3.8 OUTLINE OF EXISTING MANAGEMENT OPERATIONS AND TRAINING

3.8.1 Organizational Context

1) Civil Aviation Administration of Vietnam

The Civil Aviation Administration of Vietnam (CAAV) is a wholly state owned and managed entity governed by the National Civil Aviation Law promulgated in 1992. The present organizational structure was established by Decision Number 204 of the Director General of the CAAV on 2 April, 1993. The CAAV previously came under the authority of the Ministry of Transport but the with approval, by the National Assembly on 19 April, 1995, of amendments to the National Civil Aviation Law, the CAAV now comes under the direct authority of the Office of the Government.

The CAAV is headed by a Director General, assisted by 3 Deputy Directors General and 11 departmental heads who work out of the CAAV Headquarters complex near Gia Lam airport just outside of Hanoi. The CAAV also manages 3 other categories of organization: administrative organizations; semi-administrative organizations; and aviation enterprises.

1) Administrative Organizations

This category includes:

a) Aviation Scientific Research Institute;
b) Civil Aviation Training Centre (located in Ho Chi Minh City);
c) Aviation Health Care Centre; and
d) Aviation Bulletin.

2) Semi-administrative Organizations

This category includes the following organizations, each headed by a director general:

a) The Northern Airports Region;
b) The Central Airports Region;
c) The Southern Airports Region; and
d) The Air Navigation Department of Vietnam.

Each of the Airports Regions comprises one international airport and a number of domestic

airports. In each case, the Regional Director General is also the Director of the international airport.

3) Aviation Enterprises

Organizations in this category operate like private companies in as much as they pay taxes on profits and are able to invest the remainder; however, they have no authority to set their own service charges or staff salaries, and the Government approvals are required for capital expenditures. These enterprises are the:

a) Vietnam Airlines;
b) Vietnam Air Service Company (VASCO) for charter flights and aerial photography;
c) Vietnam Air Petrol Company;
d) Aviation Export Impoit Company;
e) Northern Air Services Company (NASCO) (taxi services, hotels, etc.)
f) Middle Air Service Company (MASCO) " "
g) Southern Air Service Company (SASCO) " "
h) Aviation Construction Company;
j) Aviation Survey and Design Company;
k) Aviation Printing Company;
l) Aviation Plastic Company (mainly producing plastic eating utensils for Vietnam Airlines);
m) Aviation Vehicle Company; and
n) the Aviation Service Company.

2) The Northern Airports Region

The Northern Airports Region is headed by a Director General (DG/NAR) who reports directly to the Director General of the CAAV (DG/CAAV). It comprises:

a) Noi Bai International Airport;
b) Cat Bi Airport (serving the main Northern port city of Haiphong);
c) Nasan Airport;
d) Dien Bien Airport; and
e) Vinh Airport.

3) Noi Bai International Airport

Noi Bai International Airport is the international gateway airport to North of Vietnam. The Airport Director is also the DG/NAR. Chiefs of 10 departments currently report directly to the DG/NAR:

The line departments are:

a) Airport Management (Airside and Groundside Facilities Maintenance, and Commercial Services);
b) Air Navigation;
c) Airport Directory (Apron and Groundside Operations);
d) Emergency Services; and
e) Security Services.

The staff departments are:

a) Construction;
b) Planning;
c) Northern Airports Region Secretariat;
d) Labour (Personnel); and
e) Finance.

The directors of each of the 4 regional airports also report directly to the DG/NAR. The consolidated NAR organization chart appears in Figure 3.8.1.

The Approach and Area Control Centre (AACC) which serves the Hanoi Flight Information Region (FIR) and also provides Approach control to the NBIA is also located at Noi Bai, but it comes under the direct authority of the Director General of the Air Navigation Department of Vietnam at the CAAV H.Q.

All Airside and Groundside ground handling services at the NBIA for all carriers are currently the responsibility of Vietnam Airlines (VNA).

At the NBIA, joint ventures between NASCO and foreign investors, and Vietnam Airlines and foreign investors manage duty free shops and airline catering respectively.

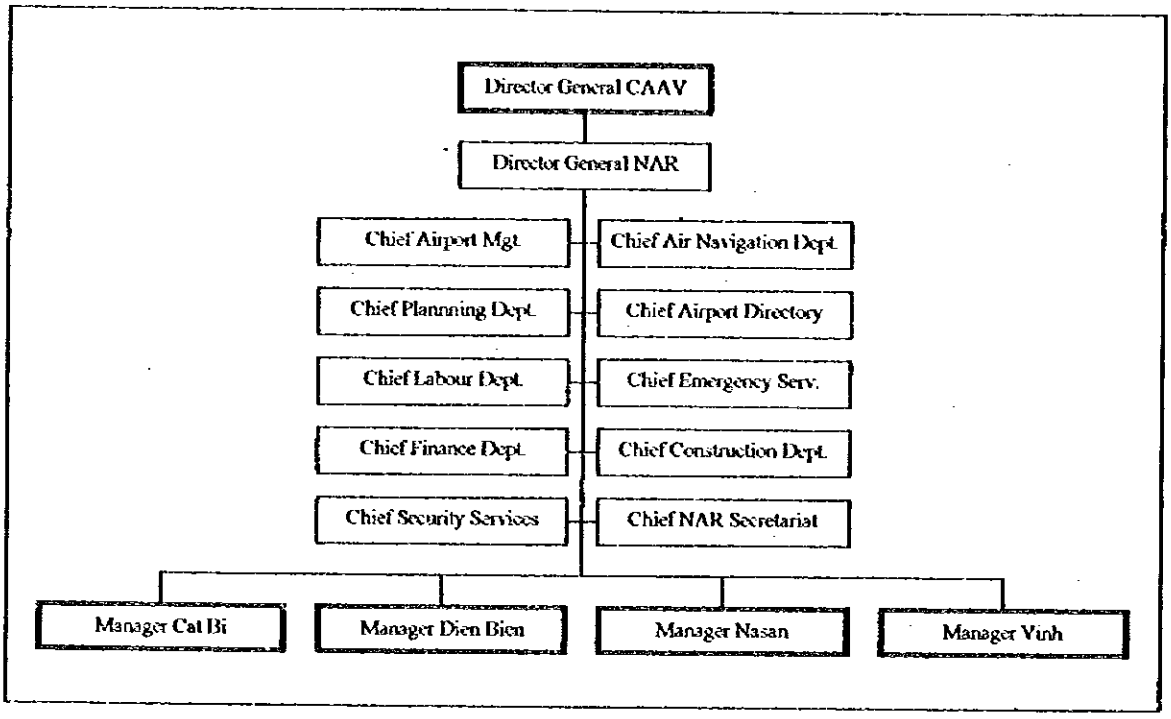

Figure 3.8.1 Civil Aviation Administration of Vietnam Northern Airports Region

4) Impending Organizational Change

It has been reported that amendments to 11 clauses to the Civil Aviation Law were approved by the National Assembly on 19 April, 1995 which provide for changes with respect to:

a) state administration of civil aviation;
b) aircraft registration;
c) state management of airports;
d) air traffic service units;
e) investigations of air accidents;
f) the establishment of air transport businesses;
c) traffic rights for scheduled foreign carriers and for non-scheduled carriers;
f) passenger rights concerning ticket contracts in the event of a journey interruption due to a forced landing;
g) tariff setting;
h) limits of liabilities of carriers; and
j) compensation liability limits for foreign carriers.

The only definitive organizational change known to result from the recent amendments is that the

CAAV now comes under the direct authority of the Prime Minister's Office as opposed to the Ministry of Transport.

3.8.2 Staffing

The total complement of CAAV staff within the NAR is 1,416 as of 1 April, 1995. The distribution of staff is as follows:

a)	Ten departments at the NBIA	856
b)	Cat Bi Airport	160
c)	Vinh Airport	50
d)	Dien Bien Airport	40
e)	Nasan Airport	40
f)	Short term contracts	145
g)	Probationary staff	20
h)	Construction Board for the NBIA, and Dien Bien and the Vinh Airports	50
j)	Trainees at the CATC	55

The NBIA staffing complement of 856 persons is a very high figure by any comparable norms in other countries, even taking into account that some of these staff members are engaged in supporting the 4 domestic airports. This can be attributed to the following factors:

a) the low level of automation and technological content inherent in airport facilities and equipment which lowers productivity;
b) low unit labour costs;
c) social conventions which result in the provision of facilities and services to CAAV staff which are not usually provided elsewhere, such as housing, child care and education facilities and medical services;
d) the provision of services by airport employees which are often contracted out elsewhere, such as terminal management services, car parks, restaurants and retail outlets; and
e) the need to manage high unemployment levels, which can often become evident during periods of significant economic transitions, such as those that Vietnam has been embarked upon since 1986.

3.8.3 Training

There is a widespread recognition among all the NAR managers who provided information for the FFS of the importance of training in all areas. This is evidenced by the indicative training plan presented by the Labour Department which proposes the following consolidated training needs to the year 2000:

- in-country training requirements in 8 separate disciplines for approximately 736 training years at a total estimated cost of VND 15 billion or USD 1.36 million. This training would be conducted at the CATC in HCMC or locally in Hanoi; and

- overseas training requirements to the year 2000 in 6 separate disciplines for approximately 204 training years at a total estimated cost of 45 billion VND or USD 4 million.

Training expenditures for the NAR during 1994 were just over VND 926 million (USD 84 thousand) or about 2% of total expenditures of nearly VND 45 billion (USD 4 million).

A number of important training issues are evident pertaining to: education levels; exposure to current civil aviation practices; and training availability in Vietnam.

1) Education Levels

The high level of general secondary school and post secondary education among the CAAV employees, achieved primarily in Vietnam but supplemented at the post secondary level in the former Comecon countries of Eastern Europe such as the Soviet Union, East Germany and Czechoslovakia. While this education has sometimes lacked the necessary content regarding modern technologies and market orientated commercial practices, it has nevertheless provided a good foundation for further applied training in all the skills needed to manage and operate a modern international airport.

2) Exposure to Current Civil Aviation Practices

Over the last 3 to 4 years, a modest but useful exposure to current practices in management, airport operations and technical services, air navigation operations and technical services, and commercial practices. This has been achieved almost exclusively through short duration training courses and study tours, primarily in neighbouring South East Asian countries and usually through the exploitation of funding available from a variety of multilateral and bilateral technical cooperation programmes. It is evident from the efforts of the Labour Department, that the need for a comprehensive and coherent training is well recognized.

A major impediment to training and itself a major training need is the low level of English language capability among the NAR's professional staff. The situation has improved over the last 3 years but much more needs to be done because English has not only been internationally mandated as the language of civil aviation operations but has also emerged as the most widely accepted language of commerce and technology. Most of the overseas training which will be required by CAAV staff is available in English only, even if this is not the primary language of the host country.

3) Training Availability in Vietnam

There is a variable availability of training in Vietnam. A number of staff are taking English language training in Vietnam and also training in economic and commercial subjects to enable them to function more effectively in an increasingly more market orientated environment. The Civil Aviation Training Centre in Ho Chi Minh City has received some limited upgrading through earlier limited assistance from ICAO technical cooperation programmes but is not able to cope with the most of the current training needs in civil aviation disciplines or the anticipated needs into the foreseeable future. It is understood, however, that the French Government is considering sponsoring a project to improve the training programmes for Air Traffic Services, and for the maintenance of electronic navaids and communications equipment at the CATC.

3.8.4 Aviation Security

The security situation at the NBIA was addressed in the context of the security assessment conducted at NBIA in 1991 by a consultant under ICAO Civil Aviation Master Planning Project VIE/88/023. Despite local efforts to address the problems highlighted in that assessment, a number of problems remain unresolved.

To date, only about 25% of the airport perimeter has been fenced, the major constraint being the high costs involved; however, the clearest manifestation of security problems at NBIA was the apparent ease with which an unauthorized person could access the apron area from the terminal buildings. There were few signs of a vigilant security presence at many terminal/apron access points, or on the apron area. While doors to the apron were locked, some were of flimsy construction and could be easily forced open; however, there were rarely any signs of a security presence at or near these areas.

The effectiveness of the large staff in the Security Department is primarily hampered by a lack of training, procedures and equipment.

1) Training

The staff receive a good basic training in general policing and security functions at institutions operated by either the Ministries of Interior or Defence but less than 10 % a have received any formal training in Aviation Security. The attendance of two staff from the CAAV HQ at an ICAO sponsored regional "Train the Trainers Course" conducted in Malaysia in 1991 has resulted in the subsequent local training of only 10 local staff members at the NBIA. Five staff members have received training in terminal screening in Singapore. In 1995, five more are due to receive similar training in Singapore as well as a further 5 in Germany. This is clearly insufficient to meet existing needs.

2) Procedures

A lack of adequate security plans and procedures exacerbates the training problem. Related to the procedural issue is the rather uneasy jurisdictional relationship between the Immigration Department and the Security Department at NBIA, whereby the former is responsible for the screening of all international passengers and the latter for screening domestic passengers and all other security functions. The problem has been exacerbated by the expressed annoyance of the Immigration staff at not receiving any guidance from ICAO on aviation security matters (probably due to oversight rather than intention).

3) Equipment

As is the case in many developing countries, a shortage of security equipment was reported, primarily x-ray machines and terminal surveillance equipment.

3.8.5 Airport Facilitation

Facilitation, in the context of international airport and air transport operations, refers to the measures taken by states to ensure a smooth flow of aircraft, passengers and cargo through international airports while effectively applying border control regulations with respect to such activities as customs, immigration and public health.

During the course of the FFS, no evidence was found to indicate the existence of a national air transport facilitation programme or national and airport facilitation committees specified in Annex 9 "Facilitation", ICAO. There is, however, informal coordination between NAR officials and officials from the Customs and Immigration organizations located at NBIA. This coordination appeared to be reasonably effective,

except in the area of security screening of international passengers as indicated earlier. Furthermore, Customs and Immigration officials contacted were unaware of Annex 9 and had not had access to ICAO Standards and Recommended Practices covering aviation security such as Annex 17 Aviation Security or otherwise received any guidance from ICAO on this matter. This is important because the availability of such information can be of great assistance in enabling the various border control and airport organizations to harmonize airport facilitation and security activities.

3.8.6 Facilities and Equipment Maintenance

During the course of the FSS, many problems were reported or observed concerning the maintenance of facilities and equipment.

During the last several years, the CAAV has made substantial investments in facilities and equipment, most notably the AACC at the NBIA, the AAC at Tan Son Nhat airport, and the purchase of Rescue and Firefighting equipment for all 3 international airports. Other equipment has been supplied through technical cooperation programmes.

In many instances, purchases and installations were planned and implemented with inadequate provisions made to maintain these valuable assets in an acceptable condition over an extended life period. Current or potential problems were reported due to shortages of spare parts, tools and test equipment, and to inadequate equipment training given to CAAV staff. In some areas, such as the ACC, it must be said that CAAV staff have managed remarkably well in maintaining sophisticated electronic and electrical equipment despite these difficulties, but how long they can continue to do so without receiving appropriate support is questionable.

During 1994, the NAR expended about VND 11.3 billion (USD one million) or 25% of its total expenditures on routine maintenance and repair work (excluding staff pay and benefits). The expenditures were divided almost equally between routine maintenance and repair work.

1) Electronic Equipment

Airports use an increasingly growing quantity of sophisticated electronic equipment for: air navigation systems; ground communications; security; displaying flight information in terminals etc. This equipment appears to be quite well maintained despite problems with spare parts acquisition, a lack of tools and test instruments and inadequate equipment training for maintenance staff. These problems are exacerbated by fragmented responsibilities for maintenance. There are separate maintenance workshops, tools and test instruments for the AACC equipment, and the

airfield navigation and communications equipment. Terminal equipment is maintained by other organizations such the Customs and Immigration Departments.

2) Mobile Equipment

VNA has a large inventory of special mobile ground handling equipment (63 pieces excluding regular buses and trucks, and much of recent purchase) but the only maintenance facility for this equipment is a small and ill equipped area which is covered but otherwise unenclosed. There is a clear need for a well-equipped and fully enclosed workshop, staffed by trained personnel, to properly maintain this and other mobile equipment at the NBIA, such as the RFF vehicles and general purpose transportation vehicles.

3) Runways, Taxiways and Aprons

The most immediate, significant facility maintenance issue at the NBIA concerns the runways, taxiways and aprons. The Airport Management Department advised that the airside surfaces are inspected regularly throughout the day, before landings and after take-offs, but there is insufficient equipment for extensive cleaning and all but the simplest repair work. Other than: these inspections; daily cleaning and grass cutting; and water drainage work (conducted twice per year before and after the rainy season), there is no regular preventive maintenance programme. This is most serious with regard to runway friction testing and any subsequent cleaning activities. It was reported that friction tests are only conducted whenever pilots report that runway surface conditions may be suspect. The friction testing and cleaning equipment is located at the CAAV HQ in Gia Lam which is then transported to the NBIA for testing and cleaning activities. This represents a serious inadequacy in the runway maintenance programme which should be addressed as a matter of urgency.

