vehicles

Plans and regulations need to be developed to accommodate heavy vehicles on the Abidjan road network in an efficient manner, while trying to minimize the impacts to the surrounding areas, as well as rationalizing the efficient movement of these vehicles.

To implement such a truck route system, regulations have to be implemented to prevent trucks from entering the city center and to proceed only over established truck routes. Trucks entering the Abidjan District would be able to deviate only at the intersection of the street nearest to their destination point. Upon leaving the destination point, the truck should be required to take the shortest permissible route to the truck route. A possible alternative is to designate some truck routes that are to be closed to trucks from late evening to early morning hours so as to help improve the quality of life in these neighborhoods. For instance, the Voie V28 planned to connect the port expansion with the Autoroute du Nord, will be running inside the residential area of Yopougon. It will become a major truck route for freight transport but the road should be closed to trucks during the night. The recommended time interval for closing the truck routes would be from 10:00 PM to 6:00 AM.

Currently, such regulations cannot be implemented as there are only two bridges crossing the lagoon and connecting the industrial Port area, the main truck traffic generator, with the rest of the country. However, the construction of the Vridi Bridge, connecting the Vridi Industrial Zone directly with the Third Bridge, or the Yopougon Tunnel, bypassing the Plateau area by providing an access to the Port from Yopougon, will allow the implementation of such regulations.

(6) Integrated Freight Development Plan

The future freight distribution plan will have to improve the efficiency of the freight transport whilst also trying to reduce its environmental and social impacts on Greater Abidjan. Achieving sustainable freight distribution in Abidjan should be highly encouraged and will make a real and positive contribution to the traffic conditions but also to the lives of those who live, work and visit Abidjan.

It is important to reduce the amount of goods and freight transported by road through urban centers by encouraging a modal shift to rail through the provision of an upgrade freight rail system linked to logistic centers, as shown in Figure 6.19.

Main Truck Generator/Attractor
New Logistic Park
Old Logistic Park
Main Road Truck Route
Relocation of Logistic Park
Rail Freight
Existing Arterial Roads
Planned Arterial Roads
Freight Rail Line

Source: JICA Study Team

Figure 6.19 Integrated Freight Distribution Plan

In order to encourage a modal shift to the railways, it is necessary to improve and develop a freight rail network that will serve the port traffic not only in Cote d'Ivoire but also to and from the adjacent inland countries. It will also be necessary to develop a container marshalling yard and a freight station near the existing port and its expansion area to revitalize the operation of freight trains to deal with the freight railway traffic.

6.4.2 Freight Railway Development Plan

(1) Railway Rehabilitation Project (Abidjan-Ouagadougou)

Since 1995, SITARAIL has managed the railroad granted by the Burkinabe and Ivorian States under the concession agreement on railway operation and maintenance until 2030. Through its operational and commercial performance, in particular despite two successive operating interruptions (2002/2003 and 2011) by the Ivorian crisis, the Abidjan-Ouagadougou railway is soundly managed and has obtained a good reputation from the World Bank.

However, railway infrastructure still remains in relatively poor condition due to wear and tear and extensive degradation of the rail track, outdated equipment and the low axle load standard. In the NDP, rehabilitation of the Abidjan-Ouagadougou-Kaya railway line was referred to as NDP Ref: INFR_Action 3.4.1. And its objectives were stated as follows:

- Renovating at least 50% of the rails at curves, and the weak ones among the straight tracks
- Enhancing the efficiency of track maintenance
- Ensuring the continuous availability and safety of the track
- Identifying the speed of trains

1) Investment Program

The project will be carried out in three phases, as shown below:

- Phase 1: Infrastructure works and emergency equipment
  Phase 1 accounts for necessary countermeasures to secure normal train operation under the existing track standard and consists of spare parts provision and track rehabilitation works, of which 88% are upgrading work and 12% are renewal work.
- Phase 2: Track modernization for Abidjan-Ouagadougou-Kaya
  In phase 2, railway infrastructure will be modernized to international standards for whole sections from Abidjan to Kaya (Burkina Faso), including an increase of track axle load.
- Phase 3: Route extension
  In phase 3, the railway will extend from Kaya to Niamey.

2) Current Situation of Phase 1 Implementation

Phase 1 of the project is to be implemented within a four-year term from 2013-2016. Its annual investment plan is summarized in Table 6.12. The project is undertaken by Cote d'Ivoire and Burkina Faso, and each country's cost portion is indicated in Table 6.13 by breaking down the total cost.

According to the concession agreement, a newly created investment fund, which is compensated by partial gross revenue of SITARAIL, was supposed to finance rehabilitation cost. But recently, SITARAIL entered into a dispute with authorities due to its failure to finance anticipated track rehabilitation. Because of a relatively low volume of freight traffic and competition from the road sector, it is rarely possible for rail networks to earn sufficient revenue to finance track rehabilitation. In the case of SITARAIL, it is likely that the original forecasts, made at the time of the award of the concession, overestimated the likely freight traffic flows and underestimated the extent of the investment need.

Table 6.12 Summary of Investment Plan for Phase 1

No	Designation of Different Program	Cote d'Ivoire-Burkina Faso				
		total	Annual Investment Plan (Million FCFA)			
			2013	2014	2015	2016
1	Logistics support program and various equipment	14,212	9,150	4,937	125	0
2	Equipment procurement program, tools and various track material	45,454	13,436	16,970	8,676	1,272
3	Program of rehabilitation of the railway infrastructure	20,268	1,087	5,014	9,360	4,807
4	Various services for the rehabilitation of the railway superstructure	8,006	1,202	4,225	2,098	482
5	Security program and crossings of railway	3,974	107	881	2,017	969
6	Program of renewal and improvement of telecommunications	5,655	1,957	3,545	152	0
7	Program of rehabilitation of buildings and workshops	8,968	2,124	3,516	2,688	741
8	Program of study and work control	2,566	1,199	803	371	193
9	Program of capacity building	762	381	76	305	0
	Annual Investment Total		35,642	39,967	25,692	8,565
	Accumulated Investment	109,865				
	Contingency	3,296				
	Investment Grand Total	113,161				

Source: SITARAIL

Table 6.13 Investment Amount by Countries

Country	Total (%)	2013	2014	2015	2016
CI + BF	113.2	38.7	41.2	26.5	8.8
Cote d'Ivoire (CI)	66.6 58.8)	27.2	24.3	11.7	3.4
Burkina Faso (BF)	46.6(41.2)	9.5	16.9	14.8	5.4

Note: units in billion FCFA

Source: SITARAIL

(2) Freight Railway Development for the New Port in Ile Boulay

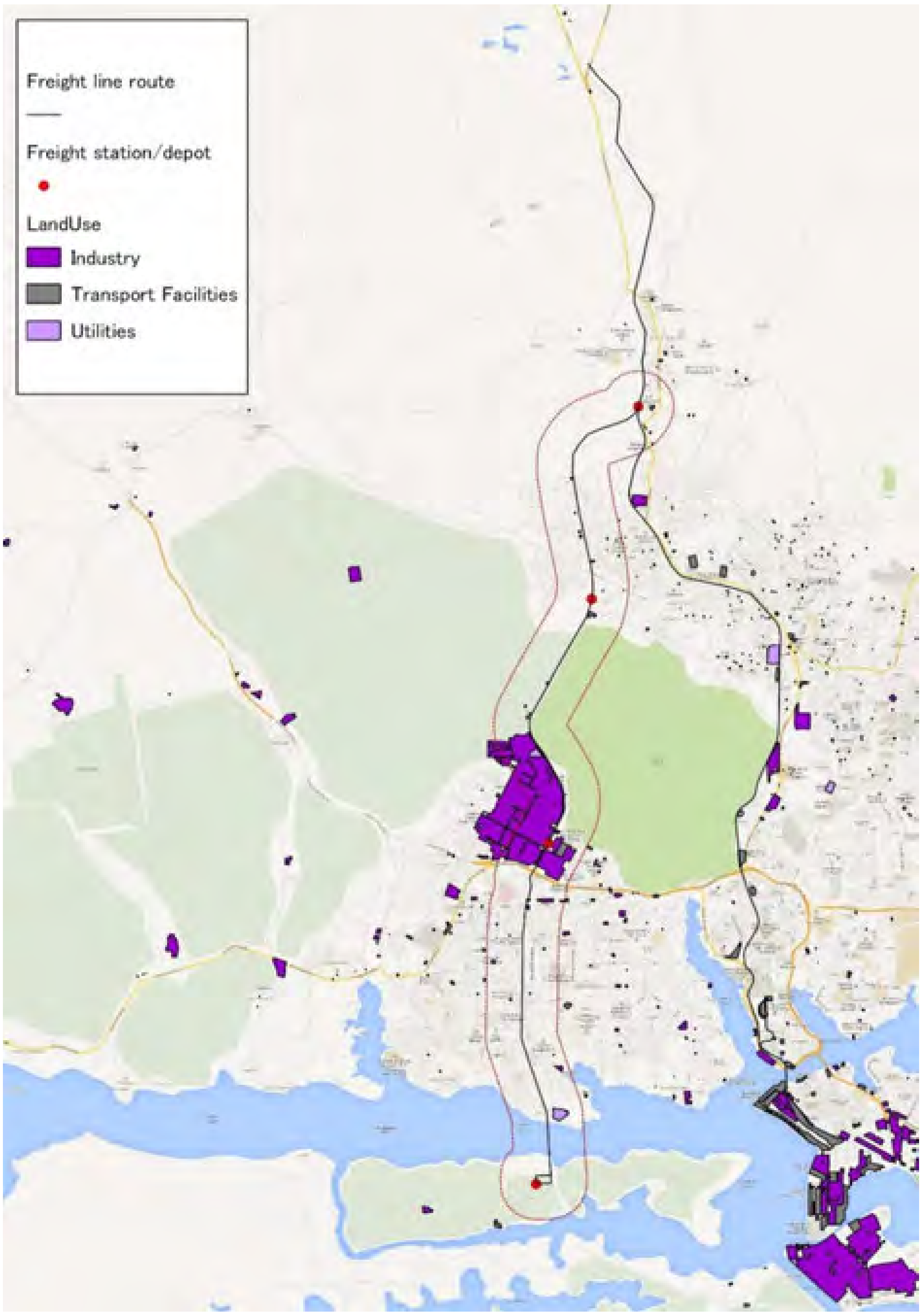
1) Background

According to the future port expansion plan of Abidjan Port, a new port location is planned in Ile Boulay, as shown in Figure 6.20. Regarding the freight access transport to the new port area, it seems that road transport will be provided by constructing a new bridge and access road.

Source: Abidjan Autonomous Port Authority

Figure 6.20 Future Port Expansion Plan of Abidjan Port

In addition to that, introduction of a new freight railway route is proposed in this study, as shown in Figure 6.21. This plan aims at not only supporting the new port development but also connecting port freight with inland industrial zones, such as Yopougon district, and integrating with the metropolitan logistic center in Anyama.



Source: JICA Study Team

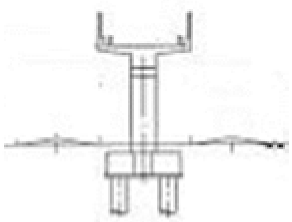
Figure 6.21 Proposed Freight Railway Route

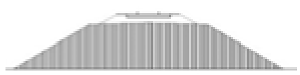
2) Freight Railway Plan

The proposed freight route is a single-track line with a length of around 24 km, as shown in Table 6.14, connecting the new port and Anyama freight terminal.

Table 6.14 Route Plan of Freight Railway Project (F-1-2)

Node	Kilometers	Remarks	Infrastructure Plan
1	0.0 km	Ile Boulay freight depot	Embankment section
2	1.03 km		Bridge section
3	2.24 km		Viaduct section with single track railway
4	10.22 km	Intermediate freight station in industrial zone	Embankment section
5	17.83 km	Passing loop siding	Embankment section
6	24.34 km	Anyama freight complex facilities	


Viaduct


Embankment

Source: JICA Study Team

3) Freight-Handling Facilities Plan

To handle cargo unloaded in the new port, the following facilities are proposed:

- A railway freight depot, in which train dispatch/arrival tracks and cargo loading/unloading facilities for container cargo, is located in Ile Boulay, as shown in Figure 6.22
- From the port area, unloaded/loaded cargo is transported by spur line between depot and port. Depending on the condition, truck transport is also used
- It is considered that the freight railway depot is to be developed not only for railway function but also for freight service function, such as warehouse function, customs clearance, etc.

Source: JICA Study Team

Figure 6.22 Location of Railway Freight Depot in Ile Boulay

(3) Development of Direct Container Freight-Handling Facilities

1) Background

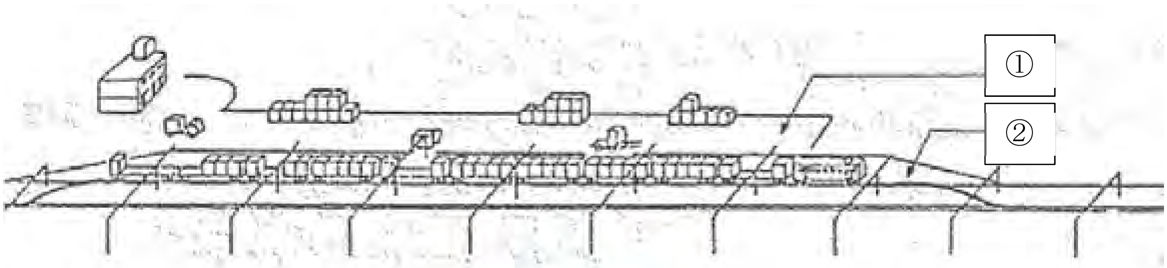
The primary commodity item currently transported by freight railway is container freight transport. Container transport demand is expected to grow steadily in the future under rapid growth of global logistics market. To gain competitive advantage under tough competition from other freight service providers, the railway container freight system based on the freight yard, should be changed from conventional method, which requires considerable lead-time, to a simple freight-handling system focusing on container freight.

2) Project Concept

The new container-handling system consists of a single container yard, which is used as the train arrival and dispatch line, and which makes it possible to carry out smooth loading and unloading work using loading equipment, such as top lifters, without time-consuming shunting work for freight cars describes this concept (Table 6.15).

Table 6.15 Outline of Direct Container-Handling System

Item	Description
Facilities	• Container yard receiving outside containers • Container loading & unloading area neighboring dispatch railway track • Special equipment for container cargo-handling (top lifter, etc.)
Railway freight service	• To cope with customers requesting shorter and more secure cargo transport, freight railway should be transformed, focusing on specific customer requirements. • Specific train operation, i.e., block train, express train, is prepared for the container transport services. • To improve railway freight service, it is important to integrate with truck hauling services.




Top Lifter

Source: JICA Study Team

3) Freight Railway Operation Issues

Currently, freight railway operation between Abidjan and Ouagadougou (Burkina Faso) is maintained by SITARAIL according to the concession agreement. However, its business performance might not be good enough to maintain self-sufficient business management. This is partly because of the poor physical condition due to the delay of railway rehabilitation, but partly because railway freight demand is not high enough to generate sufficient revenue. In this regard, it is most important for SITARAIL to make its business policy more market-oriented as follows:

- Restructure train operation to be suitable for freight transport trends, focusing on primary cargo needs such as oil transport and container transport, etc.
- Evaluate railway assets as essential core assets, which are essential to maintain principal train operation, and non-core assets, which might not be essential.
- To meet freight customers' needs more, total freight service performance should be improved through combination with feeder services, enclosing the truck hauler network.

7.0 SEA for Urban Transport Master Plan

7.1 Concept of SEA for Urban Transport Master Plan

An urban master plan and an urban transport master plan are one and indivisible. In general, therefore, the examination of options for the urban transport plan is not usually carried out apart from the urban master plan within the same study. In this JICA study, the options for urban transport were not prepared. The urban transport master plan has been examined to merge with six options, and the urban master plan, zero options. The planning objectives and strategies for the urban transport master plan, which was discussed in Chapter 1 of Part 6, will be evaluated from the viewpoints of environmental aspects in this section.

7.2 Environmental Evaluation of Goals of Transportation System Development

The goals of the transportation system development are identified in Chapter 2 as 1) efficiency, 2) equity and 3) better environment. The following table shows the goals and environmental evaluations.

Table 7.1 Goals and Environmental Evaluations

Goal of Transportation System Development	Description of Goal	Environmental Evaluation
Efficiency	• An efficient transportation system should be developed to strengthen urban functions, to enhance people's quality of life, to facilitate economic activities and to sustain stable economic growth in Abidjan. It is of great significance to achieve efficiency by decreasing negative externalities such as economic loss of travel time caused by increasing traffic. Efficiency in transportation can be achieved by balancing the growing travel demand and the transportation infrastructure supply or innate capacity.	• One of the goals for transportation system development proposed in this JICA study is efficiency. Efficient transportation is able to reduce travel time and distance, which in turn can reduce, 1) volume of air pollutants, 2) volume of greenhouse gases, 3) problems of noise/vibration and 4) traffic congestion and obstacles to smooth economic activities. These will lead to improved quality of life and economic growth conditions.

Table 7.1 Goals and Environmental Evaluations (cont'd)

Goal of Transportation System Development	Description of Goal	Environmental Evaluation
Efficiency	• There are three ways to balance the demand and the supply: 1) by increasing and recovering the infrastructure capacity to meet the demand, 2) by optimizing utilization of the existing transport infrastructure through efficient transportation control measures (TCMs), and 3) by decreasing excessive vehicular traffic demand through transportation demand management (TDM) and diverting private vehicle users to public transport.	
Equity	• Equity means that a certain minimum level of mobility should be assured and provided for all members of the society. Not only automobiles but also all modes of transport should have a right to share the public space and travel around the city freely and safely. • On the other hand, some low-income people cannot afford to pay expensive transportation costs. Some socially vulnerable people including the aged and the handicapped have difficulties in their mobility. An affordable and sufficient level of transportation services should be provided for those people, especially by improving the public transport system.	• Equity is also selected as one of the goals of transportation system development proposed in this JICA study. Equity means that all members of the society, including the socially vulnerable should enjoy the improved transportation system. • All members also should not have any inconveniences caused by urban transportation development. Some people will be impacted by the increase of air pollution, noise/vibration, involuntary resettlement, social damages to their life and livelihood. Careful correspondence with these people should be ensured at the FS stage of each project.
Better Environment	• As implied in the visions of Greater Abidjan for "providing quality living environments," air pollution and noises caused by automobiles should be minimized by promoting use of public transport and controlling traffic demand. At the same time, air pollution and noises should be reduced by applying stricter vehicle emissions standards. The abovementioned TCMs were originally designed to reduce air pollutant emissions. • In addition, traffic safety should be enhanced and the number of accident victims should be minimized through the enforcement of laws and regulations, intensive public campaigns and training and education of drivers as well as the general public. Improvement of traffic facilities through engineering design would also contribute to the reduction of traffic accidents.	• The reduction of air pollution, noise/vibration and traffic accidents provides a better environment.

Source: JICA Study Team

7.3 Environmental Evaluation of Urban Transportation Objectives

In order to achieve the above-mentioned goals of transportation system development, the urban transportation objectives, such as 1) enhancement of road network capacity that supports economic activities, 2) promotion of public transport use, 3) intermodal development/ transit-oriented development and 4) realization of an environmentally sound transportation system, are prepared. The following table shows the urban transportation objectives and environmental evaluations.

Table 7.2 Environmental Evaluation of Urban Transportation Objectives

Urban Transportation Objectives	Specific Policies	Environmental Evaluation
Enhancement of Road Network Capacity that Supports Economic Activities	• To structure a hierarchical road network to support multi-core, integrated urban sub-centers and to meet the growing future travel demand • To increase road capacity through development and improvement of the road network • To make the most of the existing capacity through efficient TCMs (transportation control measures) and avoid excessive traffic concentration through TDM • To structure a functional goods distribution system	• The development and improvement of the road network leads to reduction of air pollution and noise/vibration problems and contributes to reduction of greenhouse gas emission. These improve the environmental condition in the whole Abidjan area. • Some areas that face roads to be expanded or newly developed will worsen air pollution, noise/vibration problems and will cause some inconveniences to lives and livelihoods, such as community severances, change of livelihood means, unemployment, traffic congestion and accidents. The examination of alternatives and mitigation measures should be carried out at the FS stage. • The establishment of multi-core and integrated urban sub-centers, an increase of road network, introduction of TCMs and a functional goods distribution system lead to smooth traffic flow and reduction of traffic time and distance. These improve the environment by reduction of air/noise/vibration pollution and greenhouse gas emission and activation of economic activities. • These have may require land acquisition and involuntary resettlement. The efforts to minimize impacts by land acquisition and resettlement, including the examination of alternatives, the establishment of resettlement programs of compensation and a livelihood reconstruction scheme and a system to pay compensation and to secure relocation sites/housing before starting the relocation and construction works. The adequate RAP (resettlement action plan), including a monitoring system and procedure for processing complaints, should be prepared at the FS stage.