3.9 OUTLINE OF EXISTING FINANCIAL SYSTEM OF THE AIRPORT

3.9.1 General System of the Airport Finance

Noi Bai Airport belongs to the Northern Airport Region (NAR), which is one of four semi-administrative organizations of the CAAV, together with Middle Airport Region, Southern Airport Region and Air Navigation Department of Vietnam. It is financially structured as a governmental department, whose expenditures are allocated from the national treasury through the CAAV, and whose revenues are surrendered, vice versa, to the national treasury.

Limited financial authority is accorded to the NAR whereby only surplus exceeding a pre-determined target can be spent, mainly in the form of bonuses to its staff, equipment purchase, etc. The rates of airport charges as well as basic salaries of the staff are determined by the Prime Minister's Office.

The revenues and expenditures of the NAR and those at Noi Bai Airport in 1994 were as follows:[1]

NAR Revenue:	VND40,559 million
NAR Current Expenditure:	Vllion
Noi Bai Airport Revenue:	VND37,613 million
Noi Bai Airport Current Expenditure:	VND38,484 million

The NAR's current expenditures exceed the revenues by about 11%. Therefore, the NAR's capital expenditures are met entirely from the general revenues of the Government, mainly taxes, not from user charges. In addition, there is little incentive in the current system for the NAR to improve its financial situation since there is no direct relationship between its spending capability and revenues.

In addition, there are inherent complications in the financial system of the NAR. The most important one is that Vietnam Airlines, the main user of airside infrastructures and terminal rent spaces, does not pay the rates applied to other foreign carriers. There is an agreement, effective from May 1, 1995, that Vietnam Airlines will pay 80% of landing and air navigation charges set forth in the AIP for international flights and 50% of those for domestic flights. It has also been agreed that approximately VND480 million per month will be payed to the NAR as a lump sum fee for aircraft parking and terminal space rental at Noi Bai Airport. This amount represents only a fraction of the total revenue, regardless of the fact that Vietnam Airlines' aircraft movements account for about two-thirds of international traffic, and almost all of domestic traffic, and that most of the check-in counters and airline offices are occupied by them.[2] The other major difficulty for the NAR is that many

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1 Since the NAR was established in July 1992, the data covering a whole accounting year are only available for 1994. The accounting year of the NAR is January to December.

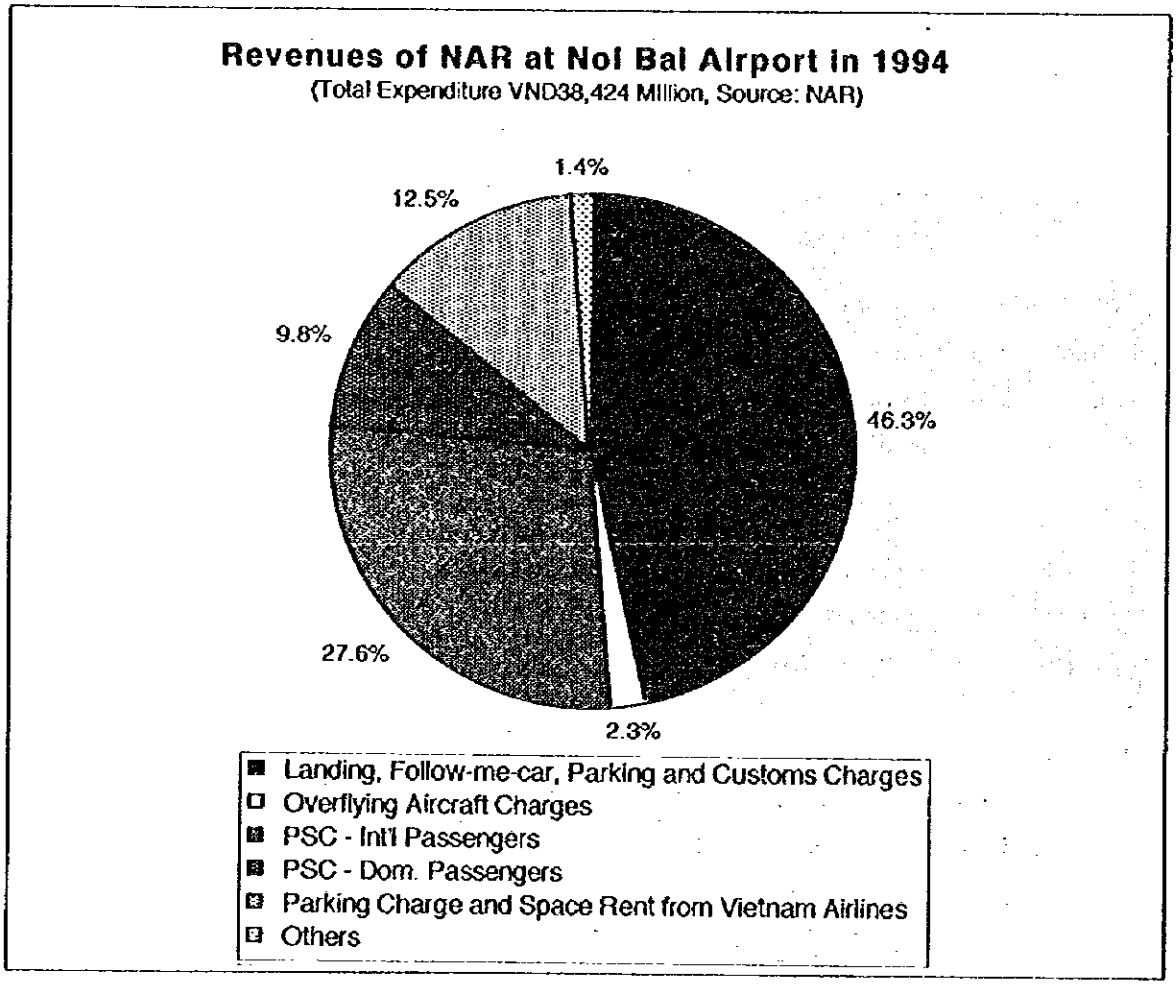
2 It is said by the NAR officials that the amount collected from Vietnam Airlines does not cover even the depreciation of facilities. This situation makes the NAR very difficult to move towards financial autonomy.

government officials are exempted from the passenger service charge. According to the NAR, approximately 20% of passengers do not need to pay passenger service charges, a significant loss of income.

These problems are also related to the absence of financial autonomy for the NAR. The NAR is in fact used by the Government to subsidize Vietnam Airlines. This arrangement potentially impedes the optimum allocation and efficient use of resources.

3.9.2 Revenues

The breakdown of the revenues from the operation of Noi Bai Airport in 1994 is shown in the following figure. Approximately 95% of the NAR's revenues are generated from and 84% of the current expenditures are spent for the operation of Noi Bai Airport, including NAR's headquarters. Those at other airports are very limited.



As seen in the above figure, approximately 86% of revenues from Noi Bai Airport are aeronautical revenues, defined as the total of landing charges, parking charges, air navigation charges from arriving and overflying aircraft, and passenger service charge from international and domestic departing

passengers.[3] The non-aeronautical revenues consist of space rent, advertising fees, etc.[4] No concession fees, which are normally levied against 5-7% of gross sales at duty-free shops, have been introduced at Noi Bai Airport.[5]

The landing charge of B747 with the maximum take-off weight of 395 tons is US$2,458, compared to Hong Kong's US$3,040 and Bangkok's US$1,770. The international passenger service charge of $US7 is similar to Hong Kong's US$6.5 (HK$50) and Bangkok's US$8 (TB200). The service charge for domestic passengers is D15,000 (US$1.4), which is also similar to the US$1.3 (TB30) collected at Bangkok Airport. Given the level of services provided at the existing airport, the current rates are relatively high. No further increases in charges can be justified without significant improvements in facilities and services.

3.9.3 Expenditures

1) Current Expenditures

The current expenditure of the NAR at Noi Bai Airport is broken down to items as follows:

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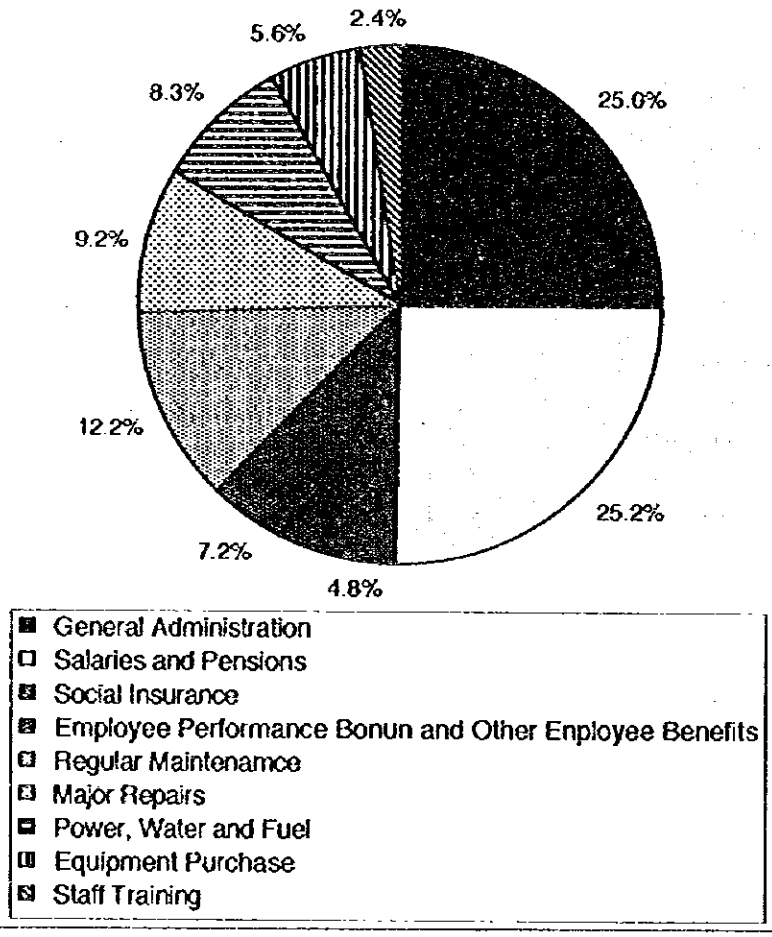
[3] The enroute air navigation services are provided by the Air Navigation Department of Vietnam (ANDV). There is an agreement between the NAR and the ANDV that approximately 12% of air navigation charges collected from overflying aircraft are given to the NAR.

[4] Car parking is operated by the Northern Air Service Company (NASCO), which is one of the CAAV controlled aviation enterprises.

[5] Duty free shops pay higher space rent than other concessions -- US$16/sq.m/month. US$8/sq.m/month is collected for the use of priority passenger lounges, offices and restaurants, and US$5/sq.m/month for others.

Current Expenditures of NAR at Noi Bai Airport in 1994

(Total Expenditure VND37,613 Million, Source: NAR)



Given its scale of facilities, the annual budget of approximately VND8.1 billion (US$0.7 million) for regular maintenance and major repairs at Noi Bai Airport appears to be insufficient.

2) **Capital Expenditures**

The amount of capital expenditures spent for Noi Bai Airport by the NAR was VND29.6 billion (US$2.7 million), the major part of VND19.5 billion (US$1.8 million) was spent at Noi Bai Airport for the expansion of apron and taxiway, construction of the new control tower, equipment purchase, etc. The remaining VND10.1 billion (US$0.9 million) was spent for the construction of a new runway at Vinh Airport. The state budget is insufficient for the NAR to expand the capacities of its facilities in line with increases in air traffic.[6]

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[6] In 1995, the budget for the capital expenditures was significantly increased to D120 billion (US$11 million) for starting T1 project. However, given short time allowed for the completion of the project by the end of 1997, the state budget may still be insufficient.

3.9.4 NAR's Plan towards Financial Autonomy

The Department of Planning and Investment of the NAR has a plan to improve the financial system of the NAR. The plan is to transform the NAR into a financially autonomous organization, and it has been sabmitted for the Government approval. It is expected that the plan will be implemented by the end of 1995 or early 1996.

The accounting system will first be improved to the internationally accepted standards used by business enterprises. Then the NAR intends to introduce extensive concession fees, such as those from duty free shops, restaurants, the ground handling company, the fuel supply company, taxi operators and the catering company. The cargo handing charges and environmental protection fees will also be introduced. The NAR intends to increase the non-aeronautical revenues to about 20-30% of the total revenues. On the expenditure side, employee performance bonuses, which are currently paid as a certain percentage of the revenues, will only be paid when the NAR has an operating profit.

In addition, organizational reform of the NAR is under consideration. Two models are being considered at present for the operation of five airports under the NAR. In both models, the five airports will each have independent accounts. The NAR will act as a regulating organization to adjust financial surpluses and shortfalls between the airports in the first model while in the second model, the CAAV will act as a regulating organization and the NAR will no longer exist.

These reforms should significantly improve the efficiency and finances of the airport. The current system tends to reduce the incentives for the NAR to develop new revenue sources or increase income from existing sources, since it cannot use revenues to defray expenses for which it held responsible. Also, since an autonomous authority need not to use the civil service regurations and salary structures applied by the Government, the NAR could offer more advantageous terms to personnel and thereby increase motivation and productivity.

3.10 LEGISLATION ON ENVIRONMENT

3.10.1 Laws and Regulations

In Vietnam, there is a "Law on Environmental Protection" (EPL), the fundamental law on the environment. The EPL was passed on 27 December, 1993 by the National Assembly, 9th Legislature, at 4th Session and went into effect on 10 January, 1994. The objectives of the EPL are to: protect people's health; ensure people's right to live in a healthy environment; and to promote the sustainable development of the nation while participating in global and regional environmental protection activities.

The GOV promulgated the "Government Decree on providing Guidance for the Implementation of the Law on Environmental Protection" (hereinafter referred to as "the Guidance") by No. 175 /CP dated 18 October, 1994. The objective of the Guidance is to ensure implementation of the EPL.

3.10.2 Environmental Impact Assessment (EIA) System

In the EPL, the EIA is defined as the process of analyzing, evaluating and forecasting the effects on the environment of implementing projects and plans, and proposing appropriate protection measures. Project executing agencies must submit EIA reports to the State Management Agency for Environmental Protection for appraisal in accordance with the EPL and Guidance.

The airport project is one of the project types for which an EIA report is required. The CAAV, which is the executing agency of the new development plan of NBIA, is responsible for making the EIA reports.

The scope for assessing environmental impact includes:

a) To assess the current environmental situation in the operating area of the project or unit;
b) To assess the impact on the environment as a result of the activities of the project or unit;
c) To present measures for environmental protection.

The findings and proposals shall be presented in a form of a separate report called Report of Assessment on Environmental Impact. The preparation of these reports shall be conducted in two stages: preliminary and detailed, in accordance with the Guidance: Article 11.

All organizations and units have to use Vietnamese standards to prepare environmental impact assessment reports. For those activities for which environmental standards have not been set up, the

responsible organizations have to get agreement, in the form of documentation, from the offices in charge of state management on environmental protection in accordance with the Guidance: Article 12.

A dossier for appraising environmental impacts includes;

a) An environmental impact assessment report
b) A description of the project and related appendixes

All dossiers are to be submitted in triplicate and written in Vietnamese in accordance with the Guidance: Article 13.

3.10.3 Environmental Standards

Environmental standards are described generally in the EPL and Guidance. However, detailed environmental standards in accordance with the EPL have not yet been finalized. These were being considered by the Government as of May 1995.

In Vietnam, "Provisional Environmental Criteria" were published by the Ministry of Science, Technology and Environment in 1993. These are valid until environmental standards are promulgated by the Government.

Provisional Environmental Criteria have been established on the following items:

a) Maximum permissible concentration for toxic chemicals in ambient air in workplaces;
b) Maximum permissible concentration for toxic chemicals in ambient air in populated areas;
c) Maximum permissible concentration for toxic chemicals in surface water;
d) Drinking and domestic water quality - physical and chemical aspects;
e) Drinking and domestic water quality - microbiological and biological aspects;
f) Maximum limit of constituent waste water discharging into water sources;
g) Surface water quality flowing into water plants before treatment;
h) Ground water quality for water supply;
i) Coastal sea water quality;
j) Microclimate in workplaces;
k) Lighting for industrial construction;
l) Allowable noise levels in workplaces;
m) Allowable noise levels in populated areas;

n) Vibration criteria;

o) Maximum allowable concentration of dust in ambient air in workplaces;

p) Chimney height requirements for places of fuel combustion;

q) Sanitary protective distance requirements for thermoelectric power plants and boilers;

r) Classification of minimum sanitary protective distances for enterprises and plants; and

s) Safety regulation for ionizing radiations.

Many items in these Environmental Criteria are the same as those used in other industrial countries. Environmental Impact Assessment should be based on these criteria.

However, a criteria for aircraft noise levels, which is very significant for the airport projects, has not yet been established. The degree of aircraft noise impact will affect the compensation levels and resettlement plans. Therefore, it is necessary to determine with the authorities concerned the criteria which needs to be employed for noise assessment during the early stages of the Study.

3.11 OUTLINE OF CONSTRUCTION SECTOR

3.11.1 Local Construction Company

Most of the local construction companies were established for implementing large state projects. Their origins were the construction departments of the Ministries in charge of these projects or were construction sections of institutes under these Ministries. Many of the companies still use the name of the projects for which they were created. Those companies work exclusively under the originating Ministries and their staff are still civil servants in the most cases.

Major factories producing brick and precast concrete products, ready-mixed cement concrete and material suppliers have close ties with particular construction companies, Ministries and local governments in the most cases.

3.11.2 Availability of Materials and Equipment

Local major construction materials, which meet the international standards, are sand, aggregate, cement, brick and some precast concrete products. Other construction materials locally available are usually below the international standards, and it is sometimes difficult to obtain the required quantities of these products. They are, therefore, imported from foreign countries in the most cases for major joint venture and/or international projects (especially for the building construction projects) which usually

use higher standards than minor local projects. Major sources of Western standard construction materials and equipment are Malaysia and Singapore. The supply of local cement is insufficient due to the recent boom in construction in Vietnam, and large quantities of cement are imported.

Since the importation of construction materials is very common in Vietnam, CIF (Cost, Insurance and Freight) prices of major materials and equipment are published weekly in "Market Price". About US$ 30 per freight tonne should be added to the CIF at Hai Phong when estimating prices in Hanoi.

3.11.3 Construction Cost

Pricing in Vietnam is complicated due to the mixture of market oriented prices and government regulated prices. In the case of construction prices there are three rates as follows:

a) State Project's Rate : This rate is used for the central and local government's projects. The rates are stated in VND, and based on the schedule of unit construction prices published by the Ministry of Construction.

b) Local Contractor's Rate :This rate is used for local projects other than those of the governments. The rates are stated in either VND or US$, and based on the current market prices of locally available material, equipment and labor. Local standards are used for materials/equipment and methods of construction.

c) International Contractor's Rate : This rate is used for international projects (including those of joint ventures of foreign and local companies). The rates are stated in US$, and based on the current prices of material, equipment and labor which meet international standards. This rate varies considerably based on the requirements in the specifications, proportion of import materials and equipment, number and billing rate of supervisory staff, etc.

Construction costs have been escalating by 35 to 40 % per year for sate projects and local contractor's rates due to the boom in construction in Vietnam in recent years. The international contractor's rate has been escalating at about 15 to 20 % per year.

CHAPTER 4 AIR TRAFFIC DEMAND FORECAST

CHAPTER 4 AIR TRAFFIC DEMAND FORECASTS

4.1 GENERAL

This chapter describes air traffic demand forecast, which principally determines airport facility requirements, i.e., the size of the airport. The forecasts are made up to the year 2015 to cover passengers, cargo and aircraft movements.

4.2 SOCIO-ECONOMIC FRAMEWORK

4.2.1 GDP Growth Rate

Based on the verification of economic performance in recent years in Section 2.2.1 and the review of economic projections by various organizations in Section 2.2.2, the Vietnamese economy is likely to grow at 8.5-11.0% annually up to the year 2000. On the other hand, experience in other countries indicates that maintaining a growth rate of more than 10% is difficult because this will inevitably lead to high inflation rates, worsening income distribution etc., which will eventually require tight macro-economic management.

With these considerations in mind, a framework of long-term national economic growth was produced and is shown in Table 4.2.1. Three scenarios are assumed: (1) high case; (2) medium case; and (3) low case, of which the medium case is considered to correspond to sustainable growth with a controlled rate of inflation.

Table 4.2.1 Framework of Long-term National Economic Growth

Year		(1) High Case GDP (VND Bill.)	(1) High Case Annual Growth Rate	(2) Medium Case GDP (VND Bill.)	(2) Medium Case Annual Growth Rate	(3) Low Case GDP (VND Bill.)	(3) Low Case Annual Growth Rate
Actual	1990	29,768	5.1%	29,768	5.1%	29,768	5.1%
	1991	31,286	6.0%	31,286	6.0%	31,286	6.0%
	1992	33,991	8.6%	33,991	8.6%	33,991	8.6%
	1993	36,739	8.1%	36,739	8.1%	36,739	8.1%
	1994	39,975	8.8%	39,975	8.8%	39,975	8.8%
Estimated	1995	43,778	9.5%	43,778	9.5%	43,778	9.5%
Projected	2000	73,768	11.0%	68,917	9.5%	65,827	8.5%
	2005	118,804	10.0%	106,037	9.0%	96,721	8.0%
	2010	182,795	9.0%	155,803	8.0%	135,656	7.0%
	2015	268,586	8.0%	218,522	7.0%	185,861	6.5%

Notes: GDP at 1989 prices.
Source: 1) "Statistical Yearbook 1993", Statistical Publishing House.
2) Hearing from Ministry of Finance
3) The JICA Study Team

4.2.2 Regional Economic Growth

Following an extensive study of regional economic development in Section 2.2.3, the "Regional Master Plan 2010" recently presented by SPC has been selected as a basic framework for future regional economic development in Vietnam. It articulates a national policy of long-term economic development under which the three strategic regions will be given higher priorities through a strong industrialization policy and the concentration of industrial activities. In this study, this basic framework has been slightly modified and extended until the year 2015 for developing the air traffic forecasts as shown in Table 4.2.2.

Table 4.2.2 Regional Contribution of GDP in Three Economic Growth Areas in Vietnam

Year	Northern Triangle	Middle Corridor	Southern Triangle	Total of the Three Economic Growth Areas
1994 (Actual)	13.00%	1.80%	28.00%	42.80%
1995	13.17%	1.89%	28.54%	43.60%
2000	14.05%	2.43%	31.40%	47.88%
2005	14.99%	3.12%	34.54%	52.65%
2010	16.00%	4.00%	38.00%	58.00%
2015	16.53%	4.54%	39.87%	60.94%

Source: 1) "Development Orientation for Regional Master Plan in 2010", Institute of Development Strategy, SPC, 1995.
2) The JICA Study Team

4.3 ANNUAL AIR PASSENGER FORECAST

4.3.1 International Air Passenger Forecast for Whole Vietnam

1) Approaches and Difficulties

There are several conventional approaches to the air traffic demand forecasts. These include:

a) Time-series trend analysis;
b) Econometric modeling; and
c) Factor analysis.

None are suitable for a long-term demand projection for Vietnam because:

a) A time-series trend analysis cannot be useful due to significant differences in growth rates before 1991 and after 1991. Actual data of international air passenger traffic in Vietnam before 1991 fluctuates considerably, but those after 1991 shows a rapidly increasing trend. This approach is, therefore, unlikely to produce a reliable and significant statistical analyses for long-term projections.

b) Econometric modeling often results in plausible forecasts, however, the availability of explanatory economic variables is very limited in Vietnam. In addition, since economic data are said to be relatively reliable only from the 1990 onwards, the length of the data series is too short to produce a long-term forecast.

c) A factor analysis may be useful for analyzing the present structure of air traffic; however, even though some significant determinants are identified, the numerical values of those parameters will be difficult to determine over the long term. In particular, some parameters representing the supply side economy are likely to fluctuate because of Vietnam's immature market mechanism, or a supply system which is still determined by government policies.

2) Applied Methodology

(1) Basic Approach

It is well-known that growth of air traffic demands is linearly correlated with the growth of the aggregate economy. It was found that a regression model of GDP and international air passengers in Vietnam, using the data from 1990, also produced a significant relationship between them; however, it yielded a remarkably high elasticity of 3.57 as follows:

$$\text{Ln (INTPAX)} = \underset{[115.419]}{-19.985} + \underset{\{26.048\}}{3.5742\ \text{Ln (GDP\$)}}\ (R^2 = 0.9956)$$

where,
INTPAX: International Air Passengers
GDP$: GDP in US$ Million at 1990 prices
Figures in [ ]: t-statistic of the respective coefficients

The elasticity of 3.574 is much higher than that identified during the economic development of other countries. Although all the statistics in this regression model, such as the coefficient of determination and t-statistics, appeared statistically significant, this model did not seem to be suitable for long-term projection. This may be due to the present remarkably high growth rates of air passenger traffic demands in Vietnam being such a particular phenomenon that has never been experienced elsewhere.

Hence, the assumed elasticity over the long term should be derived from other sources, referring to historical experiences in other countries, especially in Asia, such as Japan, Korea, Hong Kong, Thailand, Malaysia, Singapore and Indonesia.

(2) Implications from Experiences in Other Countries

Figure 4.3.1 indicates a comparison of correlations between GDP and international air passenger traffic in those Asian countries on a logarithmic scale, where the slopes of the curves stand for the GDP elasticity for international air passenger demands. From those analyses, the following observations are pertinent:

a) The elasticity of international air passengers with respect to GDP fluctuates in the short term for all countries, however, it tends to fall within a range of 1.2 to 2.2 in the long term.

b) The most elastic growth occurred to Malaysia and Indonesia, while growth was less elastic for Hong Kong and Japan.

c) The Vietnam's growth line is very steep so far. It is expected that its slope will gradually decline, and will become more aligned with that of Hong Kong in the medium term.

(3) Assumed Elasticity

Based on the above observations, estimates of long-term elasticity are shown in Table 4.3.1, taking into account the following considerations:

a) Since it is thought that the strong economic performance of the past few years will continue up to the year 2000, led by foreign direct investment, the growth rate of air passenger traffic will continue to be much higher than the GDP growth rate. The very high current elasticity of more than 3.5, however, will probably not persist until 2000. It can be assumed that the elasticity will progressively decrease to within a range of 1.4 and 1.6 during the period between 1995 and 2000.

b) This trend of declining elasticity will continue after the year 2000 towards the levels experienced in the long term in Indonesia, Thailand and Malaysia. It is predicted that the elasticity will become 1.1 by the year 2010. This means that the international air passenger demand by then will increase at a slightly higher (by 10%) rate than the GDP growth rate.

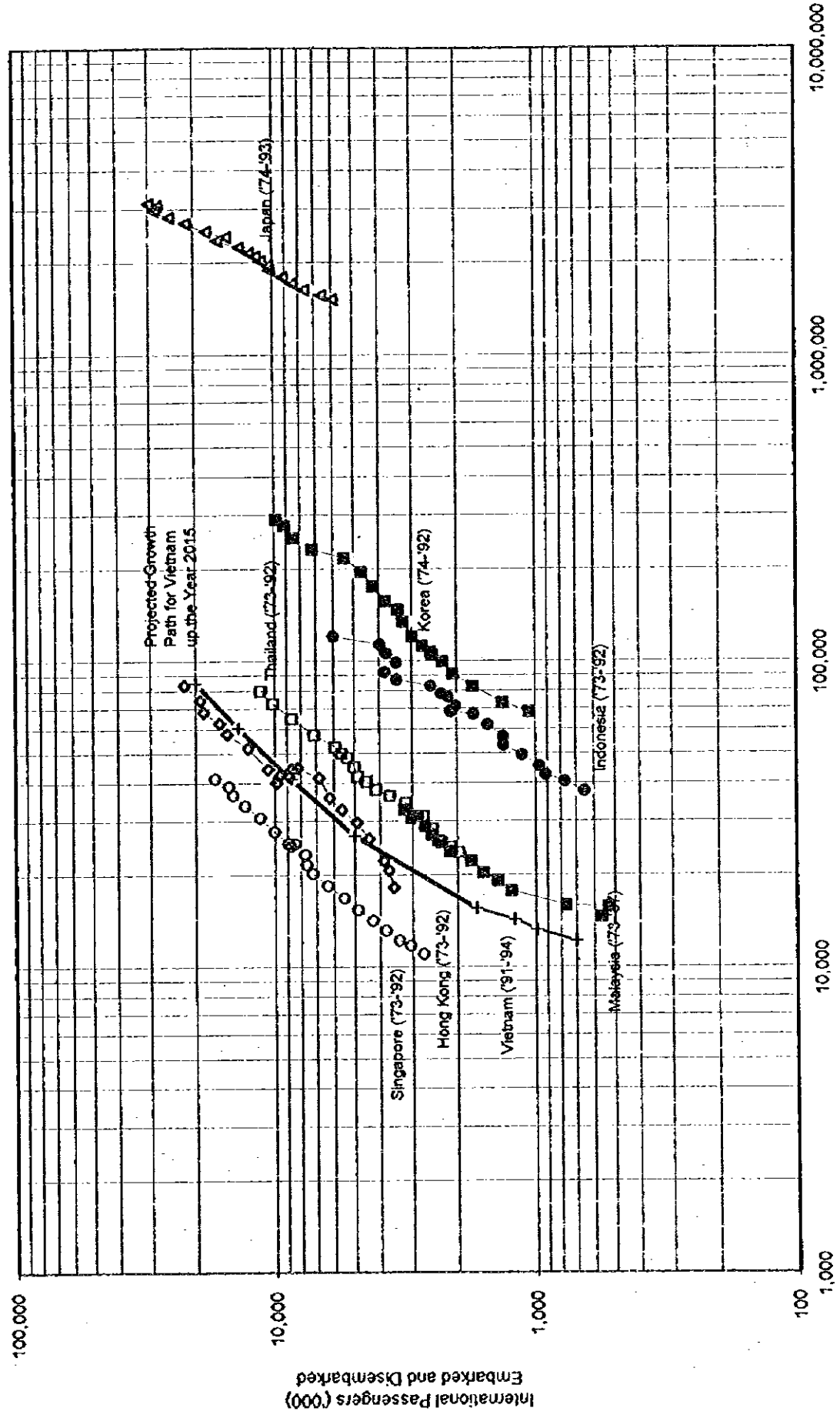

Figure 4.3.1 International Passenger Traffic vs. GDP in Selected Countries

Table 4.3.1 Predicted Elasticity of International Air Passengers to GDP in Vietnam (Whole Country)

Period	High Case	Medium Case	Low Case
1995-2000	3.0 - 1.6	2.8 - 1.5	2.6 - 1.4
2000-2005	1.4	1.3	1.2
2005-2010	1.2	1.2	1.2
2010-2015	1.1	1.1	1.1

Source: The JICA Study Team

3) Result of the Forecast

Table 4.3.2 summarizes the international air passenger forecasts for whole Vietnam. (For details of calculation see Appendix 4.3.1.)

Table 4.3.2 International Air Passenger Forecasts for Whole Vietnam

Year	High Case	Medium Case	Low Case
1994 (Actual)	1,687,800	1,687,800	1,687,800
2000	6,087,000	5,000,000	4,316,000
2005	11,720,000	8,694,000	6,826,000
2010	19,572,000	13,749,000	10,217,000
2015	29,839,000	19,923,000	14,430,000

Source: The JICA Study Team

4.3.2 Domestic Air Passenger Forecast for Whole Vietnam

1) Competition with Rail Transport

As discussed in Section 2.4.5, air transport competes with rail transport in the long distance travel market; therefore, it is necessary to examine the future competitiveness of air transport against rail transport. Taking the example of the Hanoi - Ho Chi Minh route, planned rail improvements will shorten the travel time from the present 36 hours to 24 hours by the year 2010.[1] Assuming the traveling time by air will remain unchanged, the critical income which will make the choice between the two modes of transport indifferent will be about VND 2,628,000/month or US$ 239/month at 1995 prices.[2] The present critical income is VND

[1] "The Feasibility Study on the Rehabilitation and Improvement of the Railway in Viet Nam", JICA. The final report will be submitted early in 1996.

[2] Air travel between Hanoi and Ho Chi Minh consumes 6 hours consisting of 2 hours of flying time and another 4 hours for city to airport, waiting time and airport to city. The cost is assumed to be VND 725,000, VND 700,000 for airfare plus VND 25,000 for airport access/egress and passenger service charge. Rail travel takes 24 hours on

1,724,000 or US$ 157 as estimated in Section 2.4.5. It is necessary that average per capita income will need to increase at 2.9% per annum to maintain competitiveness between the two modes as at present, while per capita GDP of Vietnam is expected to increase at an average annual growth rate of 6-8% (equivalent to 8-10% annual GDP growth less population growth). It can be concluded, therefore, that air transport will continue to increase its share of passenger traffic against rail transport for the foreseeable future. The result also implies that a forecast with a modal split model, which requires extensive data, time and cost, would not be very useful given the present status of domestic air transport in Vietnam.