Table 7.2 Environmental Evaluation of Urban Transportation Objectives (cont'd)

Urban Transportation Objectives	Specific Policies	Environmental Evaluation
Promotion of Public Transport Use	• To improve the route structure and the level of service of the existing bus transport • To introduce new mass transit systems, preferably rail-based systems • To facilitate more effective dedicated bus lanes as a base of BRT (bus rapid transit) and organize intercity bus terminals • To keep the affordable public transport fare under supervision of one managerial body	• The improvement of bus transport and introduction of BRT provide a better environment through, for example, reduction of air/noise/vibration pollution and greenhouse gas emission. It will also not cause resettlement problems. Therefore, the enhancement of the bus transport system is a desirable policy. • Some people such as Woro-Woro/Gbaka drivers will lose their employment. An inclusive job-sharing system, including preferential employment of Woro-Woro/Gbaka drivers as bus drivers will be examined. • Introduction of a rail-based system is one of the best policies from the viewpoint of environmental aspects. It leads conversion from road traffic and it will reduce air pollutants and greenhouse gas emission. • The existing railway passes near national park areas and heavily populated districts. Impacts to the national park and resettlers should be examined at the FS stage. The examination of structures such as those that are elevated and underground, and preparation of RAP, is very important.
Intermodal Development/Transit-Oriented Development	• To enhance intermodality through development and improvement of transfer facilities • To apply functional transit-oriented development for major public transport corridors with a balanced urban spatial structure	• Intermodal and transit-oriented development is favorable from the viewpoint of environmental aspects. It leads to smooth traffic flow and reduction of traffic time and distance.
Realization of an Environmentally Sound Transportation System	• To apply TCMs to reduce air pollution • To enhance traffic safety and the environment through law enforcement and public campaigns as well as through user-friendly transportation facilities for all travel modes	• Introduction of TCMs and enhancement of traffic safety is a desirable policy for environmental protection.

Source: JICA Study Team

7.4 Environmental Evaluation of Strategic Transport Network Structure

In order to achieve the above-mentioned urban transportation objectives, a strategic transport network structure, including 1) a radial concentric road network and 2) an integrated transport network structure, is proposed. The following table shows the elements of the strategic transport network structure and their environmental evaluations.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure

Strategic Transport Network Structure	Description	Environmental Evaluation
Radial-Concentric Road Network	• The Ebrie Lagoon and the Banco Forest have been two major natural obstacles for the development of the road network in Greater Abidjan, preventing it from having one or several ring roads to divert transit traffic, which are used in most major cities. All the major roads connecting Abidjan to the rest of the country converge at Plateau and Adjame, the city center, concentrating all the traffic at one location. In addition, the only north-south access to the industrial area surrounding the port is the two bridges crossing the lagoon, which forces all the heavy vehicle traffic generated by the port to transit inside the city center. • The road network structure will have to be expanded in order to provide alternatives for drivers and relieve the roads surrounding the Plateau and Adjame. The first step will be the construction of the outer ring road Y4 that will connect all the major radial roads. The primary road network will thus change from the current concentric road network, to a new radial-concentric road network that will allow transit traffic to avoid the city center and provide fast and reliable connection between the suburban activity areas (refer to the following figure). 	• The concentration of traffic in the city center, especially at Plateau and Adjame, is the most serious concern for air pollution, noise/vibration and traffic congestion. The passing of heavy vehicle traffic in the city center is also a very important problem as it generates air pollution and vibration and congestion at the two bridges. • The creation of a radial concentric road network is indispensable to provide a better environment in the city center. The construction of the outer ring road Y4 will increase ability to avoid pollution and social inconvenience in the city center, and to create smooth traffic flow in the entire area of Abidjan. • The creation of a radial concentric road network will also spread traffic flow from the city center to throughout Abidjan. The environmental consideration at the area along rehabilitated roads and newly developed roads at the FS stage. • There is no environmental monitoring system for air quality and noise/vibration levels in Abidjan. Such a system should be established by a related agency as soon as possible to maintain a better environment and to evaluate impacts from road traffic.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
Integrated Transport Network Structure	(1) Development of infrastructures to support the Port of Abidjan • The Autonomous Port of Abidjan has been the natural transshipment hub port of the West Africa region. However, in recent years it has lost market shares to surrounding ports, such as Dakar, Tokorad, Tema and Lome, due not only to the socio-military crisis but also to the delay in the development of the port. The expansion of the Port of Abidjan to Ile Boulay has long been planned but the lack of appropriate infrastructure to cross the lagoon has been the main obstacle to its development. This expansion is crucial for the Port of Abidjan to keep competing for the subcontinent transshipment market as the existing terminal in Treichville does not have sufficient depth required to berth the latest generation of container ships. • The development of the transport and road network should concentrate on providing, in the near future, adequate transport infrastructure to allow the port to continue its growth. New links will have to be built around the existing port in Treichville, such as a Vridi bridge or Vridi bypass to provide alternative access and relieve the only road running through this area. Furthermore, the 4th bridge connecting Yopougon and Ile Boulay and the dedicated truck route connecting the island with Songon, should also be targeted as short-term projects (refer to the following figure). • The port expansion will also require the construction of a new freight railway connecting the Ile Boulay to the existing freight railway and the construction of a new logistic center near Anyama for transshipment.  Accessibility to the Port	• The development of Abidjan's port is an indispensable issue and fundamentals to Abidjan city development to activate economic growth, to create job opportunities and to improve lives and livelihoods, etc. • The master plan for port development of existing and newly developed ports in Abidjan should be studied with consideration of alternatives and zero option. The examination of the location of ports including areas facing the ocean. • In case of development with dredging of the lagoon and bridge construction development across the lagoon, a detailed survey of water quality and bottom materials, including heavy metals, should be implemented at the FS stage. Also, planning for the proper disposal of polluted materials should be carried out at the FS stage. • There is no data on water quality in the lagoon, which will be located by the ports. Before the port master plan study, a detailed investigation of water quality should be carried out, and a water quality monitoring system should be established by a related agency as soon as possible. • The construction of a new freight railway to the Ile Boulay and the construction of a new logistic center near Anyama will have potential for large-scale land acquisition and resettlement. Special attentions should be paid to proper route/structure selection and mitigation measures to avoid land acquisition and resettlement.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
	(2) Efficient cargo transport for industrial growth • The Greater Abidjan economy and freight transportation are closely related as an improvement in cargo transport can be expected to have important economic effects. Lower costs and more reliable freight movement have a positive effect on all industrial activities, as factories do not have to stay in the center of the city where available lands are limited and can get supplies from a wider area with potential gains in terms of cost. • The industrial sector is currently mainly located in the Vridi area, although there is a well-established industrial park in the northern part of Yopougon. Trucks have to transit through the congested city center, increasing the costs of goods carriage and causing a consequent drop in productivity, and this situation is expected to worsen as vehicle traffic grows and congestion increases. The urban master plan is proposing to implement industrial logistics outside the urban limit. In order to do so, the road network will have to be developed so as to connect all those new industrial areas with an efficient and reliable freight transportation system. • The Y4 ring road's main function will be to create a link between those industrial areas. It is expected to become the backbone of the transport and road network, allowing trucks to avoid the city center and generating, at the same time, improvements in economic productivity. Other projects, such as a direct link between Ile Boulay and the Autoroute du Nord or the creation of a new connection between Bingerville and Bonoua, are all part of this strategic structure to help increase efficiency in transport (refer to the following figure). 	• Industrial growth is one of the key issues to support the development of Abidjan. Cargo transport improvement is indispensable for industrial growth. • To avoid traffic congestion and passage of trucks in the city center, a logistics location outside of the city center is favorable from the viewpoint of environmental aspects. • The new development of road projects for cargo transport, such as the Y4 Ring Road, a direct link between Ile Boulay and the Autoroute du Nord, and a new connection between Bingerville and Bonoua, will be implemented. • These developments will require land acquisition and resettlements. The detailed survey should be carried out at the FS stage. • Heavy vehicles are passed in that route. Air pollution, noise/vibration, some inconveniences to lives and livelihoods, such as community severances and traffic accidents. These impacts also should be studied at the FS stage.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
	(3) Increase tourism potential with convenient access • The Atlantic Coast and Ebrie, Adjin and Potou Lagoons are targeted as major tourist zones with resort style hotels and facilities for domestic and international tourists. Jacqueville will be the main tourist destination in the west and Grand Bassam the "Tourist Gateway" to the eastern coast. • In order to attract tourism in those areas, the transport network has to be upgraded to provide convenient access. Roads will have to be upgraded or built to connect those future tourist hotspots and new transport means should be implemented that are more comfortable than the existing ones (refer to the following figure). The extension of the north-south urban train up to Grand-Bassam should provide the type of fast and reliable transport that tourists are looking for. • In addition, logistic infrastructure and heavy trucks should be kept away from those tourist zones by defining a proper truck route system which will avoid those areas in order to preserve the natural beauty of those places. 	• Tourism development is likely to have a relatively quick result with relatively low investment, will not require a high degree of skill for people engaged in the tourism sector and will lead to economic promotion through various kinds of private sector activities. • The uncontrolled development will be caused by construction of hotels, restaurants and souvenir shops. The major tourism zones in Abidjan are somewhat based on the natural and historical environment. Before proceeding with unsuitable land use, the tourism master plan study should be established as soon as possible.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
	(4) Reliable access for agricultural activity • From 2020 to 2030, the outer communes of Azaguie, Alepe and N'Djem are expected to see the development of major food processing plants in parallel to the increase in agriculture production. In order to support such growth, logistic support should be implemented and reliable and safe roads should be provided (refer to the following figure). The roads connecting Azaguie and Alepe will have to be reinforced and widened as some sections of the road have been damaged and trucks can no longer use those sections. • The growth of agricultural activity will also have an impact on the population size of the outer communes and appropriate public transport will have to be implemented. Bonoua and Dabou will be linked to the Abidjan District with BRT lines, providing fast and reliable access to allow commuters to easily travel between the city center and the peripheral areas. • In order to protect agricultural activity, urban sprawl will have to be controlled since it is land-consuming. The road network will have to be developed as a means to limiting urban development, such as the Bingerville Bypass that will block urban development from expanding towards the north. 	• The agricultural activity is also important for development in Abidjan. Therefore, road developments, especially connecting roads to Azaguie and Alepe, need to support agricultural production. • The new development road projects for connecting roads to Azaguie and Alepe are passing relatively low density population areas. Significant impacts are not forecasted, however, heavy vehicles are using those routes. Air pollution, noise/vibration and some inconveniences to lives and livelihoods, such as community severances and traffic accidents will be caused. These impacts should be studied at the FS stage.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
	(5) Modern transport reflecting the preeminent financial and business position in West Africa • The high level of mobility that guarantees the smooth and efficient transportation of people is one of the key issues for a developing economy. Thus a good transport system is an important indicator of the competitiveness of a city and failure to achieve this reflects an unsustainable use of the transport infrastructure. • For Greater Abidjan to keep its leadership role in Western Africa, a modern transport system is needed that does not only rely on roads but also on other more sustainable means of transport. Two mass transit corridors have been considered in the urban transport master plan.	• To achieve the preeminent financial and business position in West Africa is vital energy for Abidjan's development. It is the base of improvement for the social environment. • Therefore smooth and efficient transportation, including two mass transit corridors, is favorable.
	(6) Transport infrastructure to promote public transport use • The traffic surveys have shown that the main transport corridors are the east-west and the north-south axes. As the SDUGA goal is to achieve sustainable development, public transport should be promoted. Currently, public transport is limited to SOTRA buses, which are mostly using the same congested roads as private cars. Thus, public transport is providing a slow and unreliable service that is completely overmatched by other private transport. • The trend will have to be reversed and adequate transport infrastructure will have to be built to promote the use of public transport. A well designed transport system that is comfortable and more convenient to the public and is faster and cheaper than private cars can help reduce traffic congestion and accelerate economic growth. • In order to achieve such goal, adequate transport means with sufficient capacity to accommodate the traffic demand should be considered along the two main transport corridors (refer to the following figure). Urban train is one of the options for those east-west and north-south corridors. 	• The various kinds of facilities are concentrated in the city center, therefore the east-west and north-south axes are indispensable. • The promotion of public transport will provide smooth traffic flow and efficient vehicle movements, and will contribute to reduction of air pollutant emission, energy consumption and generation of noise/vibration. • Urban train is also an agreeable means because of the lack of exhaust air pollutants, and it contributes to the reduction of greenhouse gas emission. • Urban train in the city center will require large-scale land acquisition and resettlement, and might impact the national park. The detailed planning of the route/structure and preparation of adequate RAP should be implemented at the FS stage.

Table 7.3 Environmental Evaluation of Strategic Transport Network Structure (cont'd)

Strategic Transport Network Structure	Description	Environmental Evaluation
	(7) Improvement of the quality of life for its citizens • The goal of the SDUGA is to improve the community's well-being from a social, economic and environmental standpoint. Currently in Abidjan, traffic congestion, road accidents and packed buses are increasing the burden on commuters and negatively impacting the daily life of those living in Greater Abidjan. Commuters have to wait a long time at bus stops and buses are frequently jam-packed with passengers. • Furthermore, trucks are forced to transit the city center, creating traffic congestion, increasing the risk of accidents, deteriorating the quality of air and generating noise. • The improvement of the quality of life can thus be achieved by tackling those major problems, by providing a fast and reliable transportation network relying on an oriented public transport system. Such a system offers a clean, environmentally friendly and safe mobility solution, guaranteeing a high quality of life. A truck route will have to be provided to divert heavy vehicle traffic from the city center and residential areas. • As a result of this analysis, the following strategic transport network structure is proposed (refer to the following figure), based on the construction of new roads to connect the areas of major activities (industrial, touristic, food processing) and on the implementation of a mass rapid transit system that would provide a stress-free and reliable public transport system. 	• The improvement of the quality of life for its citizens is realized through providing a better environment, which is one of the goals of the urban transport master plan. • The problems caused by urban transport are 1) air pollution, 2) noise/vibration, 3) global warming, 4) traffic congestion and 5) traffic accidents. These problems can be relieved by the development that follows this Urban Transport Master Plan.

Source: JICA Study Team

Japan International Cooperation Agency (JICA)
Ministry of Construction, Housing, Sanitation and Urban Development (MCLAU)

The Project for the Development of the Urban Master Plan in Greater Abidjan in the Republic of Côte d'Ivoire (SDUGA)

Final Report

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Volume III
Urban Transport Master Plan for Greater Abidjan

Part 7
Project Prioritization and Implementation Program

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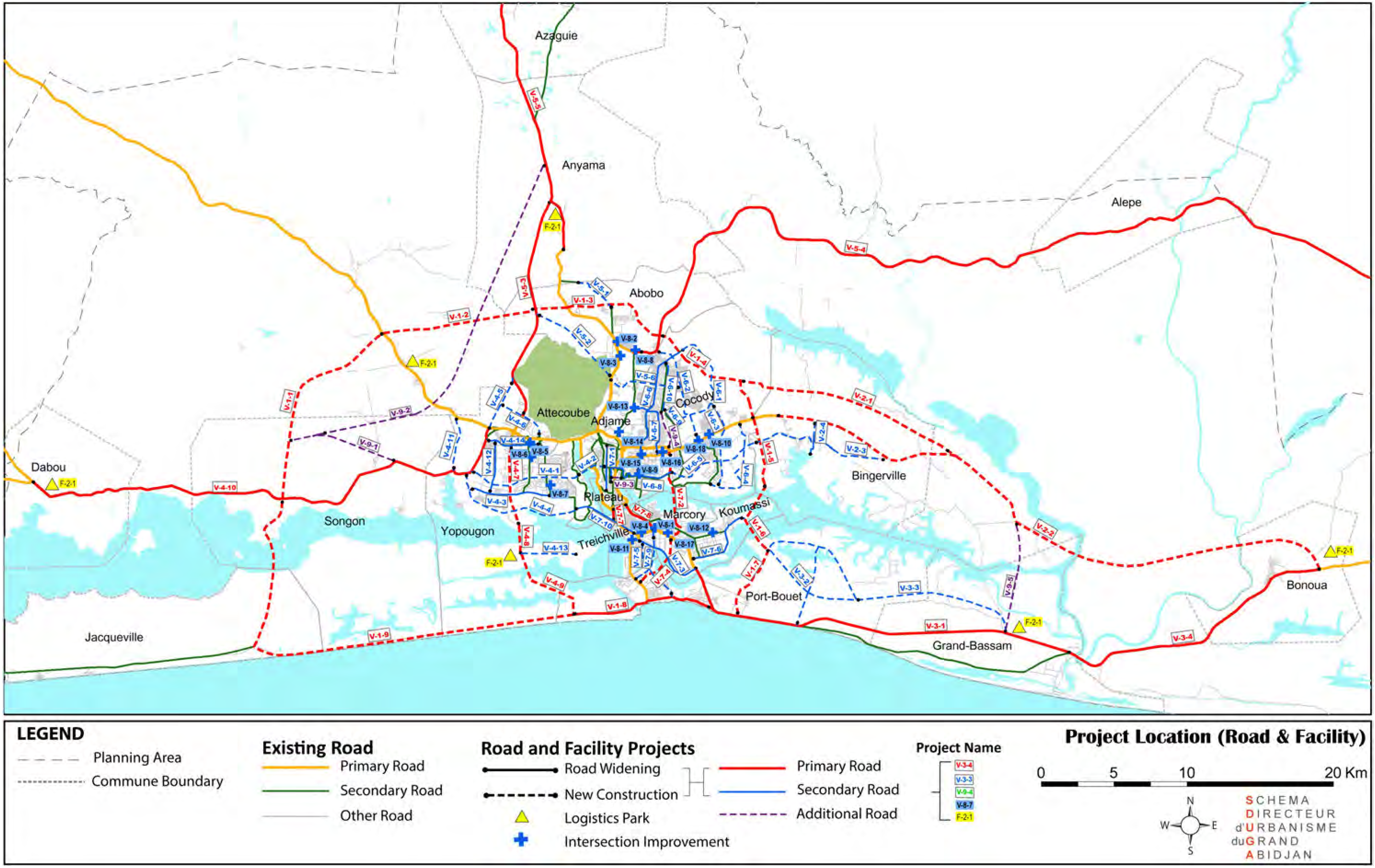
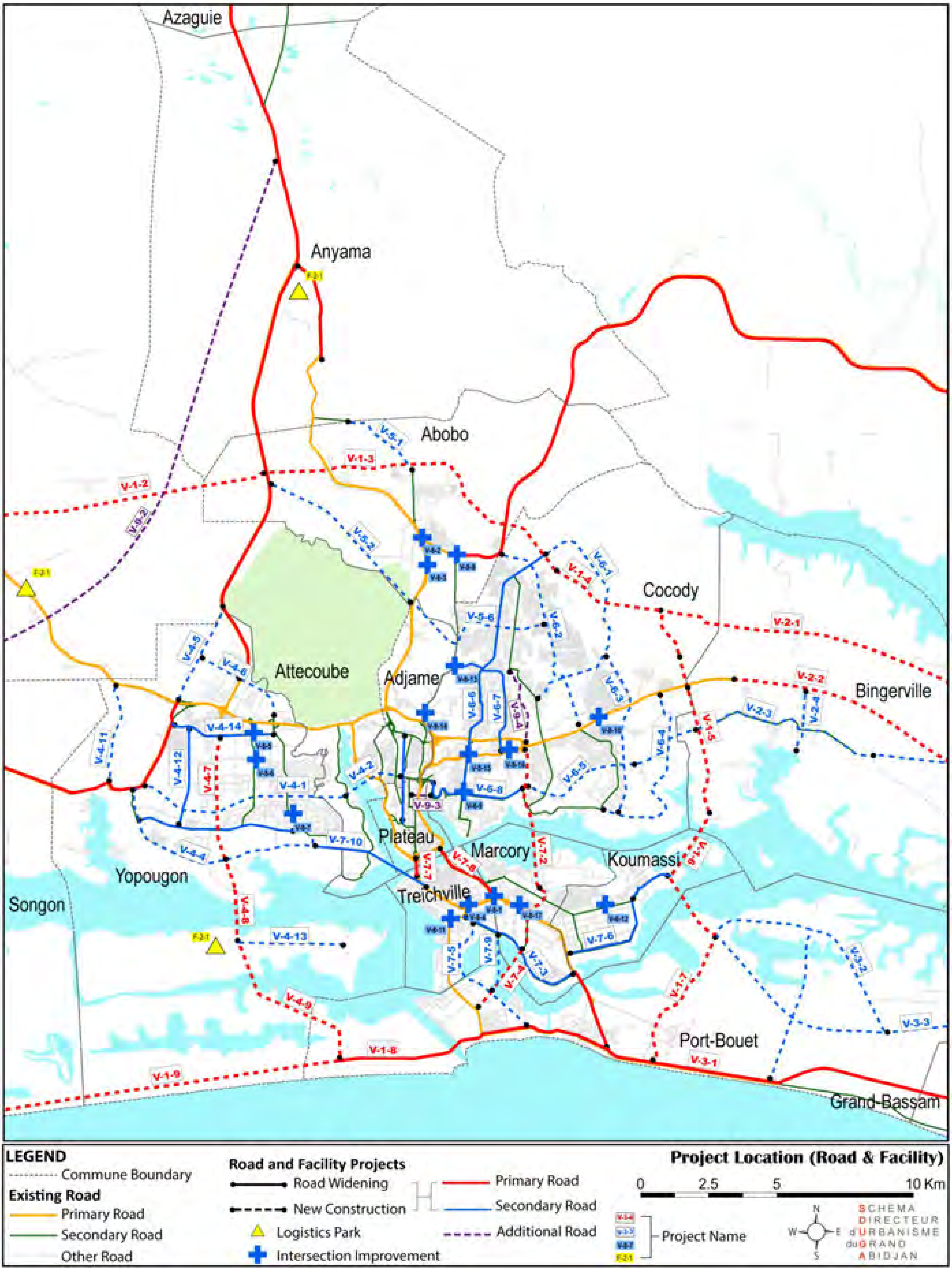