2) Applied Methodology

It has been generally found that demand for domestic air transport will increase along with improved prosperity as represented by per capita income. Figure 4.3.2 shows the propensity in selected countries on a logarithmic scale with per capita GDP (US$ at 1990 prices) and domestic air passengers carried per 1,000 population. The lines plotted represents almost 20 years of historical data from the beginning of the 1970s. From these coordinates, a regression curve (straight line) can be delineated with elasticity of 1.10 as represented by an exponential form of:

$$\underset{}{\text{Ln (DOMPAX/N)}} = \underset{[-15.095]}{-4.1195} + \underset{[32.310]}{1.0968\ \text{Ln (GDP\$/N)}} \qquad (R^2 = 0.8578)$$

where,
DOMPAX/N: Domestic Air Passengers Carried per 1,000 Population
GDP$/N: GDP per Capita in US$ at 1990 prices
Figures in [ ]: t-statistic of the respective coefficients

As can be seen, the present situation in Vietnam is represented by a remarkably steep line, compared with the regression line; however, as with international air passenger traffic, it is probable that this high elasticity will decline in the long term as has happened for Thailand, Malaysia and Indonesia.

Based on these conditions, the elasticities of domestic air passenger demand with respect to GDP are predicted as shown in Table 4.3.3.

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the fastest express train and 0.5 hour of waiting time at the station. The train fare for a first class seat will be 48,2000 in 1995 price. The critical time value is calculated as:

(725,000 - 482,000) / (24.5 - 6) = VND 13,140/hour.

Assuming 200 working hours (8 hours x 25 days) per month, the critical monthly income would be VND 2,628,000 or US$ 239.

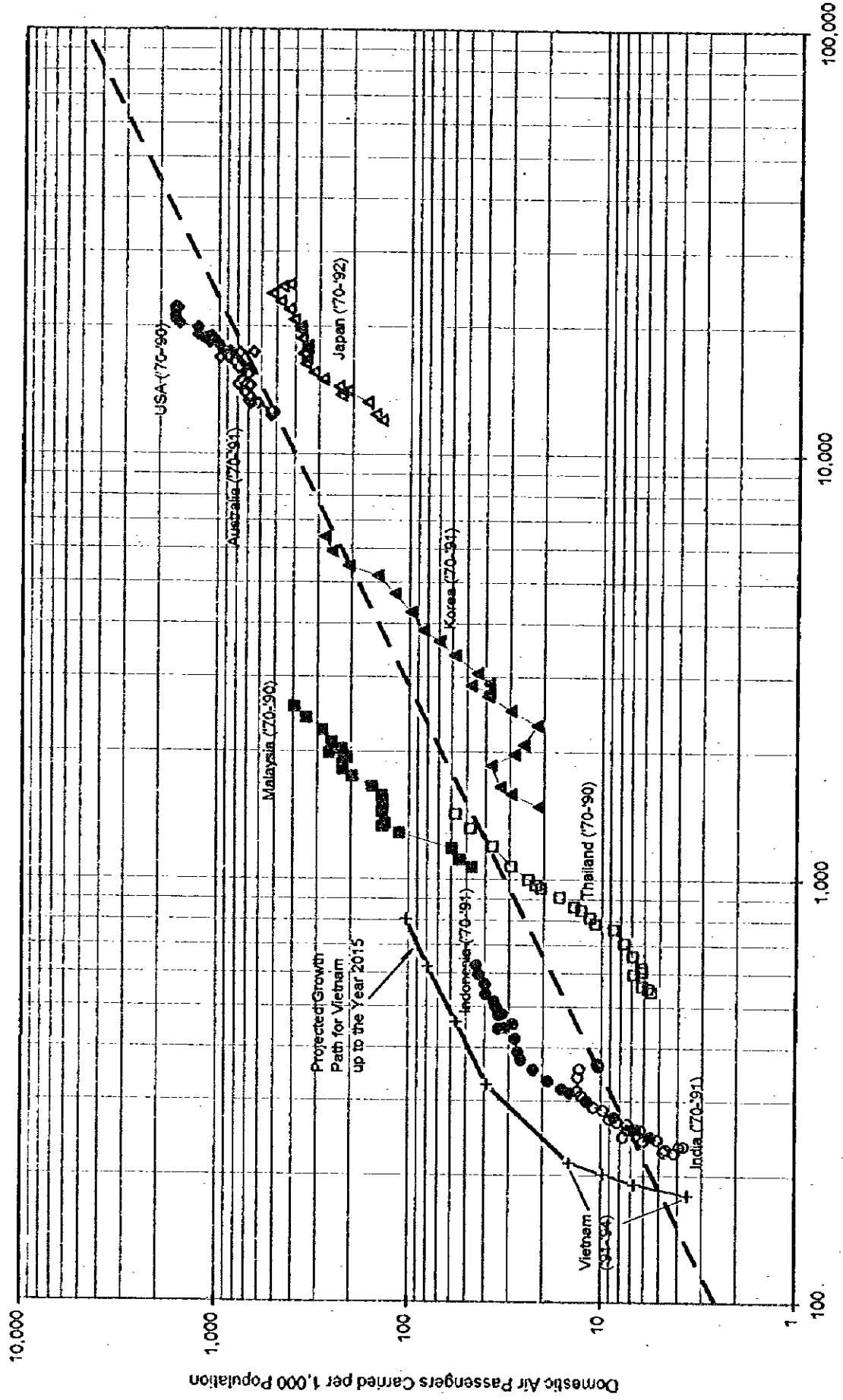

Figure 4.3.2 Domestic Passengers Carried per 1,000 Population vs. GDP per Capita in Selected Countries

Table 4.3.3 Predicted Elasticity of Domestic Air Passengers to GDP in Vietnam (Whole Country)

Period	High/Medium/Low Cases
1995-2000	3.5 - 1.1
2000-2005	1.1
2005-2010	1.1
2010-2015	1.0

Source: The JICA Study Team

3) Result of the Forecast

Table 4.3.4 summarizes the result of domestic air passenger forecasts for whole Vietnam.

Table 4.3.4 Domestic Air Passenger Forecast for Whole Vietnam

Year	High Case	Medium Case	Low Case
1994 (Actual)	2,124,800	2,124,800	2,124,800
2000	7,353,000	6,307,000	5,681,000
2005	12,391,000	10,111,000	8,662,000
2010	19,866,000	15,415,000	12,551,000
2015	29,189,000	21,620,000	17,195,000

Source: The JICA Study Team

4.3.3 International Air Passenger Forecast for Noi Bai Airport

1) Basic Considerations

International air passenger demands for Noi Bai International Airport (NBIA) are predicted taking into account the following perspectives/assumptions:

a) The two major international airports of Noi Bai International Airport (NBIA) and Tan Son Nhat International Airport (TSNIA) will share most of the international air passenger traffic demand. Danang will share a comparatively minor portion, although its international gateway role will probably increased in the future.

b) The relative share of NBIA has been declining year-by-year since 1985, while that of TSNIA has been increasing as shown in Section 2.3.3; however, the declining trend of NBIA seems to have stopped in 1994.

c) If NBIA attracts and generates air passenger traffic commensurate to its size within the regional economy, NBIA's share of international air passengers in Vietnam will be about

27% in 2015. This level represents the Northern Triangle Region's relative GDP share of the total of the three economic areas; however, economies of agglomeration are expected to continued to work more strongly at TSNIA. Considering these factors, it may be assumed that NBIA's share of international passengers in Vietnam will gradually increase from the present 21.9% to 25% in 2015 for the high and medium case forecasts. The share for the low case of the forecast is assumed to remain at the present 21.9%.

2) Result of the Forecast

Table 4.3.5 summarizes the international air passenger forecasts for Noi Bai International Airport.

Table 4.3.5 International Air Passenger Forecast for Noi Bai International Airport

Year	Annual Passengers at NBIA			NBIA's Share in Vietnam		
	High Case	Medium Case	Low Case	High Case	Medium Case	Low Case
1994 (Actual)	370,300	370,300	370,300	21.9%	21.9%	21.9%
2000	1,389,000	1,141,000	946,000	22.8%	22.8%	21.9%
2005	2,759,000	2,047,000	1,496,000	23.5%	23.5%	21.9%
2010	4,750,000	3,337,000	2,238,000	24.3%	24.3%	21.9%
2015	7,460,000	4,981,000	3,160,000	25.0%	25.0%	21.9%

Source: The JICA Study Team

4.3.4 Domestic Air Passenger Forecast for Noi Bai Airport

1) Applied Methodology

Domestic air passenger demand for NBIA were estimated by allocating Vietnam's total domestic passenger demands to NBIA and considering regionally differentiated future economic growth patterns in Vietnam.

It can be generally said that air passenger traffic demand at an airport is dependent upon the magnitude of the regional economy. In other words, the greater the magnitude of economy in terms of the gross regional domestic product (GRDP) the greater number of air passengers attracted, in a certain relation. It can be assumed, therefore, that domestic air passenger demand from one region to another is a function of the product of both GRDP's. This may be expressed by the following equation as a gravity model:

$$AP_{ij} = K_{ij} * ME_i * ME_j$$

where,

AP_{ij}:	Domestic air passengers between i-region and j-region
ME_i, ME_j:	Economic magnitude of i-region and j-region respectively
K_{ij}:	Coefficient for the relation between i- and j-regions, and estimated as $K_{ij} = ME_i^{1994} * ME_j^{1994} / AP_{ij}^{1994}$

This equation presents the basic concept used to derive NBIA's share of the total domestic air passenger demand in Vietnam.

For an analytical purpose when applying this equation, Vietnam was divided into four regions (zones) which are influenced by the major airports as follows:

Zone N: "Northern Triangle Region", including Hanoi, Hai Hong and Quang Ninh, influenced by NBIA;
Zone S: "Middle Corridor Region", including Danang and Dung Quat, influenced by Danang Airport;
Zone M: "Southern Triangle Region", including Ho Chi Minh, Bien Hoa and Vung Tau, influenced by TSNIA; and
Zone O: Other regions.

On the basis of these assumptions and the future economic perspectives described in Section 4.2, route shares of domestic passengers were estimated as shown in Table 4.3.6.

Table 4.3.6 Estimated Route Share of Domestic Air Passengers between Zones

Year	N - M	N - S	N - O	M - S	M - O	S - O	Total
1994 (Actual)	11.9%	50.3%	4.8%	12.3%	1.9%	18.8%	100.0%
2000	14.0%	49.5%	3.9%	15.1%	1.9%	15.6%	100.0%
2005	16.0%	48.4%	3.1%	17.7%	1.8%	13.0%	100.0%
2010	18.0%	46.8%	2.4%	20.6%	1.7%	10.4%	100.0%
2015	19.1%	45.8%	2.1%	22.2%	1.6%	9.2%	100.0%

Source: The JICA Study Team

2) Result of the Forecast

The number of domestic passengers at NBIA is calculated from Tables 4.3.4 and 4.3.6, and the results are summarized in Table 4.3.7.

Table 4.3.5 Domestic Air Passenger Forecast for Noi Bai International Airport

Year	Annual Passengers at NBIA			NBIA's Share in Vietnam		
	High Case	Medium Case	Low Case	High Case	Medium Case	Low Case
1994 (Actual)	712,000	712,000	712,000	33.5%	33.5%	33.5%
2000	2,479,000	2,126,000	1,915,000	33.7%	33.7%	33.7%
2005	4,180,000	3,411,000	2,922,000	33.7%	33.7%	33.7%
2010	6,679,000	5,183,000	4,220,000	33.6%	33.6%	33.6%
2015	9,779,000	7,243,000	5,761,000	33.5%	33.5%	33.5%

Source: The JICA Study Team

4.4 ANNUAL AIR CARGO FORECAST

The methodology used to develop annual cargo forecasts was exactly the same as used for the annual air passenger forecasts. International and domestic air cargo demands for the whole of Vietnam were first estimated based on GDP elasticities, and then those national totals are allocated to NBIA by using regional parameters.

4.4.1 International Air Cargo Forecast

The values of GDP elasticities for international cargo demand are usually 10-30% higher than those of international passenger demand. This tendency is particularly strong in Southeast Asia where massive inflows of investments from advanced countries are increasing the comparative advantages of the manufacturing sector, which generates disproportionate growth in cargo transport demand. Although the growth of international air cargo traffic in Vietnam has been comparable to that of international air passenger traffic in the last few years, the experience of other countries in Southeast Asia are expected to be replicated in Vietnam in the near future. The elasticities of international air cargo demands with respect to GDP is predicted as shown in Table 4.1.1 based the above-mentioned perspectives.

Table 4.4.1 Predicted Elasticity of International Air Cargo to GDP in Vietnam (Whole Country)

Period	High Case	Medium Case	Low Case
1995-2000	3.0 - 2.0	2.8 - 1.9	2.6 - 1.8
2000-2005	1.7	1.6	1.5
2005-2010	1.5	1.5	1.5
2010-2015	1.4	1.4	1.4

Source: The JICA Study Team

International air cargo demands for the whole of Vietnam are calculated accordingly as shown in Table 4.4.2.

Table 4.4.2 International Air Cargo Forecast for Whole Vietnam

Unit: Ton

Year	High Case	Medium Case	Low Case
1994 (Actual)	33,068	33,068	33,068
2000	135,000	109,000	94,000
2005	296,000	214,000	165,000
2010	557,000	378,000	272,000
2015	948,000	603,000	420,000

Source: The JICA Study Team

The result of the medium forecast for whole Vietnam indicates that the growth of international air cargo transport in Vietnam will fall between the growth paths of Hong Kong and Thailand as shown in Figure 4.4.1.

The estimated total international air cargo demand in Vietnam was apportioned to NBIA by using the same assumptions as the international air passenger forecast, i.e. NBIA will attract and generate air cargo nearly commensurate to its size of the regional economy. It can be predicted, therefore, that NBIA's share of international passengers in Vietnam will gradually increase from the present 15.3% to 25% in 2015 in the high and medium case forecasts. The share in the low case of the forecast is predicted to increase to 20%. The results of these estimates are shown in Table 4.4.3.

Table 4.4.3 International Air Cargo Forecast for Noi Bai International Airport

Year	Annual Cargo at NBIA (ton)			NBIA's Share in Vietnam		
	High Case	Medium Case	Low Case	High Case	Medium Case	Low Case
1994 (Actual)	5,062	5,062	5,062	15.3%	15.3%	15.3%
2000	24,400	19,700	15,600	18.1%	18.1%	16.6%
2005	60,300	43,600	29,300	20.4%	20.4%	17.8%
2010	126,400	85,800	51,400	22.7%	22.7%	18.9%
2015	237,000	150,800	84,000	25.0%	25.0%	20.0%

Source: The JICA Study Team

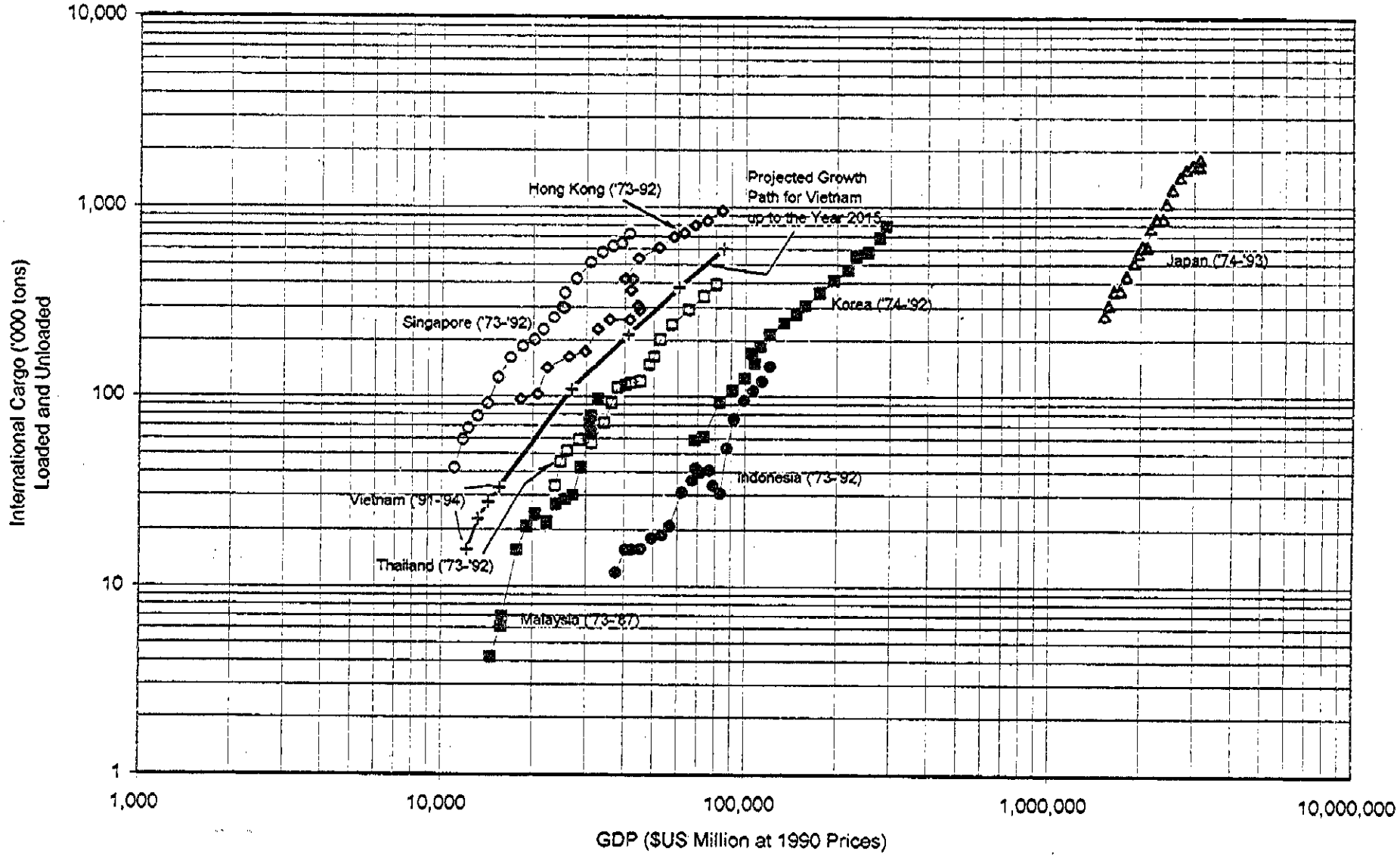

Figure 4.1.1 International Air Cargo Traffic vs. GDP in Selected Countries

4.4.2 Domestic Air Cargo Forecast

The elasticities of domestic air cargo demand for the whole of Vietnam with respect to GDP are predicted as shown in Table 4.4.4. These values are higher than those predicted for domestic air passenger demands, replicating the similar relationship between cargo and passenger demands of international transport.

Table 4.4.4 Assumed Elasticity of Domestic Air Cargo to GDP in Vietnam (Whole Country)

Period	High/Medium/Low Cases
1995-2000	5.0 - 1.3
2000-2005	1.3
2005-2010	1.3
2010-2015	1.2

Source: The JICA Study Team

Domestic air cargo demands for whole Vietnam are calculated as shown in Table 4.4.5.

Table 4.4.5 Domestic Air Cargo Forecast for Whole Vietnam

Unit: Ton

Year	High Case	Medium Case	Low Case
1994 (Actual)	24,691	24,691	24,691
2000	119,000	99,000	87,000
2005	218,000	173,000	142,000
2010	381,000	284,000	219,000
2015	603,000	425,000	318,000

Source: The JICA Study Team

Domestic air cargo demands at NBIA were estimated by allocating the Vietnam's total domestic cargo demands to NBIA by considering regionally differentiated future economic growth patterns. Following similar calculation procedures as those used for the domestic passenger forecast, NBIA's future share of the total domestic air cargo demand for Vietnam was estimated and used to develop the domestic air cargo forecast for NBIA as shown in Table 4.4.5.

Table 4.4.5 Domestic Air Cargo Forecast for Noi Bai International Airport

Year	Annual Cargo at NBIA (ton)			NBIA's Share in Vietnam		
	High Case	Medium Case	Low Case	High Case	Medium Case	Low Case
1994 (Actual)	10,756	10,756	10,756	43.6%	43.6%	43.6%
2000	51,500	42,900	37,700	43.3%	43.3%	43.3%
2005	92,100	73,100	60,000	42.2%	42.2%	42.2%
2010	156,400	116,600	89,900	41.0%	41.0%	41.0%
2015	243,400	171,600	128,400	40.4%	40.4%	40.4%

Source: The JICA Study Team

4.5. ANNUAL AIRCRAFT MOVEMENTS FORECAST

4.5.1 International Aircraft Movements

The forecast of aircraft movements depends on how airlines will meet the annual passenger demand, i.e. by increasing frequencies and/or by introducing larger aircraft. In general, average aircraft loads will rise as demand on trunk routes rises and as aircraft size increases.

This tendency can be confirmed by the average loads (annual passenger traffic divided by the annual aircraft movement for commercial transport) at major airports in Asia as indicated in Figure 4.5.1. At the busiest three airports in the region (Tokyo (Narita), Hong Kong and Singapore), the average load ranges between 160 to 200, while that at Noi Bai and Tan Son Nhat ranges between 100 to 120.

The analysis also shows that the average loads are relatively stable at around 160 to 200 for airports with international air passenger traffic greater than 5 to 10 mppa (million passengers per annum). The aircraft mixes at those airports are also similar.[3] The typical aircraft mix at those major airports may be represented as follows:

JJ (Jumbo Jet)	350 seater	B747, B777, A340, A330, etc.	:	40%
LJ (Large Jet)	250 seater	MD11, L1011, B767-300, A300, etc.	:	30%
MJ (Medium Jet)	200 seater	B767-200, A310, etc.	:	15%
SJ (Small Jet)	140 seater	A320, B737, etc.	:	15%
TP (Turbo Prop)	70 seater	ATR72, Tu154, etc.	:	0%

[3] Manila: JJ 44%, LJ 25%, MJ 7%, SJ: 24%, TP 0%
Seoul: JJ 38%, LJ 29%, MJ 17%, SJ 16%, TP 0%
Bangkok: JJ 42%, LJ 31%, MJ 16%, SJ 11%, TP 0%
Hong Kong: JJ 41%, LJ 27%, MJ 9%, SJ 23%, TP 0%

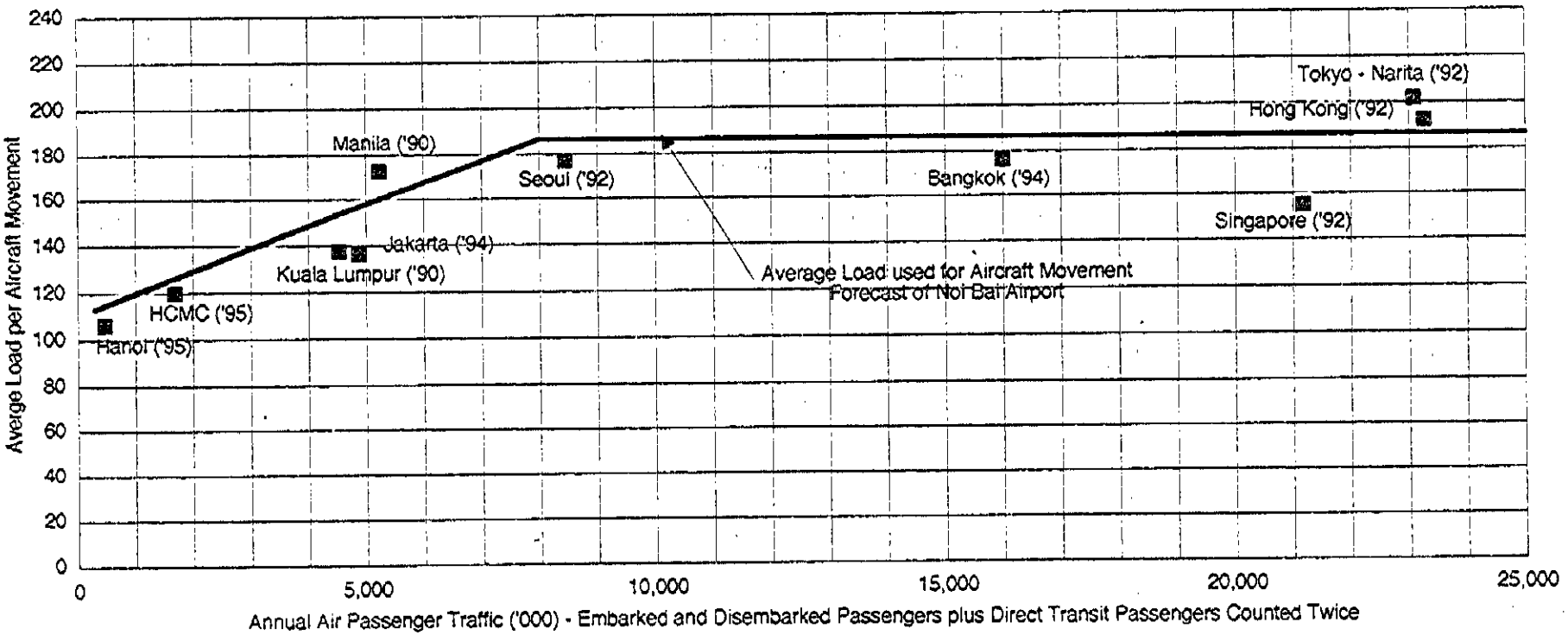

Figure 4.5.1 Relationship between Annual International Pasenger Traffic and Average Load at Major Airports in Asia

In consideration of the above characteristics common to the major airports in Asia, the average load at Noi Bai Airport is projected as shown by a solid line in Figure 4.5.1. With this increasing trend of average load and an assumed annual average load factor of 70%,[4] the aircraft mix of international traffic at Noi Bai Airport can be given as shown in Figure 4.5.2.

The annul international aircraft movements at Noi Bai Airport are calculated by dividing the forecast annual number of international air passengers by the corresponding average load in Figure 4.5.1, and then the movements by aircraft categories are estimated by use of Figure 4.5.2. The result of the calculation is shown for the three projections of the international air passenger forecast in Table 4.5.1.

Table 4.5.1 International Aircraft Movement Forecast for Noi Bai International Airport

Year		Annual Aircraft Movements by Category						Average Load per Movement
		JJ (350)	LJ (250)	MJ (200)	SJ (140)	TP (70)	Total	
High Case	2000	970	2,060	1,030	5,960	1,230	11,260	123
	2005	3,070	4,200	2,100	9,110	1,750	20,230	136
	2010	7,530	7,420	3,710	10,270	1,640	30,570	155
	2015	16,170	12,540	6,270	7,770	370	43,120	173
Medium Case	2000	710	1,690	840	5,120	1,070	9,430	121
	2005	1,860	3,080	1,540	7,760	1,550	15,790	130
	2010	4,210	5,120	2,560	9,810	1,810	23,520	142
	2015	8,130	7,800	3,900	10,200	1,570	31,610	158
Low Case	2000	520	1,390	700	4,400	930	7,940	119
	2005	1,100	2,230	1,110	6,290	1,290	12,030	124
	2010	2,160	3,380	1,690	8,180	1,620	17,030	131
	2015	3,850	4,840	2,420	9,630	1,800	22,540	140

Source: The JICA Study Team

[4] The present load factor of 65% is assumed to be improved to 70% in the future.

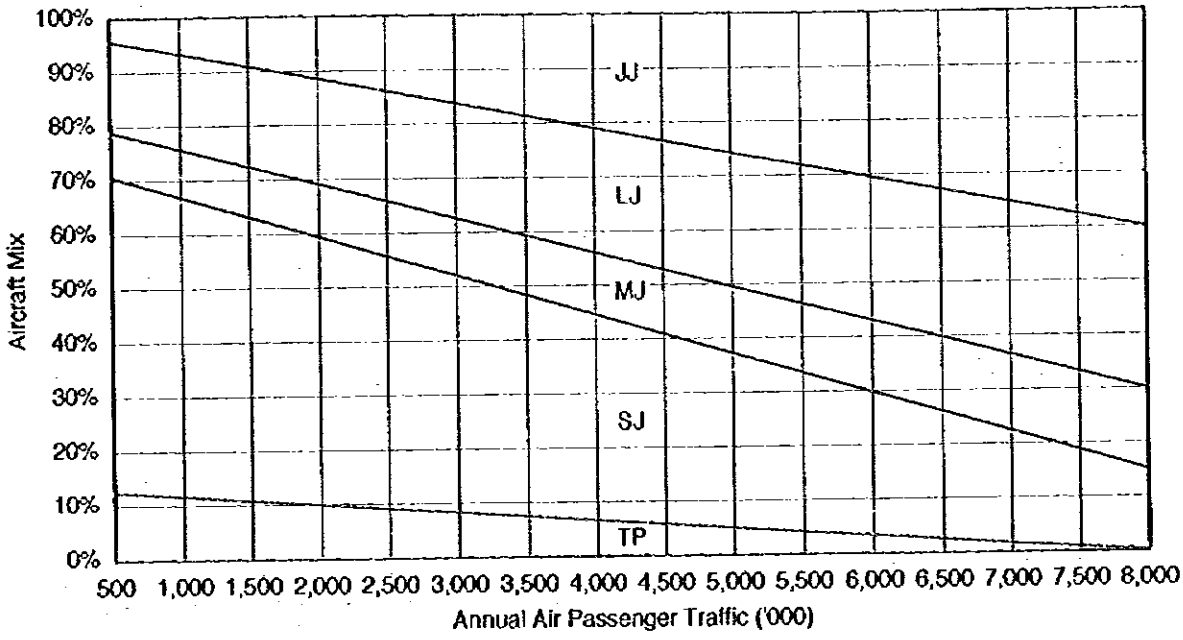

Figure 4.5.2 Future Mix of International Aircraft at Noi Bai International Airport

4.5.2 Domestic Aircraft Movements

The forecast of domestic aircraft movements requires a projection of aircraft mix by respective routes. Air passenger traffic is first estimated for each route by using the following shares:[5]

Table 4.5.2 Estimated Domestic Passenger Route Shares from/to Noi Bai International Airport

Year	Hanoi - Ho Chi Minh	Hanoi - Danang	Hanoi - Hue	Hanoi - Nha Trang	Hanoi - Others	Total
1994 (Actual)	75.10%	17.70%	3.92%	1.59%	1.69%	100.00%
2000	73.45%	20.83%	3.12%	1.26%	1.34%	100.00%
2005	71.68%	23.71%	2.51%	1.02%	1.08%	100.00%
2010	69.55%	26.84%	1.96%	0.80%	0.85%	100.00%
2015	68.34%	28.52%	1.71%	0.69%	0.74%	100.00%

Source: The JICA Study Team

Aircraft mix of each route is then determined by the aircraft assignment schedule in Figure 4.5.3,[6] which is based on an analysis of present patterns of aircraft usage in Vietnam and the experience of other countries in Asia.

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[5] The route shares are estimated from Table 4.3.6 as Hanoi - Ho Chi Minh as N - S, Hanoi - Danang as N - M, and N - O was distributed to Hue, Nha Trang and Others by 55.4%, 22.1% and 23.5%.

[6] Other routes consist of Dien Bien, Vinh, etc. Since passenger traffic on those routes are very limited, ATR72 class aircraft will continuously be used for those routes.

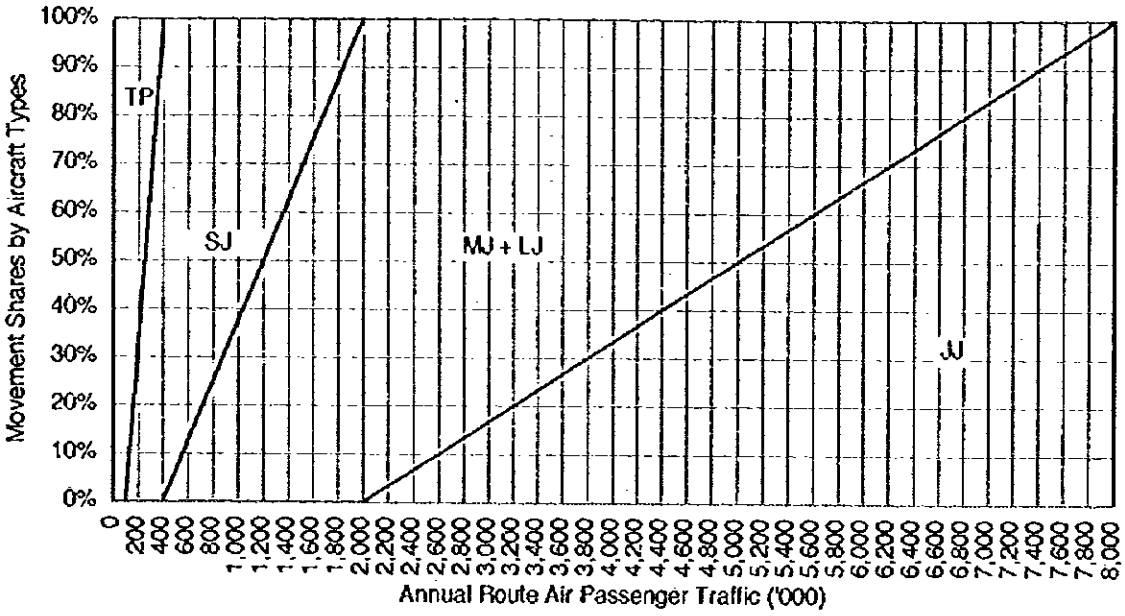

Figure 4.5.3 Aircraft Assignment Schedule for Domestic Air Routes in Vietnam

The result is shown for three projections of the domestic air passenger forecast in Table 4.5.3. It should be noted that Hanoi - Ho Chi Minh will become one of the busiest domestic routes in Asia, and B747 class aircraft will need to be introduced by the year 2005. An annual average load factor of 70% is assumed for domestic traffic.