Location of Proposed Projects (Road and Facility) in Greater Abidjan



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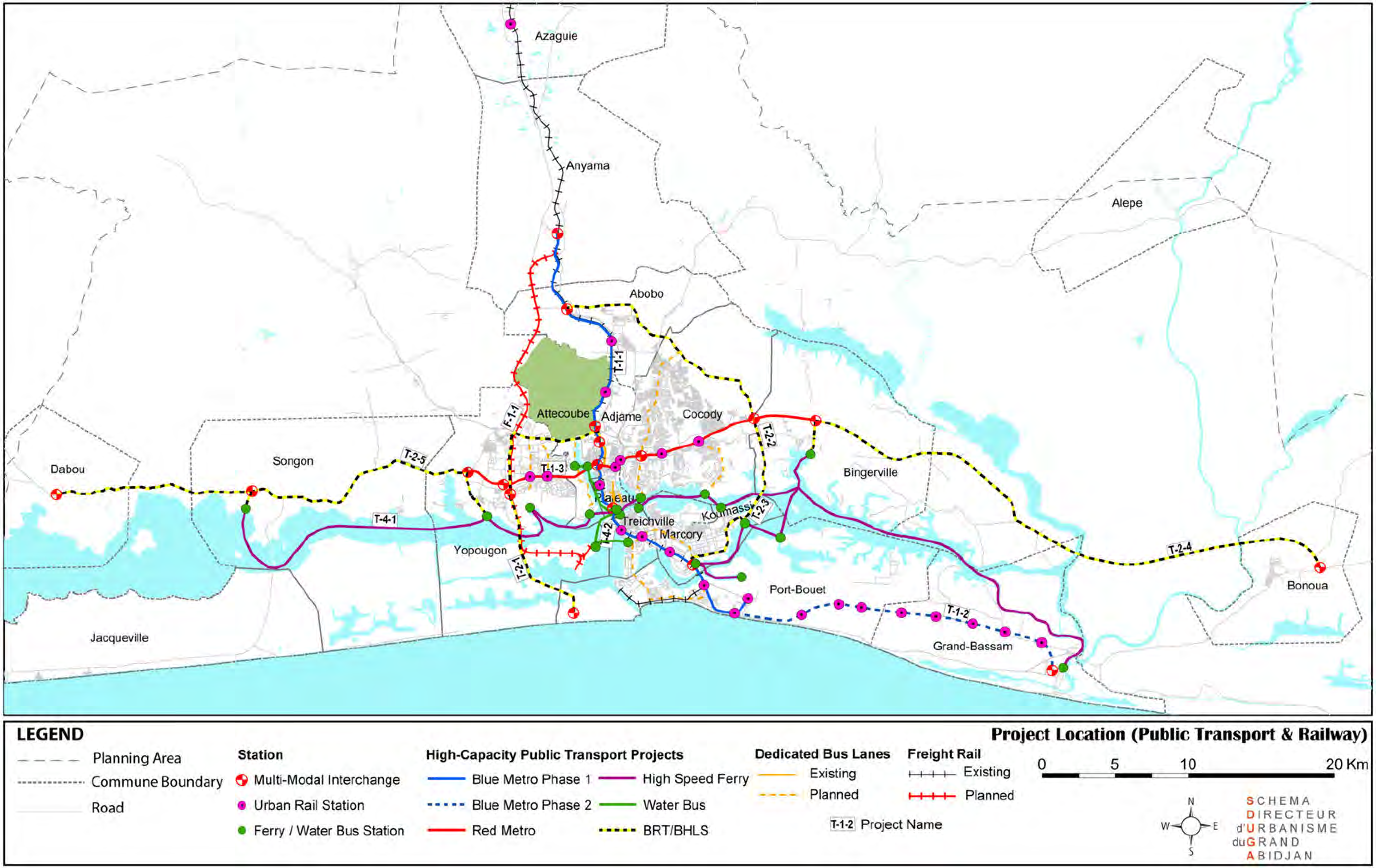


Location of Proposed Projects (Public Transport and Railway) in Greater Abidjan

Location of Proposed Projects (Public Transport and Railway) in Abidjan Autonomous District

1.0 Identification of Projects

1.1 SDUGA Long List

All the prospective development projects that have been proposed in Part 6 Urban Transport Master Plan are listed in Table 1.1 and Table 1.2 (for road sector), and Table 1.3 (for other sectors) along with the proposed period of implementation. A total of 118 projects have been set forth to be included in a long list. The total amount of investment for the listed projects is estimated at around 8.9 trillion FCFA or 13.5 billion Euros. Details of these projects are presented as Project Profiles in Appendix F.

Table 1.1 SDUGA Project Long List (Road Sector: V-1 to V-5)

Proposed Projects		Short-term						Mid-term					Long-term				
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
V	Road Development Plan																
V-1	Development of Y4 Ring Road																
V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section					■	■	■									
V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18				■	■	■										
V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section		■	■	■	■	■										
V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section		■	■	■	■											
V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section		■	■	■												
V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section		■	■	■	■	■	■									
V-1-7	Development of Y4 Ring Road - Aérocité Section	■	■	■													
V-1-8	Development of Y4 Ring Road - Canal du Vridi Section										■	■	■	■	■	■	■
V-1-9	Development of Y4 Ring Road - Jacqueville Section													■	■	■	■
V-2	Development of Bingerville Area Road Network (BiARN)																
V-2-1	Development of BiARN - Bingerville Northern Bypass								■	■	■						
V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand						■	■	■	■	■						
V-2-3	Development of BiARN - Widening of the Route de Bingerville			■	■	■	■										
V-2-4	Development of BiARN - Bingerville BHLS Road									■	■						
V-3	Development of Bassam Area Road Network (BaARN)																
V-3-1	Development of BaARN - Abidjan-Bassam Expressway (under constructio	■															
V-3-2	Development of BaARN - Aérocité Area	■	■	■													
V-3-3	Development of BaARN - Bassam Northern Bypass				■	■	■										
V-3-4	Development of BaARN - Widening of the Route de Bonoua															■	■
V-4	Development of Yopougon Area Road Network (YoARN)																
V-4-1	Development of YoARN - Voie V23 - Parkway Section	■	■	■	■	■	■										
V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section			■	■	■	■										
V-4-3	Development of YoARN - Voie V2							■	■	■	■						
V-4-4	Development of YoARN - Voie V6		■	■	■	■											
V-4-5	Development of YoARN - Voie V9						■	■	■								
V-4-6	Development of YoARN - Yopougon Industrial Zone Arterial Road									■	■	■					
V-4-7	Development of YoARN - Voie V28 - Northern Section	■	■	■	■	■	■										
V-4-8	Development of YoARN - Voie V28 - 4th Bridge				■	■	■	■									
V-4-9	Development of YoARN - Voie V28 - Southern Section									■	■	■					
V-4-10	Development of YoARN - Autoroute de l'Ouest			■	■	■	■										
V-4-11	Development of YoARN - Yopougon Western Bypass															■	■
V-4-12	Development of YoARN - Widening of the Voie V1											■	■	■			
V-4-13	Development of YoARN - Central Road of Boulay Island					■	■										
V-4-14	Development of YoARN - Widening of Siporex-Sable Link														■	■	■
V-5	Development of Abobo Area Road Network (AbARN)																
V-5-1	Development of AbARN - Extension of Q1			■	■	■											
V-5-2	Development of AbARN - Western Abobo Bypass															■	■
V-5-3	Development of AbARN - Extension of Voie N'Dotre				■	■	■										
V-5-4	Development of AbARN - Widening of the Route d'Alépé															■	■
V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo						■	■	■	■							
V-5-6	Development of AbARN - East-West Abobo-Cocody Link	■	■	■													

Source: JICA Study Team

Table 1.2 SDUGA Project Long List (Road Sector: V-6 to V-9)

Proposed Projects		Short-term						Mid-term					Long-term				
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
V	Road Development Plan																
V-6	Development of Cocody Area Road Network (CoARN)																
V-6-1	Development of CoARN - Extension of Boulevard Latrille		■	■	■	■											
V-6-2	Development of CoARN - Voie Y3			■	■	■	■										
V-6-3	Development of CoARN - Old Y4 Alignment								■	■	■						
V-6-4	Development of CoARN - Extension of the Boulevard de France					■	■	■	■								
V-6-5	Development of CoARN - Boulevard de France Redressé		■	■	■	■											
V-6-6	Development of CoARN - Widening of the Boulevard Latrille		■	■	■												
V-6-7	Development of CoARN - Widening of the Rue des Jardins					■	■										
V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche			■	■	■											
V-6-9	Development of CoARN - Widening of the Boulevard Attoban				▐	■	■										
V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche							■	■	▌							
V-7	Development of Central Area Road Network (CeARN)																
V-7-1	Development of CeARN - Voie Triomphale									■	■	■	■	■			
V-7-2	Development of CeARN - 3rd Bridge (under construction)																
V-7-3	Development of CeARN - Widening of the Boulevard de Marseille		■	■	■												
V-7-4	Development of CeARN - Vridi Bridge		■	■	■												
V-7-5	Development of CeARN - Vridi Northern Bypass					■	■	■	■								
V-7-6	Development of CeARN - Grand-Campement Arterial Road										■	■					
V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge		■	■	■	■	■										
V-7-8	Development of CeARN - Upgrade of General de Gaulle Bridge							■	■	■	■	■					
V-7-9	Development of CeARN - Vridi-Bietry Bridge				■	■	■										
V-7-10	Development of CeARN - Yopougon-Treichville Tunnel												■	■	■	■	■
V-8	Intersection Improvement																
V-8-1	Intersection Improvement - Solibra (Treichville)	■	■	▌													
V-8-2	Intersection Improvement - Mairie d'Abobo (Abobo)						■	■	▌								
V-8-3	Intersection Improvement - Banco (Abobo)												■	■	▌		
V-8-4	Intersection Improvement - Palais des Sports (Treichville)				▐	■	■										
V-8-5	Intersection Improvement - Siporex (Yopougon)		■	■	▌												
V-8-6	Intersection Improvement - Kenaya (Yopougon)							■	■	▌							
V-8-7	Intersection Improvement - Sapeur Pompiers (Yopougon)						■	■	▌								
V-8-8	Intersection Improvement - Samake (Abobo)						■	■	▌								
V-8-9	Intersection Improvement - St Jean (Cocody)		■	■	▌												
V-8-10	Intersection Improvement - Palmeraie (Cocody)				▐	■	■										
V-8-11	Intersection Improvement - CHU Treichville (Treichville)		■	■	▌												
V-8-12	Intersection Improvement - Inchallah (Koumassi)						■	■	▌								
V-8-13	Intersection Improvement - Zoo (Adjamé-Cocody)							■	■	▌							
V-8-14	Intersection Improvement - Williamsville (Adjamé)		■	■	■												
V-8-15	Intersection Improvement - Carrefour de la Vie (Cocody)				▐	■	■										
V-8-16	Intersection Improvement - Carrefour de L'Ecole Nationale de Police (Cocody)							■	■	▌							
V-8-17	Intersection Improvement - Carrefour de Marcory (Marcory)				▐	■	■										
V-8-18	Intersection Improvement - Carrefour Orca (Cocody)				▐	■	■										
V-9	Development of Additional Roads																
V-9-1	Development of an Alternative Road to the Route de Dabou								■	■	■						
V-9-2	Development of an Alternative Connection between Autoroute du Nord - Carrefour Thomasset											■	■	■	■		
V-9-3	Development of an Elevated Road over Cocody Bay				■	■	■										
V-9-4	Development of a Northern Extension of the 3rd Bridge									■	■	■					
V-9-5	Development of a Connection Road between Boulevard Mitterand and Grand Bassam												■	■	■		

Source: JICA Study Team

Table 1.3 SDUGA Project Long List (Other Sectors)

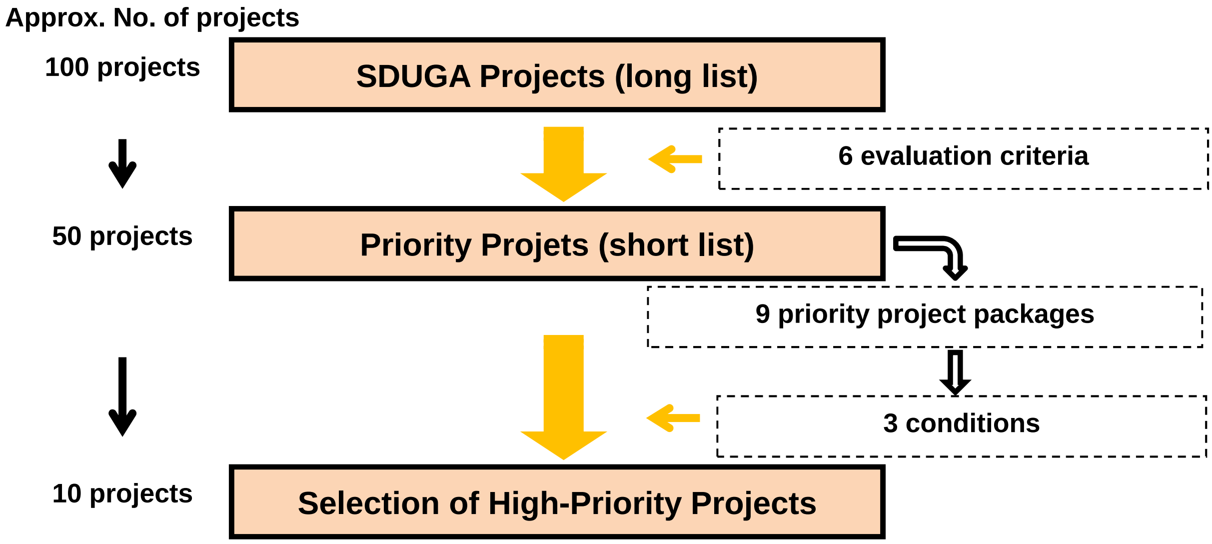
	Proposed Projects	Short-term						Mid-term					Long-term				
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
G	Traffic Control and Management Plan																
G-1	Development of Traffic Control System																
G-1-1	Development of Area Traffic Control System	■	■														
G-1-2	Development of Public Transport Priority System				■	■											
G-1-3	Development of Urban Traffic Information System	■	■														
G-2	Development of Public Transportation System																
G-2-1	Development of Dedicated Bus Lanes		■	■	■												
G-2-2	Implementation of Transportation IC-Card System											■	■	■			
G-2-3	Development of Bus Operation Monitoring and Control System								■	■							
G-2-4	Development of Public Transportation Operation Information Provision System										■	■					
G-3	Parking System Development																
G-3-1	Development of Parking Facilities/Parking Information System		■	■	■												
G-4	Development of Expressway System																
G-4-1	Development of Highway Traffic Control System					■	■	■									
G-4-2	Development of Electronic Toll Collection System												■	■	■		
G-5	Traffic Enforcement Assistance																
G-5-1	Development of Overloaded Truck Control System		■	■	■												
G-5-2	Development of Road Pricing System														■	■	■
G-5-3	Supporting System for Control of Illegal Parking									■	■	■					
G-6	Traffic Safety Assistance																
G-6-1	Pedestrian Facility Development for Better Environment	■	■	■													
G-7	Road Management																
G-7-1	Development of Road Surface Condition Survey System							■	■	■							
G-7-2	Management System of Information on Road Maintenance Works										■	■	■				
G-7-3	Development of Asset Management System															■	■
T	Public Transport Development Plan																
T-1	Commuter Rail Development																
T-1-1	North-South Rail Project-Stage 1 Anyama to Airport			■	■	■	■	■									
T-1-2	North-South Rail Project-Stage 2 Airport to Grand-Bassam												■	■	■	■	
T-1-3	East – West Rail Project (Yopougon to Bingerville)							■	■	■	■						
T-2	Bus Transportation Development																
T-2-1	Development of BRT Service: Adjamé – Braké Industrial Zone									■	■	■					
T-2-2	Development of BRT Service: Abobo – Koumassi Phase 1				■	■	■										
T-2-3	Development of BRT Service: Abobo – Koumassi Phase 2								■	■	■	■					
T-2-4	Development of BHLS Service: Bingerville – Bonoua												■	■	■	■	
T-2-5	Development of BHLS Service: Yopougon – Dabou												■	■	■	■	
T-2-6	Purchase of Additional Buses for SOTRA		■	■	■												
T-2-7	Pilot project of communal transport		■	■	■												
T-3	Intermodal Transportation Terminal Development																
T-3-1	Development/Improvement of Intermodal centers at Adjame, and Central/Southern					■	■	■									
T-4	Water-based Transportation Development																
T-4-1	East – West High Speed Ferry Service (Songon - Grand Bassam)		■	■	■												
T-4-2	Water Bus - Attecoube to Treichville	■	■	■	■												
F	Freight Transport Development Plan																
F-1	Railway Transport Services																
F-1-1	Developing Direct Container Freight Loading & Unloading System				■	■											
F-1-2	New Freight Railway Connecting to Western Part of Abidjan Port							■	■	■	■	■					
F-2	Truck Transport Services																
F-2-1	Metropolitan Logistic Center Development	■	■	■					■	■	■						
O	Organizational and Institutional Arrangements																
O-1	Establishment of Agency/Commision																
O-1-1	Establishment of Road Projects Implementation Commission		■	■	■												
O-1-2	Establishment of ITS Cote d'Ivoire				■	■	■	■	■								
O-1-3	Establishment of Clearing House Organization										■	■	■	■	■		
O-1-4	Development of Transport Planning Centre of Excellence		■	■	■	■	■										
O-2	Public Transport Services																
O-2-1	Reorganization of SOTRA Bus Services			■	■	■	■	■									

Source: JICA Study Team

1.2 Procedures for Selection of High-Priority Projects

Prioritization of the candidate projects for the feasibility study (F/S) was examined in terms of the evaluation criteria including the future demand forecast in the next chapter. The entire process of selection of the high-priority projects is presented in Figure 1.1

Based on the SDUGA urban transport master plan, a long list of about 100 projects have been set forth, as explained in the previous section. Then, in Chapter 2, a multi-criteria analysis was performed using the six evaluation criteria, and about 50 projects have been identified as priority projects to be included in a short list. These priority projects have once again been discussed in terms of development orientation to be grouped into nine packages of priority projects in Chapter 3. Finally, in Chapter 4, after due consideration of the idea of each project package, three conditions have been proposed in order to select about 10 high-priority projects that could be the candidates for the F/S.



Source: JICA Study Team

Figure 1.1 Overall Process of the Selection of the High-Priority Projects

2.0 Evaluation of Projects

2.1 Economic Analysis

The main purposes of economic analysis regardless of country/place and/or economic sector(s) are:

- To monetize investment project (or investment project group) technical features into related cost and benefit streams with a view to compare the benefits that can be harvested in the "without" (do nothing scenario) against the "with" (investment realization) cases;
- To determine whether monetized benefits exceed monetized costs under a given and/or selected rate-of-return (ROR) assumption (for example, for World Bank funded projects assume a standard ROR of 12%). The standard indicator is "net-present value" (NPV). A negative NPV (discounted net benefit streams) may eliminate a certain investment project as being "uneconomical";
- To determine the "economic-rate-of-return" (EIRR) of an investment and/or investment group;
- To filter through and rank investment projects and/or project groups in line with their respective EIRRs. The silent assumption being that the higher the EIRR the higher rank of priority the project(s) should have for realization; and
- To support the decision process of policy makers for the type and phasing of the investment project(s).

The economic analysis of the SDUGA transport projects has two broad and simple objectives, namely:

- Objective 1: To present and discuss the primary empirical evidence that was collected on input parameters for a full-scale economic analysis, and
- Objective 2: To thereby establish the base for further and more in-depth empirical work that needs to be undertaken, in order to arrive at a comprehensive and reliable empirical input data set for a comprehensive economic analysis of the projects.

2.1.1 Fundamental Assumptions for Input Parameters

The following introduces and briefly discusses the fundamental assumptions for input parameters of economic analysis. It must be emphasized that numerical values and frameworks are based on collected primary empirical evidence from the Greater Abidjan Area and/or Cote d'Ivoire. In itemized form they are:

- **Motorized vehicle fleet (MVF).** The size and composition of the MVF in the planning area and for the base year 2013 was estimated based on available numbers for 2007. The 2007 figures identify nine different vehicles types, namely: motor cycles; passenger cars; buses; vans; trucks; special vehicles; tractors; semi trailers and tricycles. The number of different vehicle types were estimated for 2013 and compressed into three major categories, i.e., passenger cars and vans; buses of all types and trucks and semi-trailers. All other vehicle types (for example motor cycles and special vehicles) which account for roughly 9% of the size of the MVF were excluded, because they are of no direct relevance to the economic analysis exercise.

The estimated size of the MVF for the base year 2013 and the three major vehicles types is estimated at around 330,250 units. Further scrutiny and empirical verification is needed for:

- The number of taxis of all types (city, bush and meter) which are estimated to account for about 11.3% of the MVF in 2013
- The exact definition and number of vans, which was estimated at about 8% of the 2013 MVF, and
- The structure of the bus fleet, in particular the number of "Gbaka"

- **Conversion into Passenger-Car-Units (PCU).** The official PCU conversion factors which cover twelve different motorized vehicle types were used to convert the MVF into PCU which is the technical unit for the transport demand modeling exercise
- **Retail (financial) prices.** The financial retail prices were obtained through primary interviews with retailers. The following items were covered: retail prices for MVF categories; tires; gasoline and lubricants, major spare parts and maintenance cost by maintenance category and motorized vehicle type. Conversion into PCU equivalents was not undertaken, since the economic analysis exercise is not concerned with a financial analysis. Also, it could not be determined conclusively whether the retail financial price for gasoline and diesel reflects border prices or not, that is whether it reflects an explicit/implicit subsidy or not
- **General conversion of "financial prices" into "economic prices".** The economic analysis investigates the net-benefit streams (cost streams plus benefit streams) that an investment project and/or package generates from the macro-economic point-of-view. Hence, all transfer payments, such as taxes, levies, tariffs (for imports) and subsidies have to be eliminated from the financial prices, in order to obtain economic prices for the cost and benefit streams. The "standard-conversion-factor" (SCF) approach was selected as the first approximation to an economic analysis. The SCF at its most general level reflects a general 18% value-added-tax (VAT) to which a 2% development tax has to be added. Hence, the most general SCF for the economic analysis is 0.8
- **"Economic prices" for cost streams.** For the investment cost stream side of the economic analysis equation transfer payments in the form of tariffs for imported materials have to be taken out in addition to the VAT and development tax transfers. Cote d'Ivoire is a member of the WTO and adheres to its various protocols to reduce and/or eliminate import tariffs. As discussed earlier, the individual investment projects suggested for the realization of the SDUGA transport projects are at a pre-basic design stage. That implies that, inter alia, "bills-of-quantities" (BOQs) and therefore a breakdown into the local and foreign cost components (LC and FC) for the individual investment projects is not yet possible. However, a rapid general assessment of likely tariff rates (if not exempted under an ODA financing scheme) illustrates that the SCF for the foreign cost component is likely to be higher than the general 0.8 SCF identified above. Table 2.1 summarizes major potential material inputs into the realization of the SDUGA transport projects.

The overview illustrates that the SCF for the cost streams generated by individual and/or packaged investment projects and depending on the relative weight of their foreign cost components can be somewhere between factor 0.7 to 0.8.

Table 2.1 Tariff Rates and Implied SCFs for Imported Material for SDUGA Investment Projects

HS CODE	DESCRIPTION	Tariff at the 8 Digit HS Code	Ad valorem equival. tariff	EXAMPLE FOR ADJUSTMENT FACTOR: Financial Price [example]	18% VAT	2.60% statistical tax	Average tariff rate	Adjustm. Factor
25	Salt, sulphur, earths & stone, plastering materials; lime & cement	72	12.19%	100.00	84.75	82.60	73.62	0.7362
44	Wood & articles of wood	76	11.24%	100.00	84.75	82.60	74.25	0.7425
68	Articles of stone, plaster, cement, etc	53	17.36%	100.00	84.75	82.60	70.38	0.7038
72	Iron & steel	171	9.98%	100.00	84.75	82.60	75.10	0.7510
84	Machinery and mechanical appliances	538	7.46%	100.00	84.75	82.60	76.86	0.7686
86	Railway locomotives, rolling stock, etc.	23	5.00%	100.00	84.75	82.60	78.66	0.7866
87	Vehicles other than railway and so on	154	14.42%	100.00	84.75	82.60	72.19	0.7219
89	Ships, boats & floating structures	28	16.12%	100.00	84.75	82.60	71.13	0.7113
27	Mineral fuels, oils, bitumous substances	60	4.61%	100.00	84.75	82.60	78.96	0.7896
40	Rubber & articles thereof	91	10.89%	100.00	84.75	82.60	74.49	0.7449

Source: WTO, ITC UNCTAD World Tariff Profiles 2013, downloaded on July 4th, 2014.

2.1.2 Preliminary Results for Potential Benefit Streams

The TOR of this project call for measuring the net benefit streams resulting from investment project(s) realization by comparing "vehicle-operating-cost" (VOC) and "travel time savings" (TTS) when measuring the "without" against the "with" scenarios. It has to be kept in mind in this context that no general and binding concept exists on the categories to be covered in a VOC and TTS exercise. Confusion even in theoretical literature exists, for example, whether VOC should cover both variable and fixed cost components.

Be this as it may, the following tables establish the groundwork to undertake an assessment in line with whatever purpose of analysis may be deemed appropriate. Table 2.2 identifies the main input data into the exercise comprising both variable and fixed cost components. Table 2.3 shows the numerical values for the "variable cost" component. Table 2.4 summarizes the "fixed cost" component. Table 2.5 summarizes the "time value" and shows the results for the time value component and Table 2.6 summarizes the VOC-cost-km components by PCU under a "life cycle" approach.

The preliminary assessment results are summarized as:

- Weighted Variable VOC (without Crew Cost, life cycle approach). The weighted variable VOC excluding crew cost are estimated for the base year at FCFA/km 378.23, equivalent to US$/km 0.78 at an exchange rate of FCFA 483 to one US$;

- Weighted Variable VOC (with Crew Cost, life cycle approach). The weighted variable VOC including crew cost are estimated for the base year at FCFA/km 472.48, equivalent to US$/km 0.98 at an exchange rate of FCFA 483 to one US$;
- The weighted PCU/per hour variable VOC (life cycle approach). They are estimated at FCFA 552.74 per hour equivalent to US$ 1.14/hour at the above quoted exchange rate;
- The weighted VOC fixed cost. The weighted fixed VOC cost component (with depreciation but without interest) amounts to FCFA/km of 80.25 equivalent to US$/km 0.11;
- VOC variable and fixed. Hence, the variable and fixed cost components combined are estimated at FCFA/km 492.73 equivalent to US$/km 1.02 at the above quoted exchange rate; and
- Passenger time value per hour. Taking into account the different income characteristics of taxi and bus ridership, the average weighted passenger time value in FCFA/hr is estimated at 186.08 FCFA/hr equivalent to US$ 0.39/hr.

Table 2.2 Input Data for VOC Variable and Fixed Cost Components for PCU Basis – Physical Units

(Unit: as indicated)

INPUT PARAMETER	Unit	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013 Private PC	Vans	Taxis	Light Trucks	Heavy Trucks	Semi-Trailers	Buses (all Sizes)	Information Source	Verified	Observations
A. Number of Vehicles in 2013	Number	136,870	n.a.	37,325	149,560	21,318	3,561	14,292	SICTA data adjusted	Yes	According to HIS: AAD= 139,525/ Study Area: 145,403
B. Relative Distribution 1 (by individual MVF category)	%	37.71%	n.a.	10.28%	41.21%	5.87%	0.98%	3.94%	SICTA data adjusted	Yes	Share light trucks: very high
C. Relative Distribution 1 (by MVF grouping)	%	47.997%			41.210%	6.855%		3.938%	SICTA data adjusted	Yes	
D. Relative Distribution 1 (by MVF grouping 2)	%	89.207%				6.855%		3.938%	SICTA data adjusted	Yes	
E. Relative Share PRIVATE OPERATORS	%	85.778%							SICTA data adjusted	Yes	
E. Relative Share PUBLIC TRANSPORT (taxi + bus)	%							14.222%	SICTA data adjusted	Yes	
PERFORMANCE DATA FOR "ECONOMIC LIFE-CYCLE" COMPUTATIONS											
a. Annual Average km Performance	km	10,000	15,000	27,000	20,000	16,000	55,000	20,000	Estimated	Not completely	For PCs based on HIS results.
b. "Economic Life Cycle" of Vehicle	years	25	20	20	25	30	25	25	Estimated	Yes, 2nd hand shops	2nd hand prices and odometer
c. Implied km Total "Economic Life cycle"	km	250,000	300,000	540,000	500,000	480,000	1,375,000	500,000	Computed	n.a.	Weighted PCU-km: 639,494 km
d. Main Engine Type	Type	Super	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Interviews	Yes	n.a.
e. Assumed Number of Crew (PC = driver)	People	1	1	1	1	2	2	2	Interviews	Yes (partly)	Bus: 2 shifts; Truck: travel distance
f. Number of Work-Shifts (person-day)	Number	1	1	2	1	2	2	2	Interviews	Yes (partly)	
g. Working Shifts Equivalent in hours/day	Hours	8	8	32	8	32	32	32	Based on "f"	Yes (partly)	
h. Total Hours Calendar Year (unadjusted)	Hours	8,760	8,760	8,760	8,760	8,760	8,760	8,760	n.a.	n.a.	
i. Normal Working Hours/Year "Normal job"	Hours	2,360	2,360	2,360	2,360	2,360	2,360	2,360	n.a.	n.a.	365-56 sundays-14 Public Holidays at 8hrs./day Standard
j. Total Vehicle-Hours OPS per Year	Hours	900	1,250	4,500	2,360	4,720	4,720	5,163	Estimated	Yes (partly)	8, 16 and 17.5 hours/day x 295
j. Total Hours Crew by MVF Type and Per Year	Hours	2,360	2,360	9,440	2,360	9,440	9,440	9,440	Estimated	Yes (partly)	Shift hrs. per day x 295 days
L. OPS-HRS-VEHICLE "Economic Life Cycle"	Hours	22,500	25,000	90,000	59,000	141,600	118,000	129,075	n.a.	n.a.	
M. Retail Financial Price MVF By Type of Vehicle (TTC)	m FCFA	15.52	23.42	15.52	29.50	139.83	139.83	43.66	Interview with trader	Yes (partly)	Reference prices fr. YUTONG buses
N. Retail Economic Price MVF By Type of Vehicle	m FCFA	11.16	17.98	11.16	23.50	111.24	111.24	35.50	Interview with trader	Yes (partly)	Reference prices fr. YUTONG buses
Implied Conversion Factor		0.719	0.768	0.719	0.797	0.796	0.796	0.813			
O. Fuel Consumption Super Gasoline	l/100 km	10	12						Research	Yes (partly)	
P. Fuel Consumption Diesel	l/100 km			13	20	30	30	15	Research	Yes (partly)	
Q. Fuel Consumption Super by Individual Category	liter life cyc.	25,000	36,000						n.a.	n.a.	
R. Fuel Consumption Diesel by Individual Category	liter life cyc.			70,200	100,000	144,000	412,500	75,000	n.a.	n.a.	
S. Lubricant's Consumption per 5,000 km	liter	5	5	7	7	8	8	8	Estimated 4,480/lit	Yes (partly)	Gasoline station interview
T. Number of Tires on Vehicle	number	4	4	4	6	10	14	4			
U. Spares for PC, Van, Taxi, L-Truck (in % of Economic Price)	%	5%	5%	5%	5%				Estimated	Yes (partly)	
V. Spares for all Trucks and buses (in % of Economic Prices)	%					10%	10%	10%	Estimated	Yes (partly)	

Source: JICA Study Team

Table 2.3 VOC Variable Cost Component

(Unit as indicated)

INPUT PARAMETER	Unit	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013 Private PC	Vans	Taxis	Light Trucks	Heavy Trucks	Semi-Trailers	Buses (all Sizes)	Information Source	Verified	Observations
A. Financial Pump Price Super per one liter	FCFA	755	755	0	0	0	0	0	Gasoline Station	n.a.	
B. Economic Pump Price Super per one liter	FCFA	619	619	0	0	0	0	0		Not yet	Issues: VAT and/or subsidy
C. Financial Pump Price Diesel per one liter	FCFA	0	0	640	640	640	640	640	Gasoline Station	n.a.	
D. Economic Pump Price Diesel per one liter	FCFA	0	0	525	525	525	525	525		Not yet	Issues: VAT and/or subsidy
E. "Life Cycle" Super Cost by MVF Category	m FCFA	15,477,500	22,287,600	0	0	0	0	0			
F. "Life Cycle" Diesel Cost by MVF Category	m FCFA			44,928,000	64,000,000	92,160,000	264,000,000	48,000,000			
G. "Life Cycle" Lubricants Cost	m FCFA	1,120,000	1,344,000	3,386,880	3,136,000	3,440,640	9,856,000	3,584,000			Economic Price: 4,480 per liter
H. "Life Cycle" Cost Replacement for Tires (at 25,000 km)	m FCFA	1,120,000	1,920,000	2,419,200	4,800,000	19,200,000	123,200,000	6,400,000	Tire Shop Interview	Yes	Based on Economic Prices
I. "Life Cycle Cost" for Spare Parts	m FCFA	13,950,000	17,980,000	11,160,000	29,375,000	333,720,000	278,100,000	88,750,000	Driver Interviews	Yes (partly)	Depends on maintenance cycle
VARIABLE VEHICLE OPERATING COST [VOC-V] WITHOUT CREW COST & IN ECONOMIC PRICES PER KM											
VOC-V (Economic Cost) by Major Vehicle Category											
Gasoline Super	FCFA/km	61.91	74.29								
Diesel	FCFA/km			83.20	128.00	192.00	192.00	96.00			
Lubricants	FCFA/km	4.48	4.48	6.27	6.27	7.17	7.17	7.17			
Tires	FCFA/km	4.48	6.40	4.48	9.60	40.00	89.60	12.80			
Spares	FCFA/km	55.80	59.93	20.67	58.75	695.25	202.25	177.50			
SUB-TOTAL	FCFA/km	126.67	145.11	114.62	202.62	934.42	491.02	293.47			
									TOTAL		
Weighted VOC-V (Economic Cost) [without crew cost]	FCFA/km	60.798	69.647	55.014	83.500	64.055	33.660	11.557	378.231		
Crew Cost (without PC) per km by MVF Category											
Gross Crew Cost per months	FCFA/m	n.a.	100,000	75,000	100,000	200,000	250,000	150,000			
Gross Crew Cost per Year	FCFA/YEAR	n.a.	1,200,000	900,000	1,200,000	4,800,000	6,000,000	3,600,000			
Gross Crew Cost "Life Cycle"	FCFA/life	n.a.	30,000,000	18,000,000	24,000,000	120,000,000	180,000,000	90,000,000			
Gross Crew Cost per km/Life Cycle	FCFA/life km	n.a.	100.00	33.33	48.00	250.00	130.91	180.00			
Gross Crew Cost per hour	FCFA/Hour	n.a.	508.47	190.68	508.47	1,016.95	1,271.19	762.71	TOTAL		
km/Life Cycle PCU-Weighted	FCFA/km	n.a.	48.00	3.43	19.78	14.68	1.28	7.09	94.25		
per PCU-hour weighted	FCFA/hour	n.a.	244.05	19.62	209.54	59.69	12.46	30.05	575.41		
Business Cost Private Car											
Gross Cost per months	FCFA/m	423,510							(Weighted 3+4 from HIS data)		
Gross Cost per year	FCFA/year	5,082,120							(Weighted 3+4 from HIS data)		
Gross Cost "Life Cycle"	FCFA/life	127,053,000							(Weighted 3+4 from HIS data)		
km/life Cycle Weighted by PC Share	FCFA/km	191.66									
per hour weighted	FCFA/Hour	812.13									

Source: JICA Study Team

Table 2.4 VOC Fixed Cost Component

(Unit as indicated)

INPUT PARAMETER	Unit	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013 Private PC	Vans	Taxis	Light Trucks	Heavy Trucks	Semi-Trailers	Buses (all Sizes)	Information Source	Verified	Observations
A. Economic Retail Price of Vehicle	m FCFA	11.16	17.98	11.16	23.50	111.24	111.24	35.50	Dealer interview	yes	
B. Vehicle Insurance Payment Yearly [economic prices]	m FCFA	0.1495	0.1835	0.1495	0.3175	0.6450	0.7250	0.1835	Insurance interview	yes	To FGA, by weight & zone
C. Vehicle Insurance Payment "life cycle" [econ. prices]	m FCFA	3.7384	3.6691	2.99072	7.93755	19.35003	18.125	4.586375	Insurance interview	yes	To FGA, by weight & zone
D. Annual "Road Worthiness Test" [econ. prices]	m FCFA	0.0124	0.0124	0.0124	0.0124	0.0124	0.0124	0.0124	Dealer interview	yes	By age; aver. 15500 *0.8
E. "Life Cycle" Road Worthiness Test" [econ.prices]	m FCFA	0.3100	0.2480	0.2480	0.3100	0.3720	0.3100	0.3100	Dealer interview	yes	By age; aver. 15500 *0.8
F. Annual Vignette [econ.prices]	m FCFA	0.0210	0.0210	0.0210	0.0210	0.0210	0.0210	0.0210	Dealer interview	yes	By age; aver. 26,250 *0.8
G. "Life Cycle" Annual Vignette (econ.prices]	m FCFA	0.5250	0.4200	0.4200	0.5250	0.6300	0.5250	0.5250	Dealer interview	yes	By age; aver. 26,250 *0.8
H. Stamp Duty	m FCFA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	Dealer interview	yes	Transfer: not considered
I. Interest Payment [econ. prices]	m FCFA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			Before Financing
J. Annual Depreciation "Life Cycle & Before Financing	m FCFA	0.5874	0.9463	0.5874	1.2368	5.8547	5.8547	1.8684			Computed
K.Other 1	m FCFA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
L. other 2	m FCFA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
M. TOTAL (with depreciation but without interest)	m FCFA	16.5037	23.4803	15.5890	33.8603	138.1252	136.8131	43.0067			Computed
N. TOTAL (with interest & depreciation)	m FCFA	16.5037	23.4803	15.5890	33.8603	138.1252	136.8131	43.0067			Computed
Weighting Factor	%	37.71%	37.71%	10.28%	41.21%	5.87%	0.98%	3.94%			
M1. Weighted Total (with depr. & without interest)	m FCFA	6.2240	8.8551	1.6032	13.9537	8.1134	1.3424	1.6936			

Weighted VOC-Fixed Cost (m FCFA)	41.7854
Weighted MVF km performance	520,680
Weighted VOC-FC/km (FCFA) on "M"	80.25

Source: JICA Study Team

Table 2.5 Time Value Component

(Unit: as indicated)

INPUT PARAMETER	Unit	Estimat. Hrs. Pass. Income	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013	Taxis				Buses (all Sizes)	Information Source	Verified	Observations
1. Taxi (all types) Ridership	FCFA/hr.	179.34							HIS Survey Results	n.a.	Income Group 1
2. Bus (all types, incl. Gbaka) Ridership	FCFA/hr.	203.67							HIS Survey Results	n.a.	Income Group 2
3. Average Transport time taxi (all types)	minutes			51.43				85.17	HIS Survey Results	n.a.	Income Group 1 and 2
4. Average Volume Ridership	people			4				50	Estimated	No	
5. Passenger Value per hour absolute	FCFA/hr.			179.34				203.67	Computed	n.a.	Based on HIS HH Survey Results
6. PCU Weighting Factor	%			10.28%				3.94%	Computed	n.a.	Based on Table 1
7. PCU-based Passenger Time Value per Passenger Hour	FCFA/hr.			18.44				8.02	Computed	n.a.	
8. Only PT Taxis & Buses	Number			37,325				14,292	Computed	n.a.	Based on Table 1: 51,617 units
9. Relative Weighting Factor	%			72.31%				27.69%	Computed	n.a.	
8. PT "Only" Passenger Time Value per Passenger Hour	FCFA/hr.							186.08	Computed	n.a.	Only "taxis" & "buses" weighted against each other

Source: JICA Study Team

Table 2.6 Summary Sheet VOC-Cost/km and Time Value

(Unit: as indicated)

INPUT PARAMETER	Unit	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013 PCU UNIT per km	Unit (US$)	Information Source	Verified	Observations Exchange rate 1 US$ = 483 FCFA
A. VOC-V PCU-Unit per km Cost (without crew cost)	FCFA/km	378.2309	0.783	Computed		Based on above tables
B. VOC-V + Crew Cost PCU-Unit per km Cost (without PC)	FCFA/km	94.2544	0.195	Computed		
C. SUB-TOTAL PCU-Unit VOC-V plus Crew Cost (A+B)	FCFA/km	472.485	0.978	Computed		
D. VOC-F PCU-Unit per km Cost	FCFA/km	80.25	0.166	Computed		Including depreciation, no interest
E. SUB-TOTAL PCU-Unit VOC-V plus Crew Cost (C+D)	FCFA/km	552.737	1.144	Computed		

(Unit: as indicated)

INPUT PARAMETER	Unit	MOTORIZED VEHICLE FLEET (MVF) "BASE YEAR" 2013 UNIT hrs	Unit (US$)	Information Source	Verified	Observations Exchange rate 1 US$ = 483 FCFA
1. TValue PCU-Unit/Hour (Incl. PC + Weighted)	FCFA/hr.	213.2500	0.442	Computed	Yes	Based on above tables
2. TValue PCU-Unit/Hour (Excl. PC + Weighted)	FCFA/hr.	184.230	0.381	Computed	Yes	Based on HIS Results
3. Tvalue PC Driver only Unweighted (Busin. Time Value)	FCFA/hr.	1,761.720	3.647	Computed	Yes	Based on HIS Results
4. Tvalue PT per Hour	FCFA/hr.	1,138.620	2.357	Estimated	No	Per Aver. Passenger Hour Needs Clarification

Source: JICA Study Team

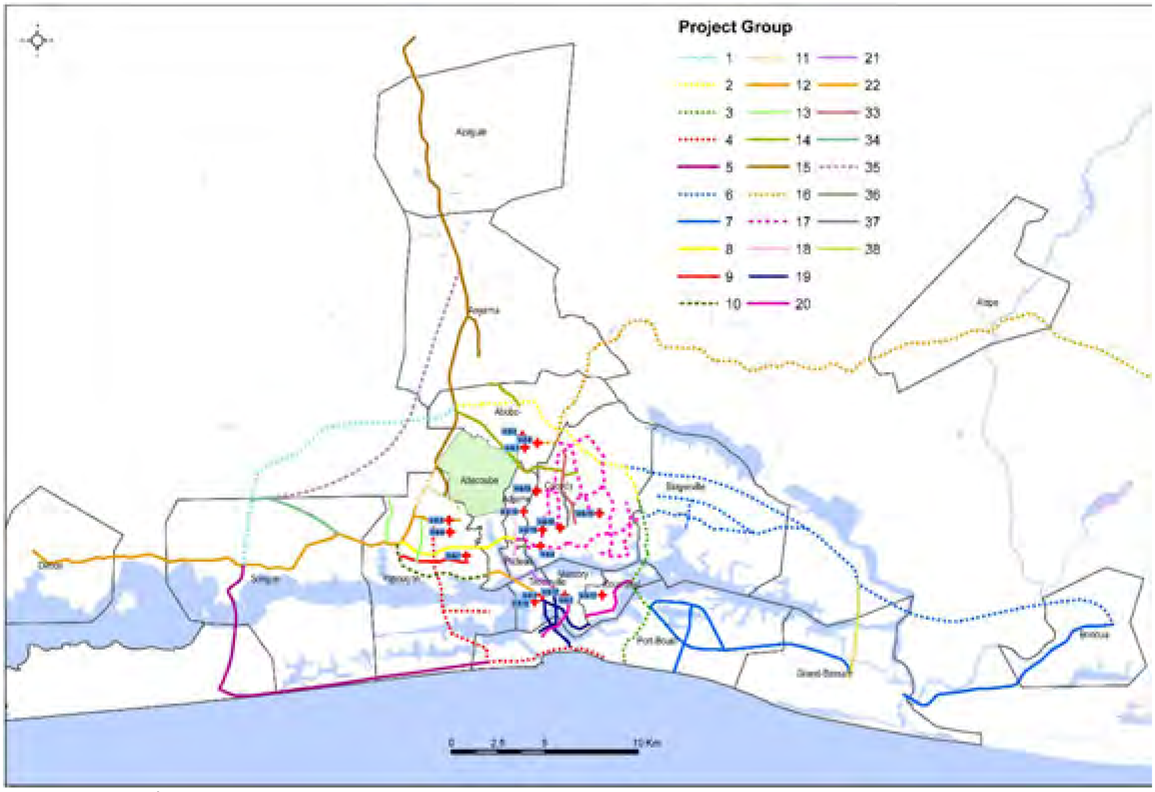
2.1.3 Project Grouping for Economic Analysis

Economic analyses of the proposed 118 projects in the long list have been conducted. Since there are so many projects to be tested, the road projects, except for intersection improvement projects, have been sorted into 28 groups for simplicity as shown in Table 2.7 and Figure 2.1. Projects in each group have similarities in terms of location, continuity, function, development period, and so on. Some projects that will attract attention are placed in a group with few other projects for more precise analysis. Along with 10 public transport projects, the total number of project groups to be tested is 38.