Table 4.5.3 Domestic Aircraft Movement Forecast for Noi Bai International Airport

Year		Annual Aircraft Movements by Category						Average Load per Movement
		JJ (350)	LJ (250)	MJ (200)	SJ (140)	TP (70)	Total	
High Case	2000	0	5,540	5,540	6,030	2,900	20,010	124
	2005	2,890	8,790	8,790	5,240	3,860	29,570	141
	2010	10,450	11,830	11,830	1,800	4,410	40,320	166
	2015	25,270	10,420	10,420	630	5,020	51,760	189
Medium Case	2000	0	4,070	4,070	7,360	2,480	17,980	118
	2005	1,110	7,810	7,810	5,320	3,210	25,260	135
	2010	5,330	10,490	10,490	3,940	3,790	34,040	152
	2015	12,280	12,720	12,720	190	4,270	42,180	172
Low Case	2000	0	3,270	3,270	7,910	2,250	16,700	115
	2005	210	7,070	7,070	5,200	2,750	22,300	131
	2010	2,670	9,310	9,310	4,900	3,110	29,300	144
	2015	6,840	11,600	11,600	2,540	3,690	36,270	159

Source: The JICA Study Team

4.6 PEAK HOUR FORECAST

4.1 Design Basis

Annual passenger demand and aircraft movements are decomposed into peak hour traffic, which is the design basis of various airport facilities. In particular, the size of terminal facilities -- aircraft stands, passenger terminal building and car park -- is more closely related to peak hour traffic rather than annual traffic.

Design peak hour is often defined as an average day of the peak month, which corresponds to the 30th to 40th busiest hour of the year in question. By using this for design purposes, the airport would expect to experience 30 to 40 hours of over-capacity traffic in a year; however, the normal experience suggests that catering for excessive peak traffic is both uneconomical and unnecessary.

4.6.2 Methodology for Peak Hour Forecast

The methodology for decomposing annual traffic into design peak hour traffic is illustrated in Figure 4.6.1. The annual aircraft movements are multiplied by the peak day ratio to obtain design day aircraft movements. Then, by further multiplying by the peak hour factor, 2-way peak hour aircraft movements (departures plus arrivals) can be estimated. One-way peak hour aircraft movements (departures or arrivals) will finally be obtained by further multiplying by the heavy direction factor. The corresponding design day, 2-way peak hour and 1-way peak hour number of passengers will be calculated as the product of estimated aircraft movements, the number of aircraft seats by categories and the load factor of aircraft.

4.6.3 Planning Parameters

1) Design Day Ratio

Based on the analysis of monthly variations of aircraft movements at Noi Bai Airport, the following design day ratios are used for both international and domestic traffic.

- Design day ratio: 1/310

2) Peak Hour Factor

The peak hour factor indicates the concentration of aircraft movements during design peak hour as a percentage of design day aircraft movements. It declines as design day aircraft movements increase so that it may represent peak spreading, i.e. patterns of peaking tend to become less pronounced over time, and thus the hourly peaks in activity rise at a slower rate than the annual traffic.

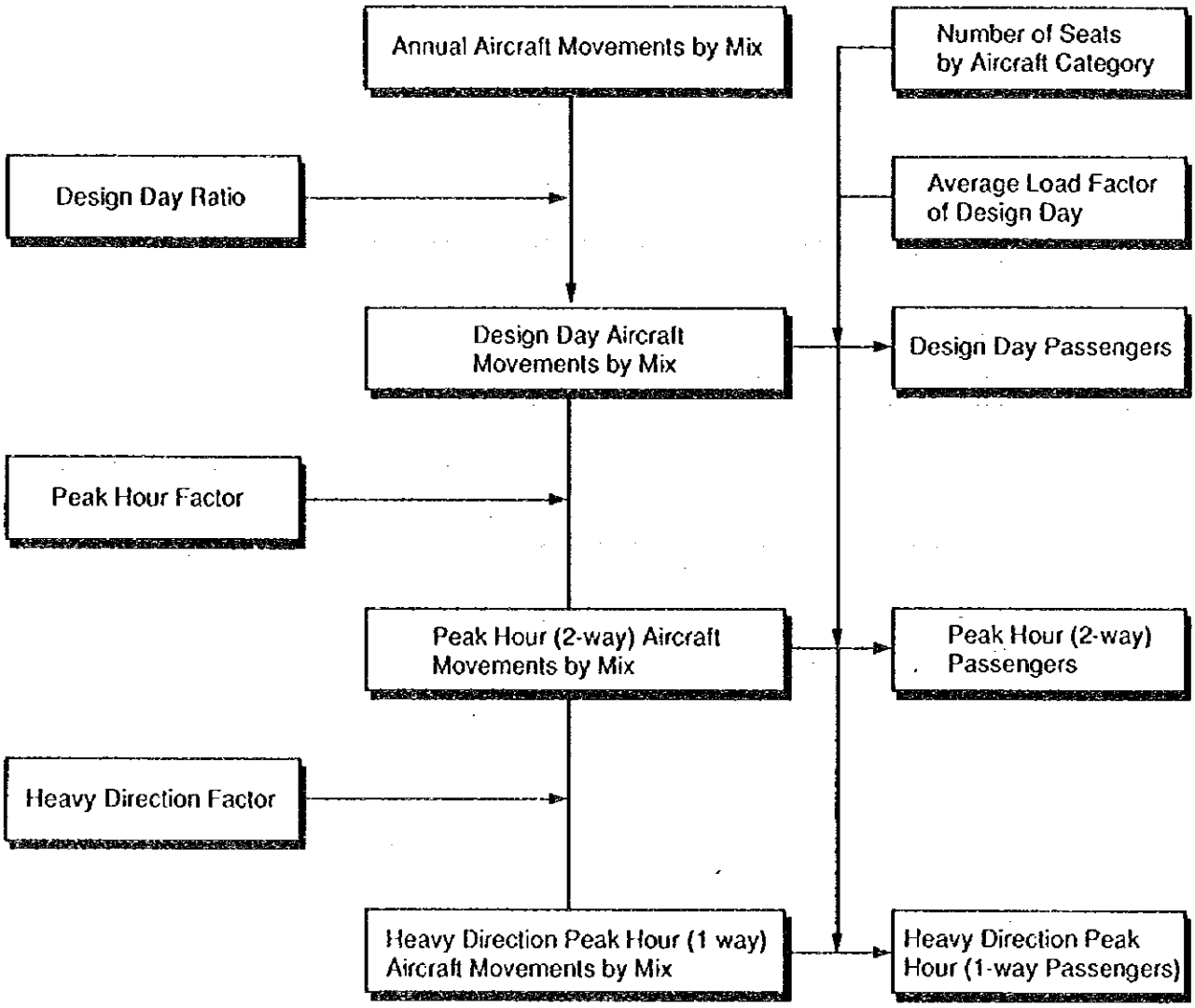

Figure 4.6.1 Work Diagram for Decomposing Annual Traffic to Design Peak Hour Traffic

The current international aircraft movements at Noi Bai Airport are relatively concentrated -- the peak hour factor of 0.39. However, it will become smaller as traffic demands increase. It is known that the peak hour factor will be around 0.1 at very busy airports, e.g., 0.11 at Bangkok Airport and 0.10 at Hong Kong Airport. Figure 4.6.2 indicates the relationship between the peak hour factor and daily aircraft movements at current Noi Bai and Tan Son Nhat Airports compared with an average for international airports in Japan (the broken line). It is obvious that the average peaking characteristic is too low for airports in Vietnam; therefore, a unique path of a declining peak hour factor is proposed in Figure 4.6.2 (the solid line) and used for the present study.

As for the peak hour factor for domestic aircraft, the average characteristic of domestic airports in Japan in Figure 4.6.3 are used for Noi Bai Airport because it nearly represents the current peak hour concentration at Noi Bai Airport.

3) Heavy Direction Factor

The heavy direction factor is defined as the ratio of 1-way traffic (departures or arrivals) to 2-way traffic (departures plus arrivals) during design peak hour. It is generally situated between 0.6 and 0.75. Based on the analysis of current peak patterns at Noi Bai Airport, the heavy direction factor of 0.67 is used for both international and domestic traffic.

4) Load Factor of Aircraft

The load factors of aircraft on the design day and during the design peak hour are generally higher than that of the annual average. The following values are used for converting estimated design day, 2-way peak hour and 1-way peak hour aircraft movements into corresponding air passenger traffic.

- Load factor of design day : 75%
- Load factor during design peak hour : 80%

4.6.4 Estimated Peak Hour Traffic and the Summary of the Forecasts

The result of the peak hour forecast together with overall results of the air traffic demand forecasts are summarized in Table 4.6.1.

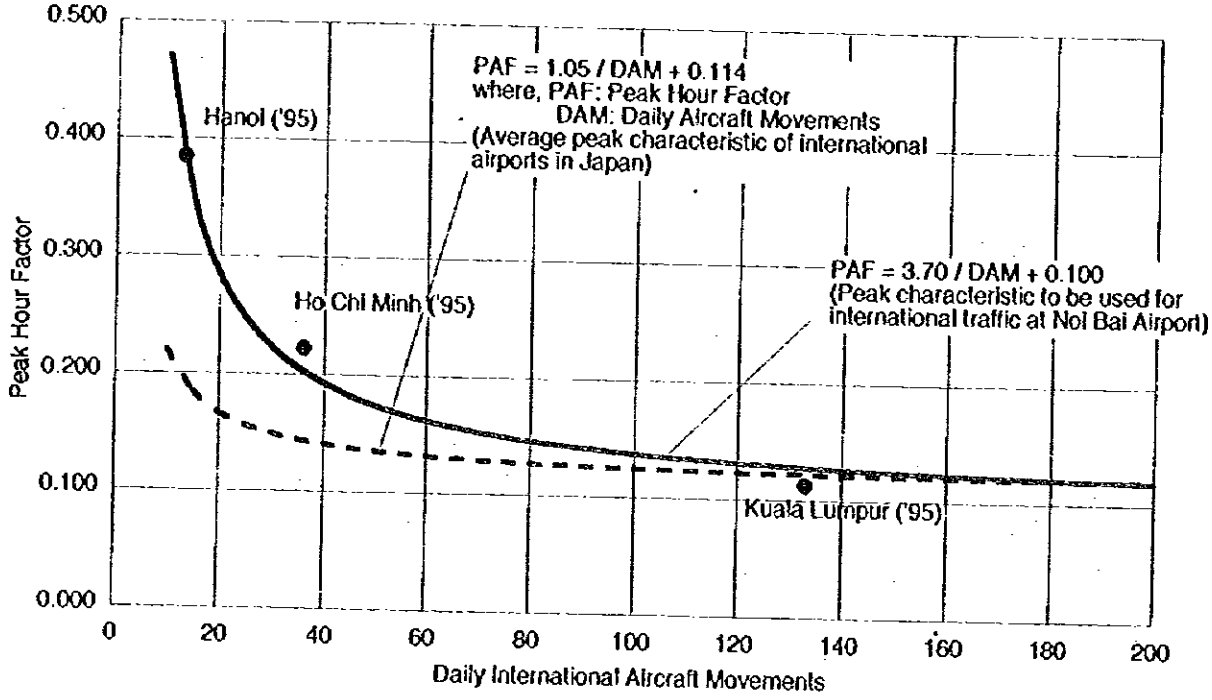

Figure 4.6.2 Relationship Between Daily Number of Aircraft Movements and Peak Hour Factor for International Traffic

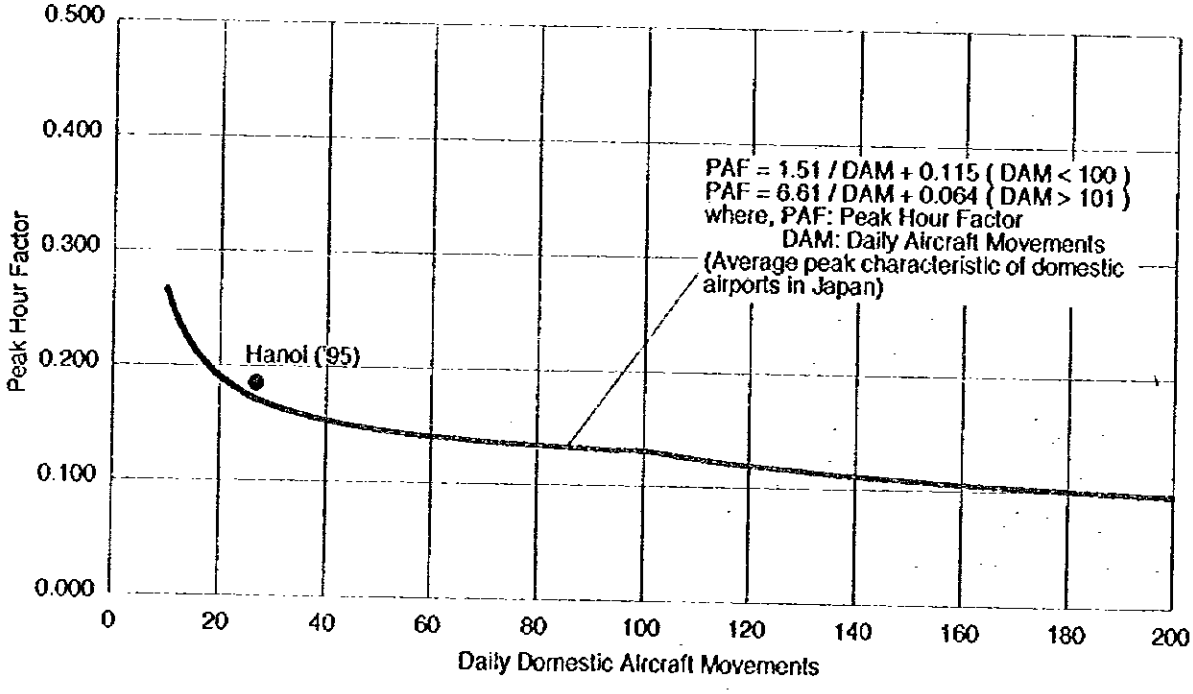

Figure 4.6.3 Relationship Between Daily Number of Aircraft Movements and Peak Hour Factor for Domestic Traffic