Table 2.7 Project Groups to be Tested for Economic Analysis

Group	Code	Group	Code	Group	Code
1	V-1-1, V-1-2	14	V-5-1, V-5-2, V-5-6	27	T-2-2
2	V-1-3, V-1-4	15	V-5-3, V-5-5	28	T-2-3
3	V-1-5, V-1-6, V-1-7	16	V-5-4	29	T-2-4
4	V-1-8, V-4-7, V-4-8, V-4-9 V-4-13	17	V-6-1, V-6-2, V-6-3, V-6-4, V-6-5, V-6-6, V-6-7, V-6-8	30	T-2-5
5	V-1-9	18	V-7-1	31	T-4-1
6	V-2-1, V-2-2, V-2-3, V-2-4	19	V-7-3, V-7-5, V-7-9	32	T-4-2
7	V-3-2, V-3-3, V-3-4	20	V-7-4, V-7-6	33	V-6-9, V-6-10
8	V-4-1, V-4-2	21	V-7-7, V-7-8	34	V-9-1
9	V-4-3	22	V-7-10	35	V-9-2
10	V-4-4	23	T-1-1	36	V-9-3
11	V-4-5, V-4-6	24	T-1-2	37	V-9-4
12	V-4-10, V-4-14	25	T-1-3	38	V-9-5
13	V-4-11, V-4-12	26	T-2-1		

Source: JICA Study Team



Source: JICA Study Team

Figure 2.1 Location of the Road Project Groups to be Tested for Economic Analysis

2.2 Multi-Criteria Analysis

The proposed 118 projects in the long list are evaluated in terms of priority. Although the most crucial criterion is the economic feasibility of the investment as mentioned in the previous section, it is not an easy task to economically evaluate all the projects over different transport sub-sectors. Moreover, economic feasibility is not the only criterion to determine the project priority. Besides economic feasibility, there should be several other viewpoints for evaluation such as existing development policies, consistency in the development orders of relevant projects and consideration of the natural and social environments.

Thus, six items, namely, coherence with visions, urgency, necessity, implicit feasibility, social acceptance, and investment efficiency have been set forth as evaluation criteria for project prioritization, as presented below. Then, the projects are evaluated and scored through a multi-criteria analysis based on those quantitative and qualitative criteria, as shown in Table 2.8 (for road sector) and Table 2.9 (for other sectors). It is assumed that projects with higher total scores shall be prioritized.

2.2.1 Coherence with Visions

Although all proposed projects must be relevant to the visions and urban planning objectives for developing Greater Abidjan, the **projects listed in the PND** (national development plan), **in the Master Plan 2000**, or **in the priority projects of the Abidjan Autonomous District** to achieve the visions should be given priority. Moreover, the project that matches with the preferred growth scenario in SDUGA, namely, **"Compact City plus Satellite City" concept** should also be given priority.

- Add 1 point if the project is included in the PND, in the Master Plan 2000, or in the priority projects of the AAD, respectively.
- Add 1 point if the project is expected to contribute to TOD, development of the primary roads or the links between the urban satellite centers, or enhancement of the transport capacity of the north-south or east-west axes in the District of Abidjan.

The score under this criterion is up to 2 points in total.

2.2.2 Urgency

Projects that are expected to contribute to **urgent transportation issues** should be given priority.

- Add 1 point if the project is intended directly for the urgent transportation issues discussed in "4. Significant Transport Issues," etc. of Part 5 of this report.
- Add 1 point if the government has somehow shown some intention of urgently implementing the project by asking any donors, releasing any TORs, and so on.

The score under this criterion is up to 2 points in total.

2.2.3 Necessity

All proposed projects are considered based on the needs of the citizens. However, projects that can more widely and more greatly respond to people's needs may be given priority. As a proxy for the population of beneficiaries, **future transportation demand** (in 2030) for each project may be used.

- Add 1 point if, for roads, the future traffic volume on the project site is over 10,000 PCU/direction/day (or total inflow of 40,000 PCU/day at intersections).
- Add 1 point if, for public transport, the future peak sectional passenger volume on the project site is over 10,000 persons/direction/hour
- Add 2 points if the future volume is more than double of these standard values.
- For other projects, though the demand cannot be estimated, the number of beneficiaries can be considered as large enough; hence, add 1 point evenly to each project.

2.2.4 Implicit Feasibility

Socioeconomic, technical and institutional feasibilities need to be considered for prioritization because these factors are closely related to the implementability and sustainability of a project. This criterion is not necessarily tangible but implicit. For example, projects that are expected to bring about **benefit** not only in Greater Abidjan but also **in the wider region of West Africa**, or projects for which **economic benefit will apparently surpass the cost** may be given priority.

- Add 1 point if the project is expected to bring benefit for West Africa through the improvement of the regional freight transport (i.e., international freight routes to/from the Port of Abidjan).
- Add 1 point if the cost of infrastructure development is relatively low (less than 10 billion FCFA).

The score under this criterion is up to 2 points in total.

2.2.5 Social Acceptance

Projects that are accepted by all people have a great potential for prompt implementation. In the IEE (initial environmental examination), **projects that are classified as Category I** (almost no impact) or **Category II** (minimum negative impact) should be given priority.

- Add 2 points if the project is classified as Category I or 1 point if the project is classified as Category II as a result of IEE (for details, see "Appendix E: Initial Environmental Evaluation of Proposed Projects for Transport Sector" of Volume 3 of this report).

2.2.6 Investment Efficiency

Investment efficiency of a project can be measured by an indicator of a benefit-cost ratio. Projects which are expected to bring a **great economic benefit per unit cost of investment** should be given priority.

- Add 2 points if the project has a very high benefit-cost ratio (over 10.0) or 1 point if the project has a high benefit-cost ratio (over 5.0) as a result of the economic analysis of the group that the project belongs to.
- For intersection improvement projects and traffic control and management projects, though the economic analyses were not conducted, these projects are essentially supposed to bring relatively great benefit compared to the input of the cost; hence, add 1 point evenly to each project.

Table 2.8 Multi-Criteria Analysis of SDUGA Projects (Road Sector)

	Proposed Projects	Total Cost (million FCFA)	Annual OM (million FCFA)	Coherence with Visions			Urgency			Necessity (Future Demand)		Implicit Feasibility			Social Acceptance (IEE)		Investment Efficiency (B/C Ratio)		Total score
V	Road Development Plan																		
V-1	Development of Y4 Ring Road																		
V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section	52,607	4,280	2	AAD	MP2000	2	Truck routes	Govn't intention	0	6,422	1		West Africa	1	Category 2	2	Very High	8
V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18	44,842	3,420	2	AAD	MP2000	2	Truck routes	Govn't intention	0	3,692	1		West Africa	1	Category 2	2	Very High	8
V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section	201,356	13,914	2	AAD	MP2000	2	Truck routes	Govn't intention	1	10,960	1		West Africa	0	Category 3	0	Medium	6
V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section	212,731	14,348	2	AAD	MP2000	2	Truck routes	Govn't intention	0	8,836	1		West Africa	1	Category 2	0	Medium	6
V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section	57,703	4,196	2	AAD	MP2000	2	Truck routes	Govn't intention	1	19,875	1		West Africa	1	Category 2	0	Medium	7
V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section	447,505	34,396	2	AAD	MP2000	2	Truck routes	Govn't intention	2	32,412	1		West Africa	0	Category 4	0	Medium	7
V-1-7	Development of Y4 Ring Road - Aérocité Section	8,247	449	2	AAD	MP2000	2	Truck routes	Govn't intention	1	10,574	2	Low Cost	West Africa	0	Category 3	0	Medium	7
V-1-8	Development of Y4 Ring Road - Canal du Vridi Section	187,148	13,030	2	AAD	MP2000	2	Truck routes	Govn't intention	1	10,567	1		West Africa	0	Category 4	0	Medium	6
V-1-9	Development of Y4 Ring Road - Jacqueville Section	96,172	6,264	2	PND	MP2000	2	Truck routes	Govn't intention	0	3,841	1		West Africa	0	Category 4	1	High	6
V-2	Development of Bingerville Area Road Network (BiARN)																		
V-2-1	Development of BiARN - Bingerville Northern Bypass	29,934	1,700	2	Compact	MP2000	1	Truck routes		0	1,692	1		West Africa	1	Category 2	2	Very High	7
V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand	163,284	10,527	2	PND	MP2000	2	Mass transit	Truck routes	0	6,114	1		West Africa	0	Category 4	2	Very High	7
V-2-3	Development of BiARN - Widening of the Route de Bingerville	8,777	559	2	Compact	MP2000	0			1	13,576	1	Low Cost		1	Category 2	2	Very High	7
V-2-4	Development of BiARN - Bingerville BHLS Road	4,605	252	0			1	Water transport		0	4,023	1	Low Cost		1	Category 2	2	Very High	5
V-3	Development of Bassam Area Road Network (BaARN)																		
V-3-1	Development of BaARN - Abidjan-Bassam Expressway (under construction)	0	0	2	PND	MP2000	1		Govn't intention	1	18,302	0			1	Category 2			5
V-3-2	Development of BaARN - Aérocité Area	6,780	323	1		MP2000	1		Govn't intention	1	13,124	1	Low Cost		0	Category 4	2	Very High	6
V-3-3	Development of BaARN - Bassam Northern Bypass	33,395	1,851	1		MP2000	0			0	6,302	0			1	Category 2	2	Very High	4
V-3-4	Development of BaARN - Widening of the Route de Bonoua	83,787	5,540	1	Compact		1		Govn't intention	1	12,649	0			1	Category 2	2	Very High	6
V-4	Development of Yopougon Area Road Network (YoARN)																		
V-4-1	Development of YoARN - Voie V23 - Parkway Section	12,559	716	2	Compact	MP2000	2	Mass transit	Govn't intention	2	24,028	0			0	Category 3	0	Medium	6
V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section	242,588	16,927	2	PND	MP2000	2	Mass transit	Govn't intention	2	58,772	0			0	Category 4	0	Medium	6
V-4-3	Development of YoARN - Voie V2	5,523	306	1		MP2000	0			1	11,979	1	Low Cost		0	Category 3	2	Very High	5
V-4-4	Development of YoARN - Voie V6	13,065	785	1		MP2000	1	Water transport		0	9,667	1		West Africa	0	Category 3	2	Very High	5
V-4-5	Development of YoARN - Voie V9	3,916	227	1		MP2000	0			0	3,409	1	Low Cost		0	Category 3	2	Very High	4
V-4-6	Development of YoARN - Yopougon Industrial Zone Arterial Road	3,861	227	0			0			0	5,451	1	Low Cost		0	Category 3	2	Very High	3
V-4-7	Development of YoARN - Voie V28 - Northern Section	129,939	8,929	2	PND	MP2000	1	Truck routes		1	19,846	1		West Africa	0	Category 3	0	Medium	5
V-4-8	Development of YoARN - Voie V28 - 4th Bridge	54,739	3,800	2	PND	MP2000	2	Truck routes	Govn't intention	2	29,427	1		West Africa	0	Category 4	0	Medium	7
V-4-9	Development of YoARN - Voie V28 - Southern Section	6,300	370	2	Compact	MP2000	1	Truck routes		1	13,933	2	Low Cost	West Africa	0	Category 3	0	Medium	6
V-4-10	Development of YoARN - Autoroute de l'Ouest	29,962	2,081	2	Compact	MP2000	1		Govn't intention	1	19,676	0			0	Category 3	2	Very High	6
V-4-11	Development of YoARN - Yopougon Western Bypass	6,092	360	0			0			0	5,506	1	Low Cost		0	Category 3	2	Very High	3
V-4-12	Development of YoARN - Widening of the Voie V1	4,340	262	1		MP2000	0			0	3,116	1	Low Cost		0	Category 3	2	Very High	4
V-4-13	Development of YoARN - Central Road of Boulay Island	4,726	254	2	PND	MP2000	1	Truck routes		1	10,977	2	Low Cost	West Africa	0	Category 3	0	Medium	6
V-4-14	Development of YoARN - Widening of Siporex-Sable Link	5,848	363	0			0			1	15,842	1	Low Cost		0	Category 3	2	Very High	4
V-5	Development of Abobo Area Road Network (AbARN)																		
V-5-1	Development of AbARN - Extension of Q1	4,522	276	0			0			1	10,425	1	Low Cost		0	Category 3	1	High	3
V-5-2	Development of AbARN - Western Abobo Bypass	89,454	6,180	0			0			0	6,484	0			0	Category 3	1	High	1
V-5-3	Development of AbARN - Extension of Voie N'Dotre	9,693	594	1		MP2000	0			0	9,431	1	Low Cost		1	Category 2	2	Very High	5
V-5-4	Development of AbARN - Widening of the Route d'Alépé	71,650	4,652	1	Compact		1		Govn't intention	0	7,645	0			1	Category 2	2	Very High	5
V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo	25,355	1,683	2	PND	MP2000	1		Govn't intention	0	4,410	0			1	Category 2	2	Very High	6
V-5-6	Development of AbARN - East-West Abobo-Cocody Link	4,566	221	1		MP2000	1	Road network		0	5,465	1	Low Cost		1	Category 2	1	High	5
V-6	Development of Cocody Area Road Network (CoARN)																		
V-6-1	Development of CoARN - Extension of Boulevard Latrille	10,292	490	1		MP2000	0			0	2,203	0			1	Category 2	1	High	3
V-6-2	Development of CoARN - Voie Y3	8,023	403	1		MP2000	0			0	3,810	1	Low Cost		1	Category 2	1	High	4
V-6-3	Development of CoARN - Old Y4 Alignment	8,468	372	1		MP2000	0			0	4,142	1	Low Cost		1	Category 2	1	High	4
V-6-4	Development of CoARN - Extension of the Boulevard de France	9,298	420	1		MP2000	0			0	1,725	1	Low Cost		1	Category 2	1	High	4
V-6-5	Development of CoARN - Boulevard de France Redressé	7,614	378	2	Compact	MP2000	1		Govn't intention	1	11,950	1	Low Cost		1	Category 2	1	High	7
V-6-6	Development of CoARN - Widening of the Boulevard Latrille	14,904	908	1	Compact		2	Bottleneck	Govn't intention	2	20,725	0			1	Category 2	1	High	7
V-6-7	Development of CoARN - Widening of the Rue des Jardins	7,695	470	0			1		Govn't intention	1	14,630	1	Low Cost		1	Category 2	1	High	5
V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche	7,003	426	1	Compact		1		Govn't intention	2	28,020	1	Low Cost		1	Category 2	1	High	7
V-6-9	Development of CoARN - Widening of the Boulevard Attoban	4,415	269	0			1		Govn't intention	1	11,481	1	Low Cost		1	Category 2	2	Very High	6
V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche	6,173	380	0			1		Govn't intention	1	18,302	1	Low Cost		1	Category 2	2	Very High	6
V-7	Development of Central Area Road Network (CeARN)																		
V-7-1	Development of CeARN - Voie Triomphale	43,450	617	1		MP2000	1		Govn't intention	2	20,080	0			0	Category 3	1	High	5
V-7-2	Development of CeARN - 3rd Bridge (under construction)	0	0	2	PND	MP2000	2	Truck routes	Govn't intention	2	26,028	1		West Africa	0	Category 3			7
V-7-3	Development of CeARN - Widening of the Boulevard de Marseille	3,790	265	1		MP2000	0			1	10,074	1	Low Cost		0	Category 4	1	High	4
V-7-4	Development of CeARN - Vridi Bridge	86,626	5,687	1	PND		2	Truck routes	Govn't intention	1	11,308	1		West Africa	1	Category 2	2	Very High	8
V-7-5	Development of CeARN - Vridi Northern Bypass	36,711	2,182	1		MP2000	0			2	20,178	0			0	Category 3	1	High	4
V-7-6	Development of CeARN - Grand-Campement Arterial Road	9,885	525	1		MP2000	0			2	20,361	1	Low Cost		0	Category 3	2	Very High	6
V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge	17,384	1,217	2	PND	Compact	2	Road condition	Govn't intention	2	51,869	0			0	Category 3	1	High	7
V-7-8	Development of CeARN - Upgrade of General de Gaulle Bridge	26,438	1,851	2	PND	Compact	0			2	50,305	0			0	Category 3	1	High	5
V-7-9	Development of CeARN - Vridi-Bietry Bridge	15,186	1,063	2	PND	MP2000	0			0	4,241	0			0	Category 3	1	High	3
V-7-10	Development of CeARN - Yopougon-Treichville Tunnel	1,277,697	89,356	0			1	Truck routes		2	24,104	1		West Africa	0	Category 3	0	Medium	4
V-8	Intersection Improvement																		
V-8-1	Intersection Improvement - Solibra (Treichville)	16,630	1,164	0			2	Bottleneck	Govn't intention	2	111,500	0			2	Category 1	1		7
V-8-2	Intersection Improvement - Mairie d'Abobo (Abobo)	9,667	677	1	PND		0			2	89,213	1	Low Cost		2	Category 1	1		7
V-8-3	Intersection Improvement - Banco (Abobo)	12,404	868	0			0			2	89,175	0			2	Category 1	1		5
V-8-4	Intersection Improvement - Palais des Sports (Treichville)	25,071	1,755	0			0			1	52,250	0			2	Category 1	1		4
V-8-5	Intersection Improvement - Siporex (Yopougon)	6,894	483	1	PND		1	Bottleneck		2	82,788	1	Low Cost		2	Category 1	1		8
V-8-6	Intersection Improvement - Kenaya (Yopougon)	8,327	583	1	PND		0			0	38,425	1	Low Cost		2	Category 1	1		5
V-8-7	Intersection Improvement - Sapeur Pompiers (Yopougon)	9,050	634	0			0			1	45,538	1	Low Cost		2	Category 1	1		5
V-8-8	Intersection Improvement - Samake (Abobo)	6,201	434	0			0			1	65,513	1	Low Cost		2	Category 1	1		5
V-8-9	Intersection Improvement - St Jean (Cocody)	5,924	415	0			1	Bottleneck		2	91,363	1	Low Cost		2	Category 1	1		7
V-8-10	Intersection Improvement - Palmeraie (Cocody)	9,201	644	1	PND		0			0	37,438	1	Low Cost		2	Category 1	1		5
V-8-11	Intersection Improvement - CHU Treichville (Treichville)	4,357	305	0			1	Bottleneck		2	81,263	1	Low Cost		2	Category 1	1		7
V-8-12	Intersection Improvement - Inchallah (Koumassi)	9,050	634	0			0			1	65,175	1	Low Cost		2	Category 1	1		5
V-8-13	Intersection Improvement - Zoo (Adjamé-Cocody)	12,649	885	0			0			1	55,625	0			2	Category 1	1		4
V-8-14	Intersection Improvement - Williamsville (Adjamé)	12,146	850	1	PND		2	Bottleneck	Govn't intention	1	75,600	0			2	Category 1	1		7
V-8-15	Intersection Improvement - Carrefour de la Vie (Cocody)	9,393	658	1	PND		0			2	83,288	1	Low Cost		2	Category 1	1		7
V-8-16	Intersection Improvement - Carrefour de L'Ecole Nationale de Police (Cocody)	13,340	934	1	PND		1	Bottleneck		2	142,763	0			2	Category 1	1		7
V-8-17	Intersection Improvement - Carrefour de Marcory (Marcory)	10,738	752	0			0			2	111,963	0			2	Category 1	1		5
V-8-18	Intersection Improvement - Carrefour Orca (Cocody)	10,806	756	0			1		Govn't intention	1	55,538	0			2	Category 1	1		5
V-9	Development of Additional Roads																		
V-9-1	Development of an Alternative Road to the Route de Dabou	6,034	422	0			1		Govn't intention	0	812	1	Low Cost		1	Category 2	2	Very High	5
V-9-2	Development of an Alternative Connection between Autoroute du Nord - Carrefour Thomasset	40,440	2,831	0			1		Govn't intention	0	1,485	0			1	Category 2	2	Very High	4
V-9-3	Development of an Elevated Road over Cocody Bay	25,690	1,798	0			1		Govn't intention	2	22,162	0			0	Category 4	1	High	4
V-9-4	Development of a Northern Extension of the 3rd Bridge	3,852	270	0			1		Govn't intention	1	14,767	1	Low Cost		0	Category 3	2	Very High	5
V-9-5	Development of a Connection Road between Boulevard Mitterand and Grand Bassam	51,489	3,604	0			1		Govn't intention	0	962	0			0	Category 4	0	Medium	1