Table 4.6.1 Summary of the Air Traffic Demand Forecasts

Item				2000 Annual	2000 Design Day	2000 Peak Hour (2-way)	2000 Peak Hour (1-way)	2005 Annual	2005 Design Day	2005 Peak Hour (2-way)	2005 Peak Hour (1-way)	2010 Annual	2010 Design Day	2010 Peak Hour (2-way)	2010 Peak Hour (1-way)	2015 Annual	2015 Design Day	2015 Peak Hour (2-way)	2015 Peak Hour (1-way)
High Case	Passengers	International		1,389,000	4,790	1,030	690	2,759,000	9,540	1,590	1,070	4,750,000	16,420	2,410	1,610	7,460,000	27,010	3,650	2,440
		Domestic		2,479,000	8,570	1,260	850	4,180,000	14,450	2,020	1,350	6,679,000	23,080	2,830	1,890	9,779,000	33,810	3,740	2,500
		Total		3,868,000	13,360	1,950	1,310	6,939,000	23,990	3,070	2,060	11,429,000	39,500	4,450	2,980	17,239,000	60,820	6,280	4,200
	Cargo (ton)	International		24,400	-	-	-	60,300	-	-	-	126,400	-	-	-	237,000	-	-	-
		Domestic		51,500	-	-	-	92,100	-	-	-	156,400	-	-	-	243,400	-	-	-
		Total		75,900	-	-	-	152,400	-	-	-	282,800	-	-	-	480,400	-	-	-
	Aircraft Movements	International	JJ	970	3	0.6	0.4	3,070	10	1.6	1.0	7,530	24	3.3	2.2	16,170	52	6.6	4.4
			LJ	2,060	7	1.3	0.9	4,200	14	2.1	1.4	7,420	24	3.3	2.2	12,540	40	5.1	3.4
			MJ	1,030	3	0.7	0.4	2,100	7	1.1	0.7	3,710	12	1.6	1.1	6,270	20	2.6	1.7
			SJ	5,960	19	3.9	2.6	9,110	29	4.6	3.1	10,270	33	4.6	3.1	7,770	25	3.2	2.1
			TP	1,230	4	0.8	0.5	1,750	6	0.9	0.6	1,640	5	0.7	0.5	370	1	0.2	0.1
			Total	11,260	36	7.3	4.9	20,230	65	10.2	6.9	30,570	99	13.6	9.1	43,120	139	17.6	11.8
		Domestic	JJ	0	0	0.0	0.0	2,890	9	1.2	0.8	10,450	34	3.9	2.6	25,270	82	8.4	5.7
			LJ	5,540	18	2.5	1.7	8,790	28	3.7	2.5	11,830	38	4.4	2.9	10,420	34	3.5	2.3
			MJ	5,540	18	2.5	1.7	8,790	28	3.7	2.5	11,830	38	4.4	2.9	10,420	34	3.5	2.3
			SJ	6,030	19	2.7	1.8	5,240	17	2.2	1.5	1,800	6	0.7	0.4	630	2	0.2	0.1
			TP	2,900	9	1.3	0.9	3,860	12	1.6	1.1	4,410	14	1.6	1.1	5,020	16	1.7	1.1
			Total	20,010	65	8.9	6.0	29,570	95	12.5	8.4	40,320	130	14.9	10.0	51,760	167	17.3	11.6
		Total		31,270	101	13.8	9.3	49,800	161	19.3	12.9	70,890	229	24.2	16.2	94,880	306	29.7	19.9
Medium Case	Passengers	International		1,141,000	3,950	930	620	2,047,000	7,070	1,300	870	3,337,000	11,530	1,830	1,230	4,981,000	17,210	2,500	1,680
		Domestic		2,126,000	7,340	1,100	740	3,411,000	11,790	1,680	1,120	5,183,000	17,910	2,370	1,590	7,243,000	25,030	3,010	2,010
		Total		3,267,000	11,290	1,730	1,160	5,458,000	18,860	2,530	1,690	8,520,000	29,440	3,570	2,400	12,224,000	42,240	4,680	3,140
	Cargo (ton)	International		19,700	-	-	-	43,600	-	-	-	85,800	-	-	-	150,800	-	-	-
		Domestic		42,900	-	-	-	73,100	-	-	-	116,600	-	-	-	171,600	-	-	-
		Total		62,600	-	-	-	116,700	-	-	-	202,400	-	-	-	322,400	-	-	-
	Aircraft Movements	International	JJ	710	2	0.5	0.3	1,860	6	1.0	0.7	4,210	14	2.0	1.4	8,130	26	3.6	2.4
			LJ	1,690	5	1.2	0.8	3,080	10	1.7	1.1	5,120	17	2.5	1.6	7,800	25	3.4	2.3
			MJ	840	3	0.6	0.4	1,540	5	0.9	0.6	2,560	8	1.2	0.8	3,900	13	1.7	1.1
			SJ	5,120	17	3.7	2.5	7,760	25	4.3	2.9	9,810	32	4.7	3.2	10,200	33	4.5	3.0
			TP	1,070	3	0.8	0.5	1,550	5	0.9	0.6	1,810	6	0.9	0.6	1,570	5	0.7	0.5
			Total	9,430	30	6.7	4.5	15,790	51	8.8	5.9	23,520	76	11.3	7.6	31,610	102	13.9	9.3
		Domestic	JJ	0	0	0.0	0.0	1,110	4	0.5	0.3	5,330	17	2.1	1.4	12,280	40	4.5	3.0
			LJ	4,070	13	1.9	1.2	7,810	25	3.4	2.3	10,490	34	4.2	2.8	12,720	41	4.6	3.1
			MJ	4,070	13	1.9	1.2	7,810	25	3.4	2.3	10,490	34	4.2	2.8	12,720	41	4.6	3.1
			SJ	7,360	24	3.3	2.2	5,320	17	2.3	1.5	3,940	13	1.6	1.1	190	1	0.1	0.0
			TP	2,480	8	1.1	0.8	3,210	10	1.4	0.9	3,790	12	1.5	1.0	4,270	14	1.6	1.0
			Total	17,980	58	8.2	5.5	25,260	81	10.9	7.3	34,040	110	13.6	9.1	42,180	136	15.3	10.3
		Total		27,410	88	12.7	8.5	41,050	132	16.7	11.2	57,560	186	21.2	14.2	73,790	238	24.8	16.6
Low Case	Passengers	International		946,000	3,270	850	570	1,496,000	5,170	1,080	720	2,238,000	7,740	1,380	930	3,160,000	10,930	1,760	1,180
		Domestic		1,915,000	6,620	1,010	680	2,922,000	10,100	1,470	980	4,220,000	14,580	2,040	1,370	5,761,000	19,910	2,560	1,710
		Total		2,861,000	9,890	1,580	1,060	4,418,000	15,270	2,170	1,450	6,458,000	22,320	2,910	1,960	8,921,000	30,840	3,670	2,460
	Cargo (ton)	International		15,600	-	-	-	29,300	-	-	-	51,400	-	-	-	84,000	-	-	-
		Domestic		37,700	-	-	-	60,000	-	-	-	89,900	-	-	-	128,400	-	-	-
		Total		53,300	-	-	-	89,300	-	-	-	141,300	-	-	-	212,400	-	-	-
	Aircraft Movements	International	JJ	520	2	0.4	0.3	1,100	4	0.7	0.5	2,160	7	1.2	0.8	3,850	12	1.9	1.3
			LJ	1,390	4	1.1	0.7	2,230	7	1.4	0.9	3,380	11	1.8	1.2	4,840	16	2.4	1.6
			MJ	700	2	0.6	0.4	1,110	4	0.7	0.5	1,690	5	0.9	0.6	2,420	8	1.2	0.8
			SJ	4,400	14	3.5	2.3	6,290	20	4.0	2.7	8,180	26	4.4	3.0	9,630	31	4.7	3.1
			TP	930	3	0.7	0.5	1,290	4	0.8	0.5	1,620	5	0.9	0.6	1,800	6	0.9	0.6
			Total	7,940	26	6.3	4.2	12,030	39	7.6	5.1	17,030	55	9.2	6.2	22,540	73	11.0	7.4
		Domestic	JJ	0	0	0.0	0.0	210	1	0.1	0.1	2,670	9	1.1	0.8	6,840	22	2.7	1.8
			LJ	3,270	11	1.5	1.0	7,070	23	3.1	2.1	9,310	30	3.9	2.6	11,600	37	4.5	3.0
			MJ	3,270	11	1.5	1.0	7,070	23	3.1	2.1	9,310	30	3.9	2.6	11,600	37	4.5	3.0
			SJ	7,910	26	3.6	2.4	5,200	17	2.3	1.5	4,900	16	2.1	1.4	2,540	8	1.0	0.7
			TP	2,250	7	1.0	0.7	2,750	9	1.2	0.8	3,110	10	1.3	0.9	3,690	12	1.4	1.0
			Total	16,700	54	7.7	5.2	22,300	72	9.8	6.6	29,300	95	12.4	8.3	36,270	117	14.1	9.4
		Total		24,640	79	11.9	8.0	34,330	111	14.8	9.9	46,330	149	18.3	12.3	58,810	190	21.3	14.3

4.7 COMPARISON WITH OTHER FORECASTS

4.7.1 International Air Passenger Forecasts for Whole Vietnam

There are two forecasts available for comparison with the present forecast for international air passenger demand for the whole of Vietnam. The first is from the Civil Aviation Master Plan (CAMP) prepared by ICAO/UNDP in 1991, and the other is the Industry Survey by the International Air Transport Association (IATA), 1995 edition. The comparison is shown in Figure 4.7.1.

The CAMP's forecast, which only covers the period up to the year 2000, seems to fail to predict the recent very rapid growth of international air passenger traffic in Vietnam, resulted in a significant underestimation for the traffic in 1994. The IATA's forecast almost falls in-between the high and low forecast of the present study; however, the growth pattern of the air traffic differs from the present forecast. It anticipates that the rate of growth of air traffic will accelerate in future -- as against the international experience shown in Figure 4.7.1.

4.7.2 Tourist Arrivals in Tourism Master Plan for Vietnam

The National Tourism Master Plan 2010, which produced by Vietnam Administration of Tourism (VINA-Tourism) and recently approved by the Government, expects 3.5 million and 9 million foreign visitors in the years 2000 and 2010 respectively. Those figures correspond to 7 million and 18 million international passengers as airport traffic, which places around the higher range of the present forecast. Since this master plan figure does not include Vietnamese international passengers, the figures seem to be quite optimistic. One reason of this may be that VINA-Tourism's statistical base was overestimated as discussed in Section 2.2.1.

4.7.3 Air Passenger Forecasts for Noi Bai International Airport

Three forecasts in Figure 4.7.2 are available for comparison with the air passenger forecast (international and domestic) of the present study. ICAO/UNDP's CAMP again provides the lowest figures. The medium forecast of the present study may be described as the average of the CAAV's Master Plan for NBIA and the NAR's Feasibility Study for T1 Terminal at NBIA.

Further comparisons of the forecasts for international passengers and domestic passengers at NBIA have respectively revealed that the medium forecast of the present study places between the CAAV's Master Plan and the NAR's Feasibility Study.

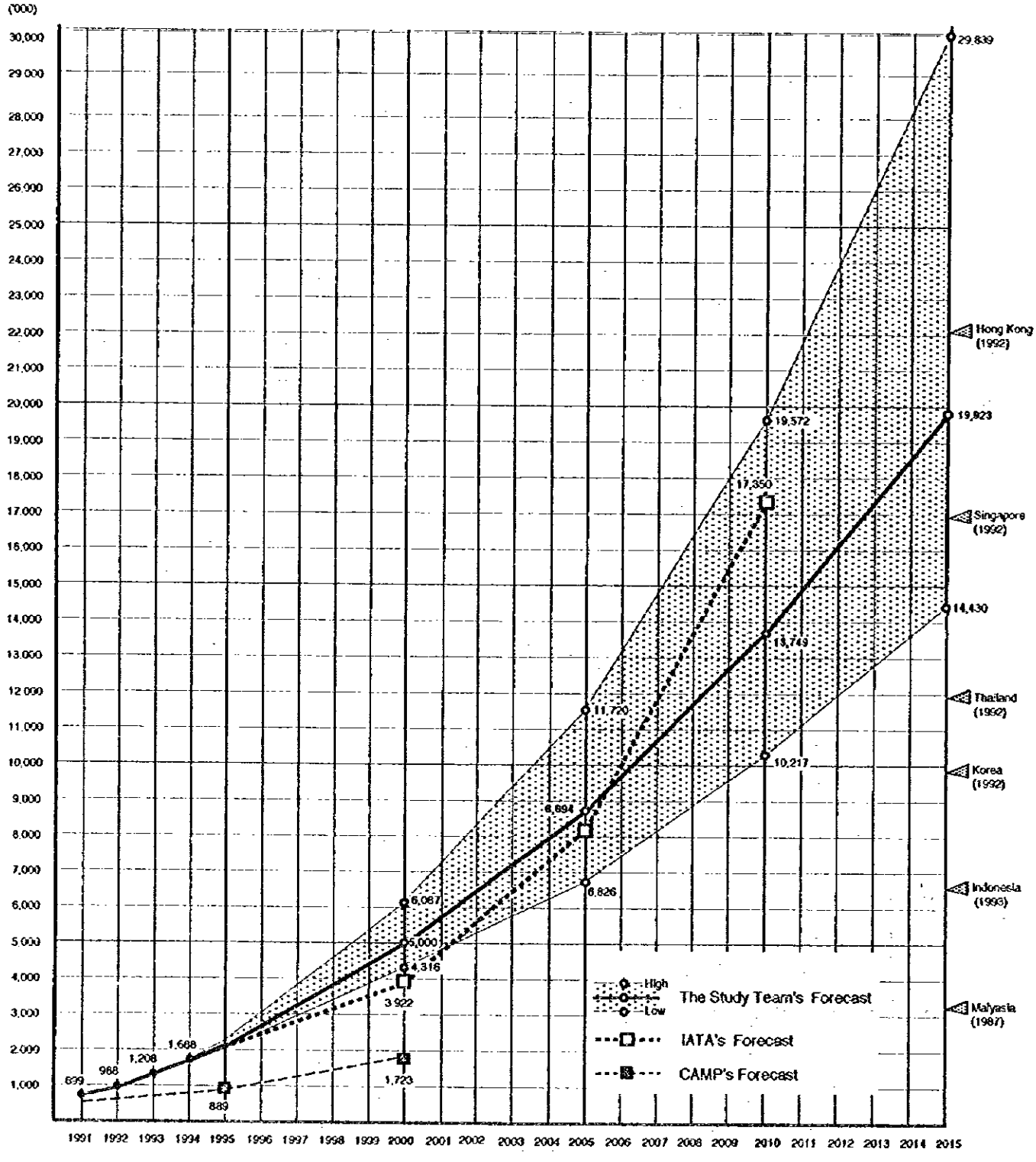

Figure 4.7.1 International Air Passenger Forecast for Whole Vietnam

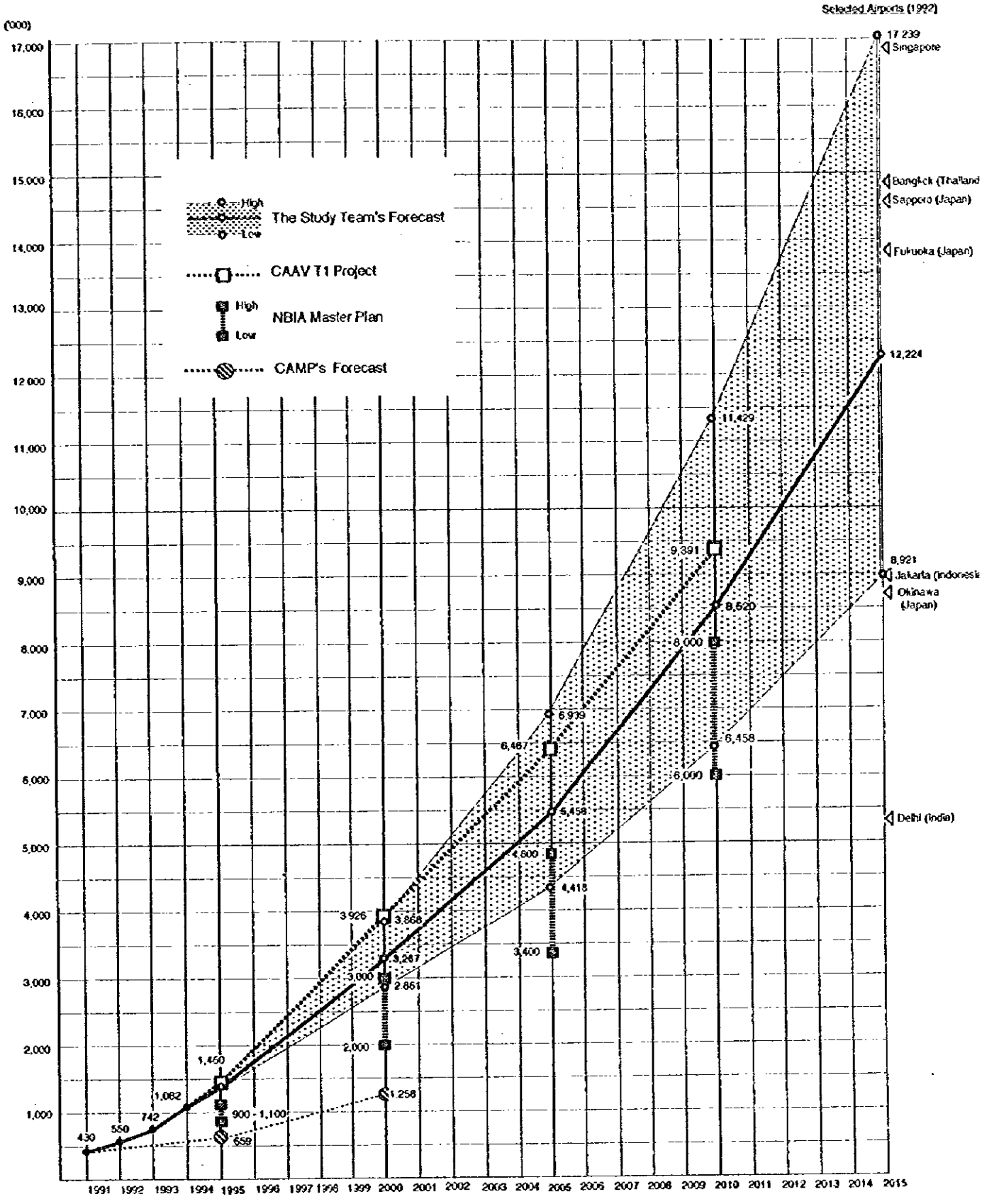

Figure 4.7.2 Air Passenger Forecast for Noi Bai International Airport
(International and Domestic)

4.7.3 Air Cargo Forecasts for Noi Bai International Airport

Figure 4.7.3 compares the air cargo forecast for Noi Bai Airport in the present study with two other forecasts in the ICAO/UNDP's CAMP and the CAAV's Master Plan for NBIA. As is the case of the air passenger forecast, the CAMP's forecast significantly underestimates the traffic in 1994. The CAAV's Master Plan also seems to fail to predict the recent surge of air cargo traffic at NBIA.