Source: JICA Study Team

Table 2.9 Multi-Criteria Analysis of SDUGA Projects (Other Sectors)

Proposed Projects		Total Cost (million FCFA)	Annual OM (million FCFA)	Coherence with Visions			Urgency			Necessity (Future Demand)		Implicit Feasibility			Social Acceptance (IEE)		Investment Efficiency (B/C Ratio)		Total score
G	Traffic Control and Management Plan																		
G-1	Development of Traffic Control System																		
G-1-1	Development of Area Traffic Control System	58,704	2,935	1		MP2000	1	Traffic control		1		0			2	Category 1	1		6
G-1-2	Development of Public Transport Priority System	5,598	280	0			1	Bus priority		1		1	Low Cost		2	Category 1	1		6
G-1-3	Development of Urban Traffic Information System	1,401	70	0			1	Traffic control		1		1	Low Cost		2	Category 1	1		6
G-2	Development of Public Transportation System																		
G-2-1	Development of Dedicated Bus Lanes	9,824	491	1		MP2000	1	Bus priority		1		1	Low Cost		2	Category 1	1		7
G-2-2	Implementation of Transportation IC-Card System	2,050	103	0			0			1		1	Low Cost		2	Category 1	1		5
G-2-3	Development of Bus Operation Monitoring and Control System	9,988	499	0			0			1		1	Low Cost		2	Category 1	1		5
G-2-4	Development of Public Transportation Operation Information Provision System	2,484	124	0			0			1		1	Low Cost		2	Category 1	1		5
G-3	Parking System Development																		
G-3-1	Development of Parking Facilities/Parking Information System	4,263	213	1	PND		2	Traffic control	Govn't intention	1		1	Low Cost		2	Category 1	1		8
G-4	Development of Expressway System																		
G-4-1	Development of Highway Traffic Control System	21,202	1,060	0			1	Traffic control		1		0			2	Category 1	1		5
G-4-2	Development of Electronic Toll Collection System	21,506	1,075	0			0			1		0			2	Category 1	1		4
G-5	Traffic Enforcement Assistance																		
G-5-1	Development of Overloaded Truck Control System	1,912	96	0			2	Traffic control	Govn't intention	1		1	Low Cost		2	Category 1	1		7
G-5-2	Development of Road Pricing System	1,686	84	0			0			1		1	Low Cost		2	Category 1	1		5
G-5-3	Supporting System for Control of Illegal Parking	810	41	0			1	Traffic control		1		1	Low Cost		2	Category 1	1		6
G-6	Traffic Safety Assistance																		
G-6-1	Pedestrian Facility Development for Better Environment	2,347	117	0			1	Traffic control		1		1	Low Cost		2	Category 1	1		6
G-7	Road Management																		
G-7-1	Development of Road Surface Condition Survey System	1,609	80	0			0			1		1	Low Cost		2	Category 1	1		5
G-7-2	Management System of Information on Road Maintenance Works	1,161	58	0			0			1		1	Low Cost		2	Category 1	1		5
G-7-3	Development of Asset Management System	1,600	80	0			0			1		1	Low Cost		2	Category 1	1		5
T	Public Transport Development Plan																		
T-1	Commuter Rail Development																		
T-1-1	North-South Rail Project-Stage 1 Anyama to Airport	753,843	59,953	2	PND	MP2000	2	Mass transit	Govn't intention	2	72,200	0			0	Category 5	0	Low	6
T-1-2	North-South Rail Project-Stage 2 Airport to Grand-Bassam	1,316,811	105,345	1	Compact		1	Mass transit		2	25,100	0			0	Category 4	0	Low	4
T-1-3	East – West Rail Project (Yopougon to Bingerville)	1,637,963	130,827	2	PND	MP2000	2	Mass transit	Govn't intention	2	68,600	0			0	Category 4	0	Low	6
T-2	Bus Transportation Development																		
T-2-1	Development of BRT Service: Adjamé – Braké Industrial Zone	65,172	4,556	1		MP2000	1	Mass transit		0	9,400	0			2	Category 1	0	Medium	4
T-2-2	Development of BRT Service: Abobo – Koumassi Phase 1	36,621	2,560	2	PND	MP2000	1	Mass transit		0	6,800	0			2	Category 1	0	Low	5
T-2-3	Development of BRT Service: Abobo – Koumassi Phase 2	37,666	2,629	1		MP2000	1	Mass transit		1	11,500	0			1	Category 2	0	Medium	4
T-2-4	Development of BHLS Service: Bingerville – Bonoua	40,741	2,851	0			0			0	7,700	0			1	Category 2	0	Medium	1
T-2-5	Development of BHLS Service: Yopougon – Dabou	28,774	2,014	0			0			1	11,300	0			2	Category 1	1	High	4
T-2-6	Purchase of Additional Buses for SOTRA	127,961	8,957	0			1	Bus transport		1		0			2	Category 1			4
T-2-7	Pilot project of communal transport	31,990	2,239	0			1	Bus transport		1		0			1	Category 2			3
T-3	Intermodal Transportation Terminal Development																		
T-3-1	Development/Improvement of Intermodal centers at Adjame, and Central/Southern	2,661	168	1	PND		2	AAD	Govn't intention	1		1	Low Cost		2	Category 1			7
T-4	Water-based Transportation Development																		
T-4-1	East – West High Speed Ferry Service (Songon - Grand Bassam)	66,244	4,637	2	PND	MP2000	2	Water transport	Govn't intention	2	26,000	0			0	Category 3	0	Medium	6
T-4-2	Water Bus - Attecoube to Treichville	45,369	3,176	2	PND	MP2000	2	Water transport	Govn't intention	2	21,800	0			1	Category 2	0	Low	7
F	Freight Transport Development Plan																		
F-1	Railway Transport Services																		
F-1-1	Developing Direct Container Freight Loading & Unloading System	24,805	1,984	0			1	Port Related		1		1		West Africa	2	Category 1			5
F-1-2	New Freight Railway Connecting to Western Part of Abidjan Port	192,395	15,386	1		MP2000	1	Port Related		1		1		West Africa	0	Category 4			4
F-2	Truck Transport Services																		
F-2-1	Metropolitan Logistic Center Development	25,954	1,945	1	PND		2	Truck routes	Govn't intention	1		1		West Africa	2	Category 1			7
O	Organizational and Institutional Arrangements																		
O-1	Establishment of Agency/Commision																		
O-1-1	Establishment of Road Projects Implementation Commission	897	63	0			0			1		1	Low Cost		2	Category 1			4
O-1-2	Establishment of ITS Cote d'Ivoire	666	47	0			0			1		1	Low Cost		2	Category 1			4
O-1-3	Establishment of Clearing House Organization	419	29	0			0			1		1	Low Cost		2	Category 1			4
O-1-4	Development of Transport Planning Centre of Excellence	916	64	0			0			1		1	Low Cost		2	Category 1			4
O-2	Public Transport Services																		
O-2-1	Reorganization of SOTRA Bus Services	1,174	82	0			1	Bus transport		1		1	Low Cost		2	Category 1			5

Source: JICA Study Team

2.3 Priority Projects

Through the above-mentioned scoring method based on those criteria, projects that scored 6 or more have been selected as priority projects. As a result, 51 projects (excluding those that are already under construction) have been selected and presented as a short list in Table 2.10.

These priority projects are to be noted as projects that should be urgently undertaken with special, strategic attention. The total amount of investment for the short-listed projects is estimated at around 4.8 trillion FCFA or 7.4 billion Euros, accounting for about 54% of the total amount of the projects to be implemented by 2030 in the SDUGA Long List.

For earlier completion of these priority projects, it is hoped that the target implementation years will be properly scheduled and the necessary preparations will be started as soon as possible. To this end, central governments, as well as local governments, such as Abidjan Autonomous District (AAD), are required to secure a strategic special budget. In addition, cooperative assistance from donors is also required.

Table 2.10 Priority Projects (Short List)

Sector	Code	Project	Executing Schedule Short -2020	Medium -2025	Long -2030	Cost Estimate (Million FCFA)
Road Development Plan						
	V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section				52,607
	V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18				44,842
	V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section				201,356
	V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section				212,731
	V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section				57,703
	V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section				447,505
	V-1-7	Development of Y4 Ring Road - Aérocité Section				8,247
	V-1-8	Development of Y4 Ring Road - Canal du Vridi Section				187,148
	V-1-9	Development of Y4 Ring Road - Jacqueville Section				96,172
	V-2-1	Development of BiARN - Bingerville Northern Bypass				29,934
	V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand				163,284
	V-2-3	Development of BiARN - Widening of the Route de Bingerville				8,777
	V-3-2	Development of BaARN - Aérocité Area				6,780
	V-3-4	Development of BaARN - Widening of the Route de Bonoua				83,787
	V-4-1	Development of YoARN - Voie V23 - Parkway Section				12,559
	V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section				242,588
	V-4-8	Development of YoARN - Voie V28 - 4th Bridge				54,739
	V-4-9	Development of YoARN - Voie V28 - Southern Section				6,300
	V-4-10	Development of YoARN - Autoroute de l'Ouest				29,962
	V-4-13	Development of YoARN - Central Road of Boulay Island				4,726
	V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo				25,355
	V-6-5	Development of CoARN - Boulevard de France Redressé				7,614
	V-6-6	Development of CoARN - Widening of the Boulevard Latrille				14,904
	V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche				7,003
	V-6-9	Development of CoARN - Widening of the Boulevard Attoban				4,415
	V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche				6,173
	V-7-4	Development of CeARN - Vridi Bridge				86,626
	V-7-6	Development of CeARN - Grand-Campement Arterial Road				9,885
	V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge				17,384
	V-8-1	Intersection Improvement - Solibra (Treichville)				16,630
	V-8-2	Intersection Improvement - Mairie d'Abobo (Abobo)				9,667
	V-8-5	Intersection Improvement - Siporex (Yopougon)				6,894
	V-8-9	Intersection Improvement - St Jean (Cocody)				5,924
	V-8-11	Intersection Improvement - CHU Treichville (Treichville)				4,357
	V-8-14	Intersection Improvement - Williamsville (Adjamé)				12,146
	V-8-15	Intersection Improvement - Carrefour de la Vie (Cocody)				9,393
	V-8-16	Intersection Improvement - Carrefour de L'Ecole Nationale de Police (Cocody)				13,340
Traffic Control and Management Plan						
	G-1-1	Development of Area Traffic Control System				58,704
	G-1-2	Development of Public Transport Priority System				5,598
	G-1-3	Development of Urban Traffic Information System				1,401
	G-2-1	Development of Dedicated Bus Lanes				9,824
	G-3-1	Development of Parking Facilities/Parking Information System				4,263
	G-5-1	Development of Overloaded Truck Control System				1,912
	G-5-3	Supporting System for Control of Illegal Parking				810
	G-6-1	Pedestrian Facility Development for Better Environment				2,347
Public Transport Development Plan						
	T-1-1	North-South Rail Project-Stage 1 Anyama to Airport				753,843
	T-1-3	East – West Rail Project (Yopougon to Bingerville)				1,637,963
	T-3-1	Development/Improvement of Intermodal centers at Adjame, and Central/Southern Plateau				2,661
	T-4-1	East – West High Speed Ferry Service (Songon - Grand Bassam)				66,244
	T-4-2	Water Bus - Attecoube to Treichville				45,369
Freight Transport Development Plan						
	F-2-1	Metropolitan Logistic Center Development				25,954
					Total	4,826,350

Note: Construction Work

Preparation

Source: JICA Study Team

3.0 Priority Project Packages

3.1 Identification of Project Packages

Projects with relatively high scores in the Multi-Criteria Analysis, using the six items of evaluation criteria, are grouped into nine project packages for further feasibility studies (F/S). These project packages indicate directions for development of the urban transport sector and may help to clarify the relevance among the component projects in each package and hence to select the projects for further F/S. Location of the short-listed projects is indicated in the figure under the following description of each project package.

(1) Development of Water Bus Transport and Enhancement of Intermodality with Road Transport

Project No: T-4-1, T-4-2, V-3-2, V-7-6

(Total cost: 128,278 million FCFA = 26.7 billion yen)

It is a development of east-west high-speed ferry service between Songon and Bingerville/Port Bouët (T-4-1) and water bus between Attecoube and Treichville (T-4-2). While development of about 20 lagoon transport stations is the main objective, enhancement of intermodality with land public transport shall be emphasized by implementing development of some access roads to the new water bus stations (V-3-2, V-7-6).

Source: JICA Study Team

Figure 3.1 Location of Projects for Development of Water Bus Transport and Enhancement of Intermodality

(2) Development of the North-South Transport Corridor

Project No: T-1-1, V-5-5, V-7-7

(Total cost: 796,581 million FCFA = 166.0 billion yen)

This project package includes development of rail-based mass transit on the north-south corridor (Anyama to Airport) (T-1-1) as well as renovation of the north-south primary arterial road and bridge (V-5-5, V-7-7).

Source: JICA Study Team

Figure 3.2 Location of Projects for Development of the North-South Transport Corridor

(3) Development of the East-West Transport Corridor

Project No: T-1-3, V-2-2, V-2-3, V-3-4, V-4-1, V-4-2, V-6-5, V-6-8

(Total cost: 2,163,574 million FCFA = 450.9 billion yen)

The result of the transport surveys shows that the east-west corridor has a passenger demand that is as large as that in the north-south corridor. Thus, this project package includes development of mass transit on the east-west corridor (T-1-3). Although rail-based transport is considered for this corridor, due to its rolling topography, rubber-tired new transport, which can share the same bridge with roads, or linear-motor metro, etc., could be considered as appropriate. Development of a primary road (V-2-2, V-3-4) that will run parallel to this mass transit is also included as part of this east-west transport corridor development. Furthermore, development of new secondary roads (V-2-3, V-4-1, V-6-5) and a new bridge (V-4-2) as well as widening of the existing secondary road (V-6-8) will also form another east-west traffic corridor.

Source: JICA Study Team

Figure 3.3 Location of Projects for Development of the East-West Transport Corridor

(4) Development of Various Infrastructures Supporting the Port of Abidjan

Project No: F-2-1, V-4-8, V-4-9, V-4-13, V-7-4

(Total cost: 178,344 million FCFA = 37.2 billion yen)

In order to support the development of the Port of Abidjan, which will become the driving force for the CI's economy, and the urban logistic corridor, this package includes development of the surrounding infrastructures such as roads (V-4-9, V4-13), bridges, (the fourth bridge: V-4-8, Vridi bridge: V-7-4), and metropolitan logistic centers (F-2-1). Among others, for the metropolitan logistic center development, the land near Autoroute du Nord has already been made available under the initiative of OIC (Office Ivoirienne des Chargeurs / Ivorian Shippers Office); thus, it could be developed in the first phase.

Source: JICA Study Team

Figure 3.4 Location of Projects for Development of Various Infrastructures Supporting the Port of Abidjan

(5) Development of Roads Serving Newly Developed Area in Cocody

Project No: V-6-6, V-6-9, V-6-10

(Total cost: 25,492 million FCFA = 5.3 billion yen)

In order to support the newly developed area in Cocody, this package includes development of the roads (V-6-6, V-6-9, V-6-10) where rapid growth in private vehicular traffic is most outstanding.

Source: JICA Study Team

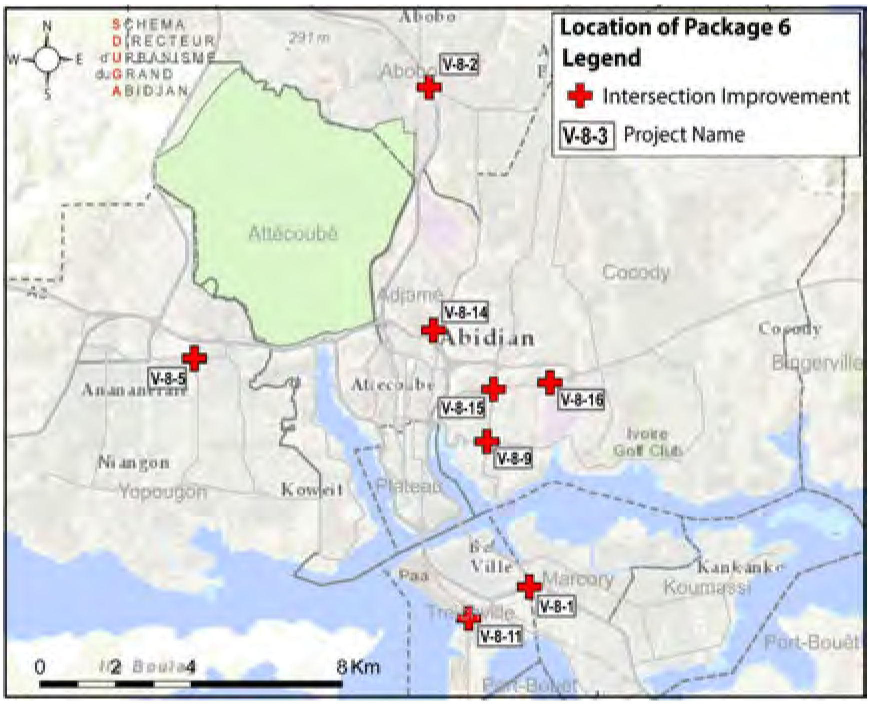
Figure 3.5 Location of Projects for Development of Roads Serving Newly Developed Area in Cocody

(6) Improvement of the Bottleneck Intersections

Project No: V-8-1, V-8-2, V-8-5, V-8-9, V-8-11, V-8-14, V-8-15, V-8-16

(Total cost: 78,351 million FCFA = 16.3 billion yen)

The four most congested intersections based on the result of the Intersection Traffic Volume Survey (Volume 3, Part 5, Figures 2.33 and 2.34), namely, Solibra (Treichville) (V-8-1), Siporex (Yopougon) (V-8-5), St. Jean (Cocody) (V-8-9), and CHU Treichville (Treichville) (V-8-11), which are notorious for bottlenecks in each area or commune, shall be improved by constructing grade separations thereby increasing the intersection capacity. Also, three more signalized intersections, namely, Williamsville (Adjamé) (V-8-14), Carrefour de la Vie (Cocody) (V-8-15), and Carrefour de L'Ecole Nationale de Police (Cocody) (V-8-16) shall be improved by constructing grade separations. For an unsignalized bottleneck intersection, Mairie d'Abobo (Abobo) (V-8-2) shall be improved by signalization or grade separation. Since most of those intersections do not overlap with any of the SDUGA road development projects, it will be better if they are improved as independent intersections.



Source: JICA Study Team

Figure 3.6 Location of Projects for Improvement of the Bottleneck Intersections

(7) Transportation Control Measures (TCM)

Project No: G-1-1, G-1-3, G-3-1, G-5-1, G-5-3, G-6-1

(Total cost: 69,437 million FCFA = 14.5 billion yen)

In order to make the most of the existing capacity of the transport infrastructure as well as to achieve a better transportation environment in Abidjan, some transportation control measures (TCMs) are included in this package. Among others, developments of area traffic control system (G-1-1), urban traffic control system (G-1-3), and pedestrian safety facilities (G-6-1) are to be implemented first. Also, as one of the main measures, construction of additional parking facilities for on-street parking vehicles is urgently needed, especially in the CBD, to clear away the current on-street parking from the arterial roads to utilize the road space for public transport (G-3-1, G-5-3). Last but not least, development of overloaded truck control system (G-5-1) is also included.

(8) Operational Support for Bus Transport

Project No: G-1-2, G-2-1, T-3-1

(Total cost: 18,083 million FCFA = 3.8 billion yen)

In order to support the operation of the current bus transport, the existing partially dedicated bus lanes should be extended more continuously on the urban primary roads to form a continuous, smooth network for buses (G-2-1, G-1-2). For this, enhancement of public transport use shall also be emphasized by improving intermodality at major interchange sites, with particular reference to Adjamé, where the transfer modes are bus/rail/Gbaka (T-3-1). However, it should be noted that implementing extension of the bus fleet for SOTRA (T-2-6) and reorganization of SOTRA bus services (O-2-1) are prerequisites for this package, though these projects were not short-listed.

(9) Development of Outer Ring Road as part of Abidjan-Lagos Corridor

Project No: V-1-1, V-1-2, V-1-5, V-1-6, V-1-7, V-1-8, V-1-9, V-2-1, V-4-10

(Total cost: 1,368,208 million FCFA = 285.1 billion yen)

The outer ring road (Y4) has long been planned since the Master Plan 2000 and is an important logistic corridor for the industrial and economic development of the Greater Abidjan. Development of this corridor has also been focused on from an international perspective by donors as part of the Abidjan-Lagos Corridor. In order to accelerate development of the outer ring road, all the priority projects that comprise the outer ring road (V-1-1, V-1-2, V-1-5, V-1-6, V-1-7, V-1-8, V-1-9) are included in this project package. In addition, projects of radial primary arterial roads (V-2-1, V-4-10) that will extensively serve the logistics in the Greater Abidjan by connecting to the outer ring road are included in this package as well.

Source: JICA Study Team

Figure 3.7 Location of Projects for Development of Outer Ring Road as part of Abidjan-Lagos Corridor

3.2 Implementation Schedule

Approximate implementation schedules for projects under each of the above-mentioned project package are presented in Table 3.1.

Table 3.1 Priority Project Packages

Proposed Projects			Short-term						Mid-term					Long-term				
			2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Development of Water Bus Transport and Enhancement of Intermodality with Road Transport																	
	T-4-2	Water Bus - Attecoube to Treichville																
	T-4-1	East – West High Speed Ferry Service (Songon - Grand Bassam)																
	V-3-2	Development of BaARN - Aérocité Area																
	V-7-6	Development of CeARN - Grand-Campement Arterial Road																
2	Development of on the North-South Transport Corridor																	
	V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge																
	T-1-1	North-South Rail Project-Stage 1 Anyama to Airport																
	V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo																
3	Development of on the East-West Transport Corridor																	
	V-4-1	Development of YoARN - Voie V23 - Parkway Section																
	V-6-5	Development of CoARN - Boulevard de France Redressé																
	V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche																
	V-2-3	Development of BiARN - Widening of the Route de Bingerville																
	V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section																
	V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand																
	T-1-3	East – West Rail Project (Yopougon to Bingerville)																
	V-3-4	Development of BaARN - Widening of the Route de Bonoua																
4	Development of Various Infrastructures Supporting the Port of Abidjan																	
	F-2-1	Metropolitan Logistic Center Development																
	V-7-4	Development of CeARN - Vridi Bridge																
	V-4-8	Development of YoARN - Voie V28 - 4th Bridge																
	V-4-13	Development of YoARN - Central Road of Boulay Island																
	V-4-9	Development of YoARN - Voie V28 - Southern Section																
5	Development of Roads Serving Newly Developed Area in Cocody																	
	V-6-6	Development of CoARN - Widening of the Boulevard Latrille																
	V-6-9	Development of CoARN - Widening of the Boulevard Attoban																
	V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche																
6	Improvement of the Bottleneck Intersections																	
	V-8-1	Intersection Improvement - Solibra (Treichville)																
	V-8-5	Intersection Improvement - Siporex (Yopougon)																
	V-8-9	Intersection Improvement - St Jean (Cocody)																
	V-8-11	Intersection Improvement - CHU Treichville (Treichville)																
	V-8-14	Intersection Improvement - Williamsville (Adjamé)																
	V-8-15	Intersection Improvement - Carrefour de la Vie (Cocody)																
	V-8-2	Intersection Improvement - Mairie d'Abobo (Abobo)																
	V-8-16	Intersection Improvement - Carrefour de L'Ecole Nationale de Police (Cocody)																
7	Transportation Control Measures (TCM)																	
	G-1-1	Development of Area Traffic Control System																
	G-1-3	Development of Urban Traffic Information System																
	G-6-1	Pedestrian Facility Development for Better Environment																
	G-5-1	Development of Overloaded Truck Control System																
	G-3-1	Development of Parking Facilities/Parking Information System																
	G-5-3	Supporting System for Control of Illegal Parking																
8	Operational Support for Bus Transport																	
	G-2-1	Development of Dedicated Bus Lanes																
	G-1-2	Development of Public Transport Priority System																
	T-3-1	Development/Improvement of Intermodal centers at Adjame, and Central/Southern Plateau																
9	Development of Outer Ring Road as part of Abidjan-Lagos Corridor																	
	V-1-7	Development of Y4 Ring Road - Aérocité Section																
	V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section																
	V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section																
	V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section																
	V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section																
	V-4-10	Development of YoARN - Autoroute de l'Ouest																
	V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18																
	V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section																
	V-2-1	Development of BiARN - Bingerville Northern Bypass																
	V-1-8	Development of Y4 Ring Road - Canal du Vridi Section																
	V-1-9	Development of Y4 Ring Road - Jacqueville Section																

Source: JICA Study Team

4.0 High-Priority Projects for Further Studies

4.1 Selection of High-Priority Projects

For the final selection of project(s) for further studies, the following three criteria have been considered for the projects on the short list:

- Whether the project has been relatively highly prioritized as a result of the multi-criteria analysis in Chapter 2, namely with a high score of 7 points or more;
- Whether the project is represented as the main target of the project package discussed in the previous section and thus likely to fulfill the theme of the package; and
- Whether the project is a lead project in the project package with an implementation period (including survey, design, expropriation, and construction) actually scheduled to start immediately, that is, from 2015 or 2016 at the latest.

The answers to the above could be clearly determined, and priority projects that meet each criterion are checked in the corresponding column, as shown in Table 4.1. Thus, 16 priority projects that have cleared all these three criteria are listed as high-priority projects as follows:

- V-1-5: Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section,
- V-1-6: Development of Y4 Ring Road - Desirée Island Bridges Section,
- V-1-7: Development of Y4 Ring Road - Aérocité Section,
- V-6-5: Development of CoARN - Boulevard de France Redressé,
- V-6-6: Development of CoARN - Widening of the Boulevard Latrille,
- V-7-4: Development of CeARN - Vridi Bridge,
- V-7-7: Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge,
- V-8-1: Intersection Improvement - Solibra (Treichville),
- V-8-5: Intersection Improvement - Siporex (Yopougon),
- V-8-9: Intersection Improvement - St Jean (Cocody),
- V-8-11: Intersection Improvement - CHU Treichville (Treichville),
- V-8-14: Intersection Improvement - Williamsville (Adjamé),
- G-2-1: Development of Dedicated Bus Lanes,
- G-3-1: Development of Parking Facilities/Parking Information System,
- T-4-2: Water Bus - Attecoube to Treichville, and
- F-2-1: Metropolitan Logistic Center Development.

Table 4.1 Selection of High-Priority Projects in SDUGA

Proposed Projects			Total Cost (million FCFA)	Relatively High Score (7 or more)	Main Target of Package	Lead Project of Package
1	Development of Water Bus Transport and Enhancement of Intermodality with Road Transport		128,278			
	T-4-2	Water Bus - Attecoube to Treichville	45,369	+	+	+
	T-4-1	East – West High Speed Ferry Service (Songon - Grand Bassam)	66,244		+	+
	V-3-2	Development of BaARN - Aérocité Area	6,780			+
	V-7-6	Development of CeARN - Grand-Campement Arterial Road	9,885			
2	Development of on the North-South Transport Corridor		796,581			
	V-7-7	Development of CeARN - Upgrade of Felix Houphouet Boigny Bridge	17,384	+	+	+
	T-1-1	North-South Rail Project-Stage 1 Anyama to Airport	753,843		+	
	V-5-5	Development of AbARN - Widening of the Autoroute d'Abobo	25,355		+	
3	Development of on the East-West Transport Corridor		2,163,574			
	V-4-1	Development of YoARN - Voie V23 - Parkway Section	12,559		+	+
	V-6-5	Development of CoARN - Boulevard de France Redressé	7,614	+	+	+
	V-6-8	Development of CoARN - Widening of the Boulevard de la Corniche	7,003	+	+	
	V-2-3	Development of BiARN - Widening of the Route de Bingerville	8,777	+	+	
	V-4-2	Development of YoARN - Voie V23 - 5th Bridge Section	242,588		+	
	V-2-2	Development of BiARN - Extension of the Boulevard François Mitterand	163,284	+		
	T-1-3	East – West Rail Project (Yopougon to Bingerville)	1,637,963		+	
	V-3-4	Development of BaARN - Widening of the Route de Bonoua	83,787			
4	Development of Various Infrastructures Supporting the Port of Abidjan		178,344			
	F-2-1	Metropolitan Logistic Center Development	25,954	+	+	+
	V-7-4	Development of CeARN - Vridi Bridge	86,626	+	+	+
	V-4-8	Development of YoARN - Voie V28 - 4th Bridge	54,739	+	+	
	V-4-13	Development of YoARN - Central Road of Boulay Island	4,726		+	
	V-4-9	Development of YoARN - Voie V28 - Southern Section	6,300			
5	Development of Roads Serving Newly Developed Area in Cocody		25,492			
	V-6-6	Development of CoARN - Widening of the Boulevard Latrille	14,904	+	+	+
	V-6-9	Development of CoARN - Widening of the Boulevard Attoban	4,415		+	
	V-6-10	Development of CoARN - Widening of the Boulevard de la 7e Tranche	6,173		+	
6	Improvement of the Bottleneck Intersections		78,351			
	V-8-1	Intersection Improvement - Solibra (Treichville)	16,630	+	+	+
	V-8-5	Intersection Improvement - Siporex (Yopougon)	6,894	+	+	+
	V-8-9	Intersection Improvement - St Jean (Cocody)	5,924	+	+	+
	V-8-11	Intersection Improvement - CHU Treichville (Treichville)	4,357	+	+	+
	V-8-14	Intersection Improvement - Williamsville (Adjamé)	12,146	+	+	+
	V-8-15	Intersection Improvement - Carrefour de la Vie (Cocody)	9,393	+	+	
	V-8-2	Intersection Improvement - Mairie d'Abobo (Abobo)	9,667	+	+	
	V-8-16	Intersection Improvement - Carrefour de L'Ecole Nationale de Police (Cocody)	13,340	+	+	
7	Transportation Control Measures (TCM)		69,437			
	G-1-1	Development of Area Traffic Control System	58,704		+	+
	G-1-3	Development of Urban Traffic Information System	1,401		+	+
	G-6-1	Pedestrian Facility Development for Better Environment	2,347			+
	G-5-1	Development of Overloaded Truck Control System	1,912	+		+
	G-3-1	Development of Parking Facilities/Parking Information System	4,263	+	+	+
	G-5-3	Supporting System for Control of Illegal Parking	810			
8	Operational Support for Bus Transport		18,083			
	G-2-1	Development of Dedicated Bus Lanes	9,824	+	+	+
	G-1-2	Development of Public Transport Priority System	5,598		+	
	T-3-1	Development/Improvement of Intermodal centers at Adjame, and Central/Southern Plateau	2,661	+	+	
9	Development of Outer Ring Road as part of Abidjan-Lagos Corridor		1,368,208			
	V-1-7	Development of Y4 Ring Road - Aérocité Section	8,247	+	+	+
	V-1-5	Development of Y4 Ring Road - François Mitterand / Riviéra 6 Section	57,703	+	+	+
	V-1-4	Development of Y4 Ring Road - Abobo Baoulé / François Mitterand Section	212,731		+	+
	V-1-3	Development of Y4 Ring Road - Pk18 to Abobo Baoulé Section	201,356		+	+
	V-1-6	Development of Y4 Ring Road - Desirée Island Bridges Section	447,505	+	+	+
	V-4-10	Development of YoARN - Autoroute de l'Ouest	29,962			
	V-1-2	Development of Y4 Ring Road - Autoroute du Nord / Pk18	44,842	+	+	
	V-1-1	Development of Y4 Ring Road - Songon / Autoroute du Nord Section	52,607	+	+	
	V-2-1	Development of BiARN - Bingerville Northern Bypass	29,934	+		
	V-1-8	Development of Y4 Ring Road - Canal du Vridi Section	187,148		+	
	V-1-9	Development of Y4 Ring Road - Jacqueville Section	96,172		+	

Source: JICA Study Team

The above 16 projects have been identified as the most urgent projects to be subjected to further studies such as F/S. They are basically independent unless they are from the same project package. On the other hand, at least one project has been selected as a high-priority project from each project package; hence, selection of a project for further studies out of those high-priority projects will depend on toward which development direction (i.e., goal of project package) the government of Cote d'Ivoire is seeking the most as the first step.

4.2 Synopsis

(1) Development of Y4 Ring Road

The Y4 Road Ring will have an impact on various levels. At the international level, as it will be an important link to the Dakar-Lagos International Transport Corridor. At the national level, as it will help increase the efficiency of cargo transport inside the country. Furthermore, at the District level, it will contribute to the development of the urban centers inside the Abidjan Autonomous District (AAD) such as Cocody, Abobo, Yopougon, Songon, Port Bouet, and Bingerville by ameliorating traffic conditions inside the city and systematically connecting the urban centers, thereby realizing the concept of a compact city. As such both the AAD and the MIE, with its executing agency AGEROUTE, will have to be involved in its implementation.

Due to illegal land occupation, the alignment of the Y4 Ring Road has been changed in the Cocody and Koumassi areas and is now going through the Ile Desiree and the Aerocite (V-1-5, V-1-6 and V-1-7). As lands have been reserved along the former alignment, this modification could encounter opposition from among urban planners and road actors, as it could be seen as a withdrawal in front of illegal occupation of ROW.

Although some are considering implementing this project under a PPP scheme and considering the high cost of this road, financial assistance from funding agencies will be required for the implementation of this crossing.

(2) Development of Cocody Area Road Network

Most of the new road infrastructures that will be built in this area are secondary roads that could be implemented by the Cocody Commune. However, due to budget constraint, the roads will probably have to be supervised by the MIE with its executing agency AGEROUTE and funded by funding agencies.

The Cocody area is developing at a very fast pace with all the new residential areas under-construction in the eastern part of the commune. All those new residential areas have been planned without taking into account future road network development. The Boulevard de France Redresse (V-6-5) is a good example. Planned in the Master Plan 2000, it has high standard houses newly built along its alignment. During the design of this road, the alignment will have to be carefully selected to reduce the cost of land acquisition and resettlement as much as possible.

The widening to 2x3 traffic lanes of the Boulevard Latrille (V-6-6) will also have to be studied in detail to see if land acquisition and resettlement is required. The southern section seems to have sufficient ROW but some buildings may have to be removed in the northern part. Also, its crossing with the Boulevard Mitterrand and the extension of Autoroute du Nord C2 will also have to be studied in detail.

(3) Development of Central Area Road Network

The Vridi Bridge (V-7-4) is a primary road with a strategic function to create an inner ring road with the 3rd Bridge and the Voie V28. As such, it should be implemented by the MIE and its executing agency AGEROUTE. Some may be opposed to its implementation, first because restaurants on Pierre et Marie Curie Road that would be negatively impacted by the increase of truck traffic along this road; and second because another bridge, the Vridi-Bietry Bridge, is planned in its vicinity. Also, the bridge length will depend on the shape and the implementation period of the reclaimed lands that will be built in the Vridi Bay. However, considering the importance of this link for the road network, this project needs to be strongly supported by the MIE.

The Felix Houphouet Boigny Bridge (V-7-7) is an essential link of the Greater Abidjan road network and its renovation will have to be supervised by the MIE and its executing agency AGEROUTE. As it has not yet been decided whether or not the North-South Urban Train will use this bridge to cross the lagoon, the rehabilitation works will have to wait until a decision is made to ensure that the infrastructure will be upgraded sufficiently to withstand those new solicitations if necessary.

(4) Intersection Improvement

All the intersection improvement projects could be implemented by the concerned Commune or by the AGEROUTE. However, due to limited funds and technical expertise, AGEROUTE will most likely become the executing agency for most of those projects.

There are five high-priority intersection improvement projects in Abidjan, among which Solibra (V-8-1) has already been adopted by JICA for a further preparatory survey stage towards its project implementation.

The Siporex intersection (V-8-5) will probably have to be improved with the construction of a new flyover. The orientation of the flyover will not only have to be selected based on the traffic volume and traffic flow, but also on the proximity of the Autoroute du Nord Interchange. Also, there is not much space left which could complicate the implementation of this project.

In Cocody, the Carrefour St Jean (V-8-9) will also have to be upgraded. Both a flyover and underpass could be considered for this intersection.

In the Port area, the intersection located west of the CHU of Treichville (V-8-11) has a Y shape. Thus the flyover proposed to ameliorate the traffic flow will have to be curved, which could increase the cost of the overall project if a steel box girder, that is more suitable for curved bridges, is selected.

The Williamsville intersection (V-8-14) area is very complex with the interchange of the Autoroute du Nord, the route du zoo (the main access to Adjame/Plateau from the North) and the main road running inside Williamsville quartier all ending at the same point. The improvement of this intersection may require several overpasses or underpasses. Also the area where Gbaka and Woro-woro are stationed at the exit of the interchange will have to be relocated, which could further complicate the project. The proximity of the Gendarmerie Camp is also another issue, as there will probably be some restrictions on the ROW and the height of infrastructure.

(5) Traffic Control and Management

For traffic control and management, there are two high-priority projects. The first is the project for development of dedicated bus lanes (G-2-1). Dedicated bus lanes have already been constructed on some of the city bus lines. However, the dedicated bus lanes that are currently provided are limited in both length and in continuity. In reality, it is often the case that such local dedicated bus lane sections are occupied by many other private vehicles and are thus not efficiently utilized. From the viewpoint of safer and more orderly traffic, current regulations to separate public transportation from other private vehicles need to be maintained. These regulations become more effective if the existing dedicated bus lanes are applied to longer and more continuous road sections. The development of dedicated bus lanes will also match with the concept of a compact city, in which the improvement of traffic for both private vehicles and public transport passengers may be preferred from the viewpoint of urban densification.

The initial investment for this project could cost less than development of a bus rapid transit (BRT) system in which physically fixed and continuous separators are constructed along with special platforms, and it can be installed faster and more flexibly by taking less space on the existing roads. The main executing agency will be the Ministry of Transport, which has taken over the role of the former AGETU. However, efficient control and stricter enforcement of the regulations by the police or the military will be necessary for successful operation of the dedicated bus lanes.

Meanwhile, for development of parking facilities and a parking information system (G-3-1), Abidjan Autonomous District (AAD) will be the main executing agency. Development of a parking information system will help to guide car users to the most appropriate public and private parking lots. Efficient control of the on-street-parking will reduce on-street parking vehicles, especially in the central area. However, significant investment from the private sector may also be necessary for development of off-street parking facilities.

(6) Public Transport Development

For public transport development, as a major upgrade of the existing lagoon transport service, developing water bus transport serving north-south of Plateau (i.e., Attecoube to Treichville) has been selected as a high-priority project (T-4-2). Preliminary investigations undertaken by government agencies on the physical characteristics of the locations of ferry stations or piers suggest that there are no engineering problems; thus, this will also become a basis for development of the east-west high-speed ferry service. While the market for lagoon transport services has recently been opened for private operators, the Ministry of Transport will be the implementing agency for this project including development of the quays, terminals, and navigation facilities that could be commonly utilized by operators. Meanwhile, AAD is also interested in taking the initiative for developing a lagoon transport service inside Abidjan including this project.

(7) Freight Transport Development

For freight transport, development of metropolitan logistic centers (F-2-1) has been selected as a high-priority project. Under the jurisdiction of the Ministry of Transport, OIC (Office Ivoirienne des Chargeurs / Ivorian Shippers Office) is in charge of the facilitation of import and export by managing loading activities, especially trucks with loaded cargo transporting to and from Abidjan, including the port and industrial zones. OIC is currently planning to build a new logistics park at Akoupezedji, along Autoroute du Nord, outside Yopougon (in the sous-prefecture of Anyama), to improve their operation. Land has already been reserved for this purpose, also covering the accommodation for the drivers, commodity pickup services, and so on. However, due to slow implementation of this project, the Port of Abidjan also has started another project for a logistics park near Autoroute du Nord. Therefore, coordination with the Port of Abidjan would be necessary to avoid duplicating their projects and an executing agency that ensures sustainable operation and management of the logistic park should be properly decided in advance.

5.0 Implementation Program

5.1 Master Plan Costs

The preliminary cost of the Master Plan for the urban transport sector has been estimated taking into account the above-mentioned implementation schedule of the proposed projects.

Fund requirements for the Master Plan are summarized in Table 5.1 and Table 5.2, including capital investment costs and operation and maintenance costs during the period from 2015 to 2030. An amount of 12.9 trillion FCFA is required for the period between 2015 and 2030 in market prices of July 2014 including inflation, of which 8.9 trillion FCFA and 4.0 trillion FCFA are required for the investment and for the operation and maintenance, respectively. The public transport development consisting of 13 projects including the urban rail development has the highest cost amounting to 6.5 trillion FCFA, or 50% of the total cost. The road development that consists of 80 projects requires 5.8 trillion FCFA. Road and public transport developments together with traffic control and management that consists of 17 projects account for 97% of the total cost.

From the viewpoint of the timing of cost distribution, 23%, 45% and 32% of the total cost need to be allocated in the short-term period until 2020, the medium-term period (2021-2025) and the long-term period (2026-2030), respectively, as shown Table 5.2. Annual distribution of the Master Plan cost is indicated in Figure 5.1.

The share of the Master Plan cost accounts for 5.3% of the GRDP of the Greater Abidjan[1] throughout the period from 2015 to 2030. The cumulative GRDP is estimated at 246 trillion FCFA at 2014 constant prices for the period from 2015 to 2030 based on the socioeconomic framework assumed in this Study.

[1] Source: National Institute of Statistics

Table 5.1 Transport Master Plan Cost (2015-2030)

[Unit: million FCFA]

Sub-Sector	Investment Cost	Operation and Maintenance Cost	Total	Share (%)
Road Development	4,287,978	1,533,686	5,821,664	45.1
Traffic Control and Management	148,146	73,391	221,537	1.7
Public Transport Development	4,191,816	2,320,477	6,512,293	50.4
Freight Transportation Development	243,153	110,430	353,583	2.7
Organizational and Institutional Arrangements	4,071	2,566	6,636	0.1
Total	8,875,164	4,040,549	12,915,714	100.0

Note: The cost is estimated at 2014 market prices.

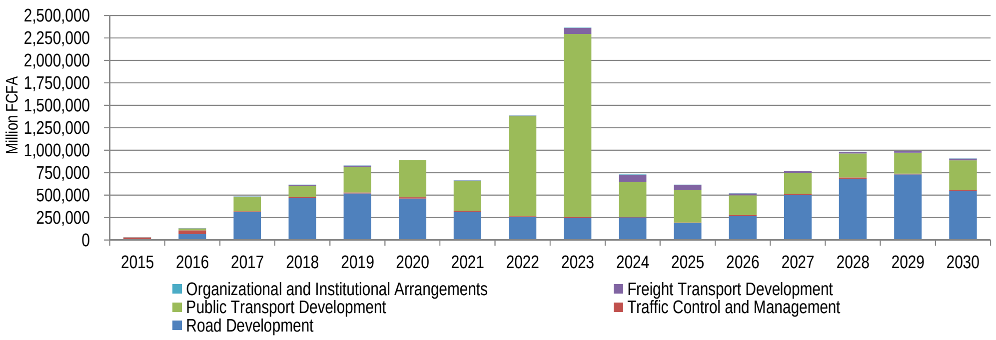
Source: JICA Study Team

Table 5.2 Road and Urban Transportation Master Plan Cost by Development Term

[Unit: million FCFA]

Sub-Sector	Development Term			
	Short Term (2015-2020)	Medium Term (2021-2025)	Long Term (2026-2030)	Total
Road Development	1,832,892	1,256,487	2,732,285	5,821,664
Traffic Control and Management	111,235	50,732	59,570	221,537
Public Transport Development	1,006,686	4,224,933	1,280,674	6,512,293
Freight Transportation Development	31,048	225,957	96,579	353,583
Organizational and Institutional Arrangements	3,277	1,772	1,587	6,636
Total (%)	2,985,138 (23%)	5,759,881 (45%)	4,170,695 (32%)	12,915,714 (100%)

Source: JICA Study Team



Source: JICA Study Team

Figure 5.1 Annual Cost of Master Plan (2015-2030)

5.2 Funding Allocation

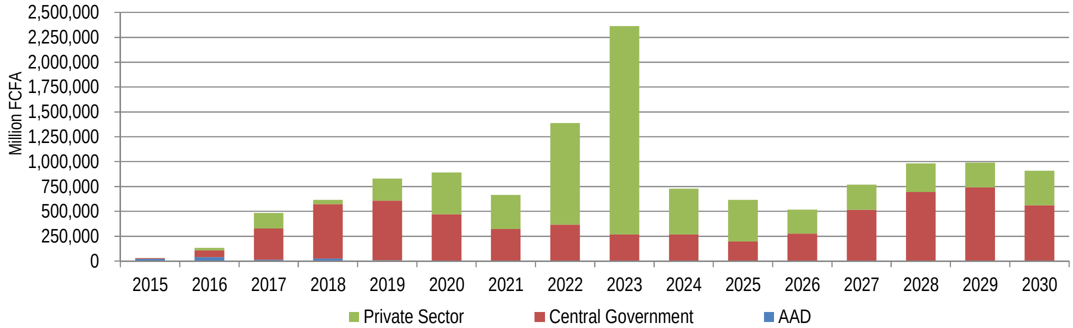
Taking into consideration the private sector involvement, the funding allocation for the Master Plan is estimated by the public/private sectors as shown in Table 5.3. Annual funding allocations by the public/private sectors are presented in Figure 5.2. Total Master Plan cost amounts to 12.9 trillion FCFA, of which 6.6 trillion FCFA, or 51% of the total cost, could be reduced from the total cost burden with the introduction of private initiative development. Consequently, the funding requirements of the public sector for the implementation of the Master Plan are estimated at 6.3 trillion FCFA at 2014 market prices including inflation for the period 2015-2030. Among others, the funding requirements of the central government for the Master Plan are estimated at 6.2 trillion FCFA, or 48% of the total cost.

Table 5.3 Cost Allocation for Master Plan by Public/Private Sector (2015-2030)

[Unit: million FCFA]

Sub-Sector	Public Sector (AAD)	Public Sector (Central Gov't)	Private Sector	Total MP Cost
Road Development	0	5,821,664	0	5,821,664
Traffic Control and Management	113,835	5,362	102,340	221,537
Public Transport Development	58,864	245,700	6,207,729	6,512,293
Freight Transport Development	0	84,256	269,326	353,583
Organizational and Institutional Arrangements	2,907	778	2,951	6,636
Total (%)	175,605 (1%)	6,157,761 (48%)	6,582,347 (51%)	12,915,714 (100%)

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2 Annual Cost Allocation for Master Plan by Public/Private Sector (2015-2030)

For reference, the central government has recently set out the Grand Projects of Emergence, which consists of 94 projects selected out of a total of 225 projects. The selected 94 emergent grand projects include 45 projects to be funded by the State budget and 49 projects to be implemented through a Public-Private Partnership (PPP). Among the 45 projects to be financed by the State budget, 44 were estimated at a total amount of around five trillion FCFA while, under the PPP, 45 projects out of the 49 were estimated at a total amount of eight trillion FCFA. In total, 89 out of the 94 grand projects were estimated at around 13 trillion FCFA. For the road sector and public transport sector, four and six grand projects were estimated at around 0.5 trillion FCFA and 1.5 trillion FCFA, respectively. It is also envisaged that all these road and public transport projects will be financed through PPP. Thus, participation of the private sector is also a key for the implementation of the transport projects at the national level.

5.3 Organizational and Institutional Arrangements

5.3.1 Establishment of a Transportation Authority

Establishment of a new agency, such as a transportation authority, is strongly recommended and a decision in this sense is being adopted by the State of Côte d'Ivoire through the draft law on the orientation of Inland Transportation which provides for the establishment of a Transport Regulatory Authority. This agency will be responsible to make a consistent metropolitan-wide transportation system development plan and to manage transportation demand in the Greater Abidjan. However, if it would take a long time to establish such a new agency, a planning commission is to be established to pursue the tasks in the short term. The Study recommends establishing a transportation authority for the Greater Abidjan in the short term and envisages the next step to be the establishment of an urban development authority.

5.3.1.1 Abidjan Transportation Planning Commission

The Abidjan Transportation Planning Commission is to be set up under the direction of the central ministries, consisting of transport-related personnel from local governments including Abidjan Autonomous District (AAD). This executive body shall consist of heads of representatives from the ministries, such as the Ministry of Construction, Sanitation and Urban Development (MCLAU), the Ministry of Transport, and the Ministry of Economic Infrastructure (MIE), the Prime Minister's Office, and the Presidential Office, as well as respective governmental agencies and local governments. Its main functions are:

- To coordinate and integrate respective transportation planning and studies at governmental agencies and local governments into an integrated metropolitan transportation plan;
- To conduct research and surveys, among others, comprehensive transportation surveys which will collect information regarding all trips in the Greater Abidjan for transportation planning; and
- To review and update the integrated metropolitan transportation plans including this Study and manage the data and the planning methodology acquired through the Study.

A permanent secretariat including technical experts should be set up to support the commission and carry out daily operations. Funding for the commission and the personnel shall be in the form of contribution by the commission members. Currently existing governmental agencies, namely, either Abidjan Urban Planning Agency (AUPA) under AAD or Integrated Management Center under the Ministry of Transport could be the base for developing such a planning commission.

5.3.1.2 Greater Abidjan Transportation Authority

A Greater Abidjan Transportation Authority shall be established as an independent public corporation which has its main accountability to the public, not just to the central or local governments. The authority would be endorsed by government law to stand as an independent public corporation. It oversees all urban transportation issues and has main responsibilities for the following:

- To formulate metropolitan transportation policies;
- To formulate integrated transportation planning, including road network development, public transport development, traffic control and management, and urban transportation system management;
- To implement the integrated transportation planning and programs, especially to realize the bus route restructuring for the Greater Abidjan;
- To issue licenses and control public transportation with conventional bus/water bus operation licenses, public transport business licenses, terminal or station development permission, and so on;
- To regulate public transport services such as rail, bus, lagoon transport, and so on;
- To support development of intercity road and public transport networks; and
- To carry out transportation demand management (TDM) measures such as road pricing or parking pricing.

The Transportation Authority would be operated by the revenue from transportation business such as public transport fares and road pricing/parking charges or subsidy from the central and local governments. As an independent corporation, however, its primary task is to achieve and maintain financial sustainability, and it should be underlined that a disclosure of financial status is one of the most important aspects to secure its position as a public corporation offering public services to users in the Greater Abidjan. As a public corporation, it could also raise funds from the capital market by issuing corporate bonds.

5.3.1.3 Cooperation between Public Transport Operators

The establishment of such a metropolitan transportation authority may be difficult for various reasons. However, for coordination of different bus and minibus lines for the Greater Abidjan and for an integrated fare system, examples that are often applied in the cities of Germany may be useful. Examples of cooperation between public transport operators in the metropolitan regions in Germany are presented in Table 5.4.

Examples of the transport federation (*Verkehrsverbund*), which is the strongest in the degree of cooperation, are observed in Hamburg, Berlin, etc. It is one form of transportation authority that focuses only on cooperation in public transport operation and its planning. It aims at realizing comprehensive public transportation systems that the citizens are attracted to by forming an alliance among transport operators. Its main task is to work cooperatively on route planning, common fare system, timetable scheduling, service level, marketing, financing, etc. based on the citizens' needs. Thus, a number of public transportation issues shall be resolved based on consensus with stakeholders including the citizens.

Table 5.4 Examples of Cooperation between Public Transport Operators in Germany

Degree of Cooperation: Strong → Weak

Type of Cooperation	Common Tariff	Bus Line Planning	Schedule Planning	Remarks
Transport Federation	Yes	Yes	Yes	Legally independent body with revenue
Transport Alliance	Yes	Yes	Yes	Managed by transport operators
Tariff Alliance	Yes	No	Cooperation	Sharing revenues based on prior agreement
Partial Cooperation	No	No	Cooperation	Various cooperation as the need arises

Source: JICA Study Team, based on (Knieps, 2009) and (Krause, 2009)

5.3.2 Private Sector Involvement in Transportation Development

In Abidjan, four major new modes of public transport, namely, urban rail, water transport, BRT, and BHLS are proposed for inclusion in the Master Plan. Each of these new modes has at least two lines and they will all operate on the high-capacity transit corridors. Key operational requirements for these new modes in Abidjan are land requirements for stations, depots, and ROW, affordability, and rolling stock (train, bus, or ferry). It is unlikely that the private sector can provide all and also meet the affordability requirement without the support of the government.

As stated earlier, the most common contract in some European examples has been DBFM (Design Build Finance Maintain), where the government receives full-cycle certainty on costs, scheduling, materials, and reliable operation, thereby minimizing their risk at the expense of the private sector. The DBFM scheme overcomes the weaknesses inherent in the traditional design-bid-build contracting scheme in which each separate step is tendered to the lowest price, though, overall, it could lead to added costs.

The private sector may not necessarily bring significant savings, as the finances needed for a project must be raised on the capital market. What is improved by private sector involvement in the implementation of a project is likely the quality aspect of a project such as the reduction of a so-called Life Cycle Cost (LCC) by applying the maintenance skills of the private sector, and reduction of the project implementation time by participation of the private sector from an early stage. DBFM is recommended for consideration in the delivery of project implementation in Abidjan as part of the preparation of any F/S.

At present SOTRA (Société des Transports Abidjanais) is the principal supplier of bus and water bus services in the formal transport sector. While SOTRA is still a state-owned company in itself, it already has a private sector partner[2]. An increase in the private sector participation of SOTRA may provide a springboard for the government to encourage the development of DBFM investment in the development of the new high-capacity transit corridors. Although further privatization is yet to be discussed, the rationalization and efficiency of the public transport business are the conditions for the private-sector participation.

Furthermore, regulations on private investment in the transportation sector should be reviewed and modified to provide a sound investment environment for the private sector in transportation business. This also includes provision of development rights to private investors in the area surrounding urban rail stations, making it possible to internalize the development benefits of transportation system development. This may relieve the financial burden on the investors, and could promote the transportation business with a view to overcoming financial problems. However, it should be done in a well-planned and controlled manner consistent with the land use plan. The role and responsibility sharing system between the public and private sectors should also be clearly determined.

[2] In 2009, Irisbus/IVECO, now a division of CNH Industrial had a 35% share in SOTRA.

6.0 Recommendations

6.1 General

The Study team received comments on the contents of the Draft Final report from the CI side, and the Study team tried to reflect all the comments in the Final Report. While some of the comments have been fully accommodated to the report, other comments correspond to further studies such as master plan studies in other sectors, PUD/PUd by each commune, F/S, and so on. Thus, as part of the responses to the comments from the CI side, this chapter describes several pending issues as recommendations.

As a general issue for formulation of the transport master plan of SDUGA, while the current laws and regulations in the urban transport sector were reviewed, further improvements on the present situation of the laws and regulations were not proposed as part of SDUGA. Among others, laws and regulations on the following aspects were not discussed:

- Planning, construction, management, and operation including concession agreements for the urban transport facilities;
- Implementation of the projects for specific transport modes including Gbaka, Woro-Woro, and meter taxis; and
- Control of traffic for the improvement of safety and mitigation of air pollution and noise.

Thus, the Study team recommends another study to cover these issues and propose relevant laws and regulations in order to clear the concerns for realization and to proceed with the implementation of SDUGA urban transport master plan.

6.2 Road and Logistic Planning

6.2.1 Additional Road Projects

As for the additional road projects of which alignments were given to the Study team in the course of finalizing the SDUGA urban transport master plan, only those which the CI side clearly insisted (i.e.,V-9-1 to V-9-5) have been incorporated into the master plan without studying the details. While the Study team did their best to make a fair evaluation and prioritization on all the projects, those additional projects are still subject to further technical studies to determine the road class, the number of lanes, cross sections, alignments, intersection types, and so on. Among others, the following projects have revealed peculiar issues as below:

- The alignments of V-9-1 and V-9-2 have very rough, rolling terrains in a mountainous area, thereby causing large earth fills and cuts, which will be about 20 meters high, or many bridges. V-9-1 seems particularly unrealistic without seriously looking into the topography;
- V-9-3 is planned to connect to the road in front of the cathedral, that is, to the short section between the interchange and the junction. Drastic change in the existing road structure may be necessary in terms of the traffic flow; and
- V-9-4 is also planned to connect close to the existing interchange, the structure of which also may need to be changed to another type including bridge ramps. Furthermore, the road structure planned on a thalweg (Gobele valley) may technically induce a higher construction cost.

The above issues need to be solved before fully adopting those additional projects into the urban transport master plan including roads and public transport.

6.2.2 Freight Rail and Port Development

In the urban transport master plan, introduction of a new freight railway (F-1-2) has been proposed. This project aims at not only supporting the new development of the western part of Abidjan Port but also connecting port freight with inland industrial zones such as Yopougon and integrating it with the metropolitan logistic center in Anyama. Thus, it has been scheduled for the medium term in accordance with this new port development. However, there is uncertainty about the implementation deadline for the port's extension on Boulay Island. Furthermore, the main relevant markets for the freight rail transport such as container terminals, refineries, and cement factories are likely to remain in the existing port area in Treichville and Port Bouet.

On the other hand, the development of ore export could lead to the saturation of not only the existing ore terminal but also the new terminal planned in the short term and designed to export a few million tons of ore a year. Thus, it will be necessary to create a new ore terminal on Boulay Island, which is designed to export tens of millions of tons of ore per year, requiring an efficient railway and a terminal, which will constitute a core asset for the development of the mining sector in Côte d'Ivoire, as well as a bulk terminal, which could also be used to import clinker, particularly for CIMAF (Ciments de l'Afrique), a cement factory in Yopougon.

While the above-mentioned future perspectives are not certain yet, the Study team recommends conducting another study on the port development master plan and having it formulated and authorized first of all. The Study team then recommends a further study, possibly a feasibility study, on this new freight rail project including discussions on these issues with all the relevant agencies when reviewing SDUGA at a later stage. Then it will become necessary to take precautions for reserving some land for this new freight railway.

6.3 Public Transport Planning

6.3.1 High-Capacity Corridors

In the transport master plan of SDUGA, all the high-capacity transit corridors have been proposed. Some corridors have been nearly finalized in terms of the route or alignment selection before the completion of the F/S. Meanwhile, other corridors have no definite route or alignment along with the location of the stations yet. While the transport master plan indicated the details of each high-capacity transit corridor for project profiling including cost and demand as well as for project prioritization, more precise routes or alignment selection along with location of the stations should be further studied and determined in the subsequent F/S.

Among others, regarding the second phase of the Blue Line (T-1-2), which includes an extension from the airport to Grand Bassam, the Study team proposed an intermediate axis between the northern coast and the Abidjan – Bassam Highway with further nine stations. However, an F/S or a further study should be carried out soon as part of the study on the Detailed Urban Master Plan (PUd) of the area of Port-Bouet – Grand Bassam to compare several routing options. The route and stations serving Grand Bassam including VITIB (Village of Information Technology and Biotechnology) and downtown should be specified. Attention should also be paid to the issue of coastal erosion on the section of the airport – Gonzagueville, where the extended Blue Line and the highway are very close to the sea and hence some protection works need to be planned in the study.

6.3.2 Water-Based Transport

In the transport master plan, two water-based transport development projects were proposed: namely, water bus transport serving north-south of Plateau (T-4-2), which has been designated as a priority project, and an east-west high speed ferry service (T-4-1). Since preliminary investigations on the physical characteristics of the locations of lagoon stations or piers suggest that there are no engineering problems, these projects may be promptly implemented at a relatively lower cost. Thus, both projects have been scheduled for the short term.

On the other hand, there will be many existing and planned bridges crossing the lagoon axes: namely, Jacqueville Bridge, the Fourth (or Boulay Island) Bridge, Felix Houphouet Boigny Bridge, General de Gaulle Bridge, the Third (Henri Konan Bédié) Bridge, Desirée Island Bridge, etc. on the east-west lagoon axis, and the Fifth Bridge on the north-south lagoon axis. Thus, for the actual implementation of the water bus development projects, clearance under those bridges must be taken into account to ensure the navigation on these lagoon axes. The Study team recommends studying these issues in the subsequent F/S, for example, leaving the possibility of revising the urban transport master plan in terms of the bridge design.

While only two water-based transport projects have been proposed in the transport master plan, the Government of CI is also interested in developing water-based transport across Koumassi Dyke; however, a significant hydraulic structure would be required, allowing the navigation of water buses between the two lagoons. Furthermore, development plans of the Autonomous Port of Abidjan (PAA) should also be taken into account to meet the compatibility with the regulation of navigation in the port area. For example, between the Container Terminals (1 or 2) and Azito (north bank of the Fourth bridge), PAA plans a transport system of several shuttle boats carrying heavy weights or barges carrying containers per day per direction, with a possibility of developing a custom area or a "dry port" in Azito or at Yopougon logistic center (PK 24), which is favorably viewed by the General Directorate of Customs. Due consideration must be paid in order to avoid the conflict in the navigation between the passenger and freight transport services on the lagoon.

Hence, the Study team recommends conducting a comprehensive study on the water-based transport that will cover all the above issues with a view to formulating a master plan in the water-based transport sector. The lagoon service scheme that is being studied by BNETD may be in the same direction toward this recommendation. Meanwhile, it is also necessary to conduct another study on the port development master plan and to have it formulated and authorized, as mentioned earlier.

6.3.3 Bus Transport

Regarding the conventional bus services, SOTRA's bus network is expected to focus on the line-haul type bus lines that will support the operations of the high-capacity transit corridors through the multiplier effect rather than to compete with each other; thus, it will continue to play an important role in the urban public transport in Abidjan. Though a clear picture of restructuring SOTRA's future bus network, including locations of the depots, was not presented in SDUGA, several dedicated bus lanes were proposed on the roads with available ROW as well as with frequent bus services to form a more continuous network. Based on the urban transport master plan, SOTRA is making its own action plan to implement the proposals. SOTRA will establish the vision of its development in accordance with SDUGA, namely, as the "Plan SOTRA 2030," which could be formulated by itself or by another institute of technical studies. SOTRA is also looking into a possibility of operating the feeder minibuses to enhance the usage of the high-capacity transit corridors.

Furthermore, during the period of 1985-1990, SOTRA had a fleet of 1,200 buses which served about 40% of the total motorized trips. As such, SOTRA envisages increasing its fleet from 500 (operational) buses in 2014 to 700 in 2015, 2,000 in 2020, and 3,000 in 2030. Meanwhile, the necessary number of buses presented earlier in Section 5.3.3 of Part 6 of this report is only an indicative figure based on the travel demand forecast model. Thus, as for the detailed improvement plans of the bus transport including all of the above issues, the Study team recommends conducting another master plan study for improving the road-based public transport system including feeder minibuses, BRT, and BHLS based on SDUGA.