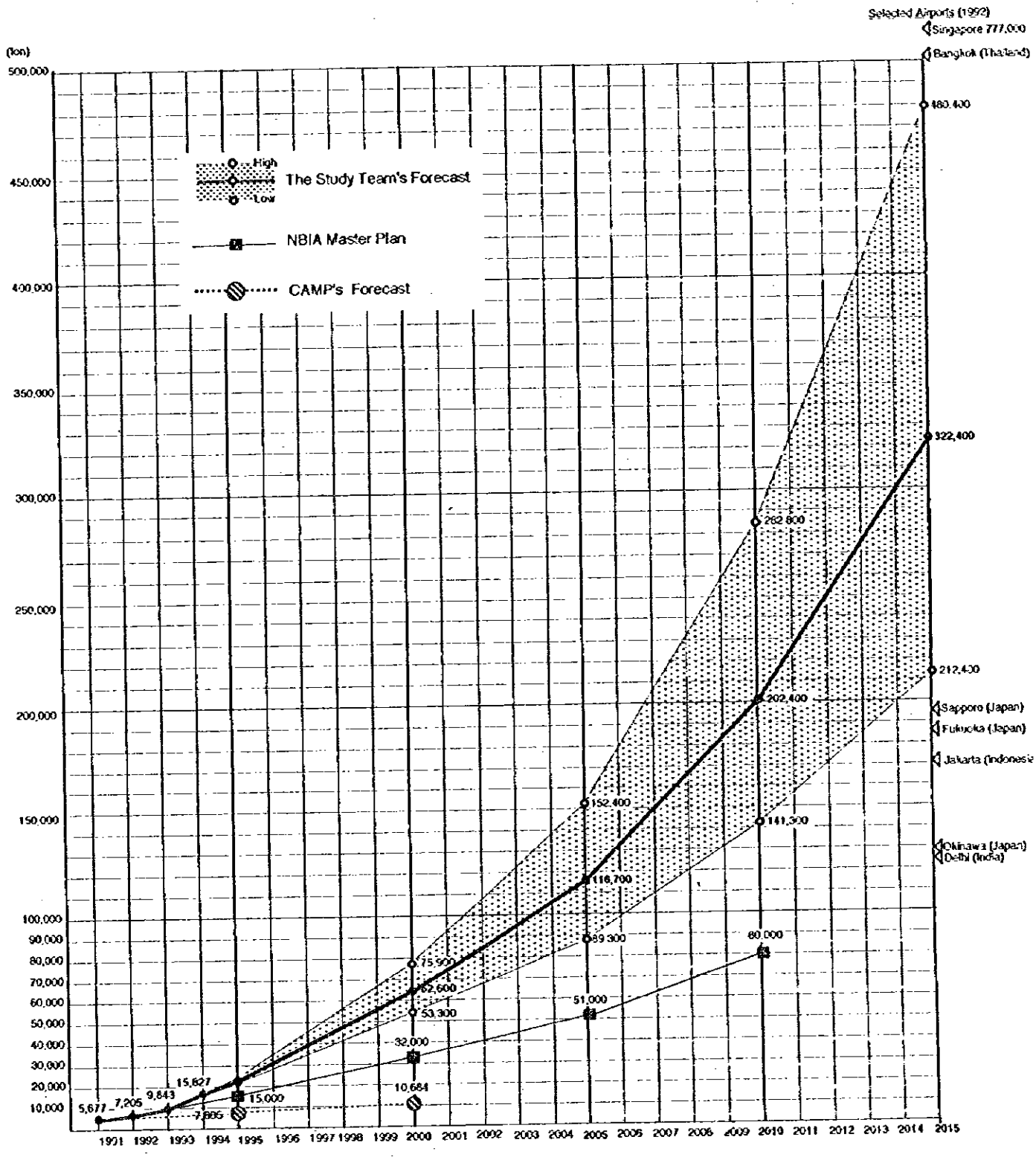

Figure 4.7.3 Air Cargo Forecast for Noi Bai International Airport (International and Domestic)

CHAPTER 5 AIRPORT FACILITY REQUIREMENTS

CHAPTER 5 AIRPORT FACILITY REQUIREMENTS

5.1 SUMMARY

In this Chapter, major airport facility requirements are established in compliance with the relevant standards and recommended practices of the International Civil Aviation Organisation (ICAO). The standards and practices of International Air Transport Association (IATA), Federal Aviation Administration of the United States (FAA) and the Civil Aviation Bureau of Japan are also referred to.

The medium case of air traffic demand forecast was used for this study for the following reasons:

a) Since facility requirements are established based on high and internationally accepted service standards, the risk of over investment will become too high if high case forecast is used for planning.

b) Airports are usually developed to accommodate the forecast demand five years after the inauguration. Therefore, it will not be difficult to accommodate the traffic demand in the year of inauguration of the new (or expanded) facilities, even if actual traffic grows to the level of the high case forecast. In this case the next phase of the development should be accelerated.

c) If actual traffic growth is close to the low case forecast, it is not difficult to delay or reduce the scale of the development.

d) Facility requirements for the high and low cases of air traffic demand forecast can be identified approximately by shifting the target years, e.g. facility requirements for the year 2005 in the high case forecast are in between those for the years 2005 and 2010 in the medium case forecast approximately.

Table 5.1.1 summarizes the facility requirements for the years 2000, 2005, 2010 and 2015.

Table 5.1.1 Summary of Airport Facility Requirements

Item	Present Condition as of 1994	Future Requirements			
		2000	2005	2010	2015
1. Annual Passengers					
Domestic	711,997	2,126,000	3,411,000	5,183,000	7,243,000
International	370,307	1,141,000	2,047,000	3,337,000	4,981,000
Total	1,082,304	3,267,000	5,458,000	8,520,000	12,224,000
2. Annual Cargo (tons)					
Domestic	10,374	42,900	73,100	116,600	171,600
International	10,884	19,700	43,600	85,800	150,800
Total	21,258	62,600	116,700	202,400	322,400
3. Annual Aircraft Movements					
Domestic	7,642	17,980	25,260	34,040	42,180
International	6,188	9,430	15,790	23,520	31,610
Others (assumed number)	6,000	6,000	6,000	6,000	6,000
Total	19,830	33,410	47,050	63,560	79,790

Table 5.1.1 Summary of Airport Facility requirements (Continued)

Item	Present Condition as of 1994	Future Requirements			
		2000	2005	2010	2015
4. Peak Hour Passengers (2 ways)	470	1,100	1,680	2,370	3,010
Domestic	510	930	1,300	1,830	2,500
International	840	1,730	2,530	3,570	4,680
Overall					
5. Peak Hour Aircraft Movements					
(2 ways)	3	8.2	10.9	13.6	15.3
Domestic	2	6.7	8.8	11.3	13.9
International	4	12.7	16.7	21.2	24.8
Overall Commercial	1	1	1	1	1
Others (assumed number)	6	15	19	24	27
Total					
6. Largest Aircraft	B747	B747	B747	B747	B747
7. Aerodrome Reference Code	4E	4E	4E	4E	4E
8 Runway					
Number	1	1	2	2	2
Length	3,200 m	3,600 m	3,600 m	3,600 m	3,600 m
Width	45 m	45 m	45 m	45 m	45 m
9. Runway Strip					
Length	3,320 m	3,720 m	3,720 m	3,720 m	3,720 m
Width	300 m	300 m	300 m	300 m	300 m
10. Taxiway					
System	Partial Parallel Taxiway	Full Parallel Taxiway	Full Parallel Taxiway	Full Parallel Taxiway	Full Parallel Taxiway & Holding Bays
Width	23 m	23 m	23 m	23 m	23 m
11. Passenger Loading Apron					
Domestic		JJ : 0 LJ : 3 MJ : 0 SJ : 2 TP : 1 Total : 6	JJ : 2 LJ : 2 MJ : 1 SJ : 1 TP : 1 Total : 7	JJ : 3 LJ : 3 MJ : 1 SJ : 1 TP : 1 Total : 9	JJ : 4 LJ : 3 MJ : 2 SJ : 0 TP : 1 Total : 10
	JJ : 1 LJ/MJ : 6 SJ/TP : 10 Total : 17				
International		JJ : 2 LJ : 1 MJ : 1 SJ : 2 TP : 1 Total : 7	JJ : 3 LJ : 1 MJ : 1 SJ : 3 TP : 1 Total : 9	JJ : 4 LJ : 2 MJ : 1 SJ : 3 TP : 1 Total : 11	JJ : 5 LJ : 5 MJ : 1 SJ : 2 TP : 1 Total : 14
12. Passenger Terminal Building					
Domestic	total 8,570 m^2	16,500 m^2	25,200 m^2	35,600 m^2	45,200 m^2
International		23,300 m^2	32,500 m^2	45,800 m^2	62,550 m^2
13. Cargo Terminal Building					
Domestic	total 1,900 m^2	2,900 m^2	4,800 m^2	7,800 m^2	11,400 m^2
International		2,800 m^2	6,200 m^2	12,300 m^2	21,500 m^2
14. Administration Building	m^2	2,800 m^2	2,800 m^2	2,800 m^2	2,800 m^2
15. Access Road	4 lanes	2 lanes	4 lanes	4 lanes	4 lanes
16. Car Park					
Domestic	total approx.	15,400 m^2	23,500 m^2	33,300 m^2	42,000 m^2
International	14,000 m^2	13,000 m^2	18,200 m^2	25,600 m^2	35,000 m^2
17. Air Navigation Systems	Precision Category I	Precision Category II	Precision Category II	Precision Category II	Precision Category II
18. Public Utilities					
Power Supply	1,260 kVA	5,000 kVA	7,100 kVA	10,000 kVA	13,400 kVA
Water Supply	3,000 t/day	1,000 t/day	1,400 t/day	2,000 t/day	2,500 t/day
Sewage Disposal	n.a.	1,000 t/day	1,400 t/day	2,000 t/day	2,500 t/day
Solid waste Disposal	n.a.	4.2 t/day	6.2 t/day	9.2 t/day	13.0 t/day
Telephone Trunk Line		31 lines	43 lines	59 lines	79 lines
19. Rescue and Fire Fighting					
Category	Category 8	Category 8	Category 9	Category 9	Category 9
Fire Vehicles	3	3	3	3	3
Fire Station	approx. 200 m^2	600 m^2	600 m^2	600 m^2	600 m^2
20. Fuel Supply Facility					
Tank Capacity	8,000 kl	3,800 kl	7,800 kl	13,600 kl	21,400 kl
Fuel Farm	approx. 60,000 m^2	10,400 m^2	21,000 m^2	27,000 m^2	33,000 m^2

5.2 RUNWAY, TAXIWAY AND APRON

5.2.1 Aerodrome Reference Code and Operational Requirements

The aerodrome reference code for NBIA should be 4E, in accordance with Annex 14 Aerodrome, ICAO, so as to accommodate B747's. Taking account of on-going discussions related to the New Large Aircraft (NLA) within the world aviation industry, the higher code, so-called code F, should be considered in planning of some facilities in the Southern area, which are very difficult to change in the future, such as the separation distances between runway and taxiway, two taxiways and taxiway centerline to object. The dimensions of the NLA assumed for this Study are as follows:

Wing Span:	80 m
Over-all Length:	80 m
Tail Height:	24 m

The operational category of the runway will be the precision approach Category-II.

5.2.2 Runway

1) Number of Runways

Wind coverage of the existing Runway 11/29 with 20 Kt cross-wind component was 99.89 % (based on the meteorological data in 1993 and 1994, Appendix 5.2.1). Usability factor of the existing runway with precision approach Cat-I for Runway 11 and VOR approach for Runway 29 at 20 Kt cross-wind is estimated to be 99.29 %. ICAO Annex 14 recommends a second (cross-wind) runway where the runway usability factor is less than 95 %. Therefore, a cross wind runway is not required.

The typical capacity of a single runway (with a complete parallel taxiway and ATC radar) under IFR is about 36 movements per hour. A short parallel runway may be justified when the forecast demand becomes greater than 60% of existing runway capacity, that is 22 movements, within five years. A short parallel runway will, therefore, become preferable in the year 2005 based on the above criteria. Furthermore, construction of the second parallel runway can be supported for the following reasons:

a) increased safety of the civil aircraft operations by segregating from the military aircraft operations;

b) increased reliability of air transport services serving the national capital, Hanoi; and

c) easier maintenance of the runway.

The timing of the construction of the second runway should be determined as part of the total airport development planning; therefore, further discussion appears in "Chapter 9 Establishment of Long Term Development Plan" of this report.

2) Runway Dimensions

The required minimum runway lengths for take-off of various types of aircraft at the maximum take-off weight are shown in Table 5.2.1 (see Appendix 5.2.2 for more details):

Table 5.2.1 Required Take-Off Runway Length at Maximum Take-Off Weight

Aircraft Type	Take Off Runway Length
B747-400	3,400 m
B747-200	3,400 m
MD-11	3,300 m
DC-10-40	3,600 m

In order to accommodate most aircraft types at their maximum take-off weight, a runway length of 3,600 m is recommended; however, if a payload restriction of 29%, a limitation of haul within 5,600 km or combination of both are acceptable, the existing 3,200 m long runway is sufficient for operations of B747-200's. This load penalty is not considered not so critical; therefore, the determination of runway length should be made as part of the total airport development planning. Further discussion, therefore, appears in "Chapter 9 Establishment of Long Term Development Plan" of this report.

The width of the runway should be 45 m with 7.5 m shoulders on each side, in accordance with the recommendations by ICAO for the aerodrome reference code E.

5.2.3 Runway Strip and Runway End Safety Area

1) Runway Strip

According to the ICAO standard for the dimensions of a runway strip, the strip for a precision approach runway code number 4 should extend before the threshold and beyond the end of the runway at least for 60 m, and extend laterally at least to 150 m on each side of the centre line of the runway. It is recommended that an object situated on a runway strip which may endanger aircraft should be regarded as an obstacle and should, as far as practicable, be removed. No fixed object, other than visual aids required for air navigation purposes and satisfying the relevant frangibility requirements in Annex 14, shall be permitted on a runway strip within 60 m of the runway centre line.

2) Runway End Safety Area

A runway end safety area should be provided at each end of the runway strip. The runway end safety area should extend from the end of runway strip for as great a distance as practicable, but for at least 90 m. The width of the runway end safety area should be at least twice that of the associated runway (2 x 45 m = 90 m). It is recommended that an object situated within a runway end safety area which may endanger aircraft should be regarded as an obstacle and should, as far as practicable, be removed.

5.2.4 Obstacle Limitation Surfaces

The following obstacle limitation surfaces shall be established, in accordance with ICAO Standards, for a precision approach runway category II:

a) conical surface;
b) inner horizontal surface;
c) approach surface and inner approach surface;
d) transitional surfaces;
e) inner transitional surfaces;
f) balked landing surface; and
g) take-off climb surface.

New objects or extensions of existing objects under these surfaces shall be controlled as stipulated in ICAO Annex 14. It is recommended that existing objects above these surface should, as far as practicable be removed except when an object is shielded by an existing immovable object, or the object would not adversely affect the safety or regularity of aircraft operations.

Dimensions of obstacle limitation surfaces are shown in Figures 5.2.1 and 5.2.2.

5.2.5 Taxiway and Taxiway Strip

A complete parallel taxiway with right angle exits may be economically justifiable when any one of the following criteria is forecast to be reached within five (5) years

a) the number of instrument approaches exceeds four (4) during the peak hour,

b) the annual operation exceeds 50,000, or

c) itinerant operations will exceed twenty (20) during the peak hour.

A holding bay should be planned when the number of operations is forecast to reach thirty (30) during the peak hour, or the annual operation exceeds 75,000.

On the basis of these criteria, a complete parallel taxiway will be required even in year 2000. In year 2015, holding bays will be required, if the second runway is not operational.

Minimum widths of the taxiway and its shoulders should be 23 m and 10.5 m respectively for code letter E. Minimum separation distances between the centre lines of the parallel taxiway and the runway should be 182.5 m (or 190 m) for code letter E (or F). The minimum separation distance between two taxiways should be 80 m (or 99 m). A taxiway strip should extend symmetrically on each side of the taxiway centre line to a distance of 47.5 m (or 59 m).

5.2.6 Apron

The required numbers of aircraft stands are calculated based on the peak hour aircraft movement forecast and assumed turn-around time. Aircraft are classified as shown in Table 5.2.1 for the planning of the aircraft parking apron.

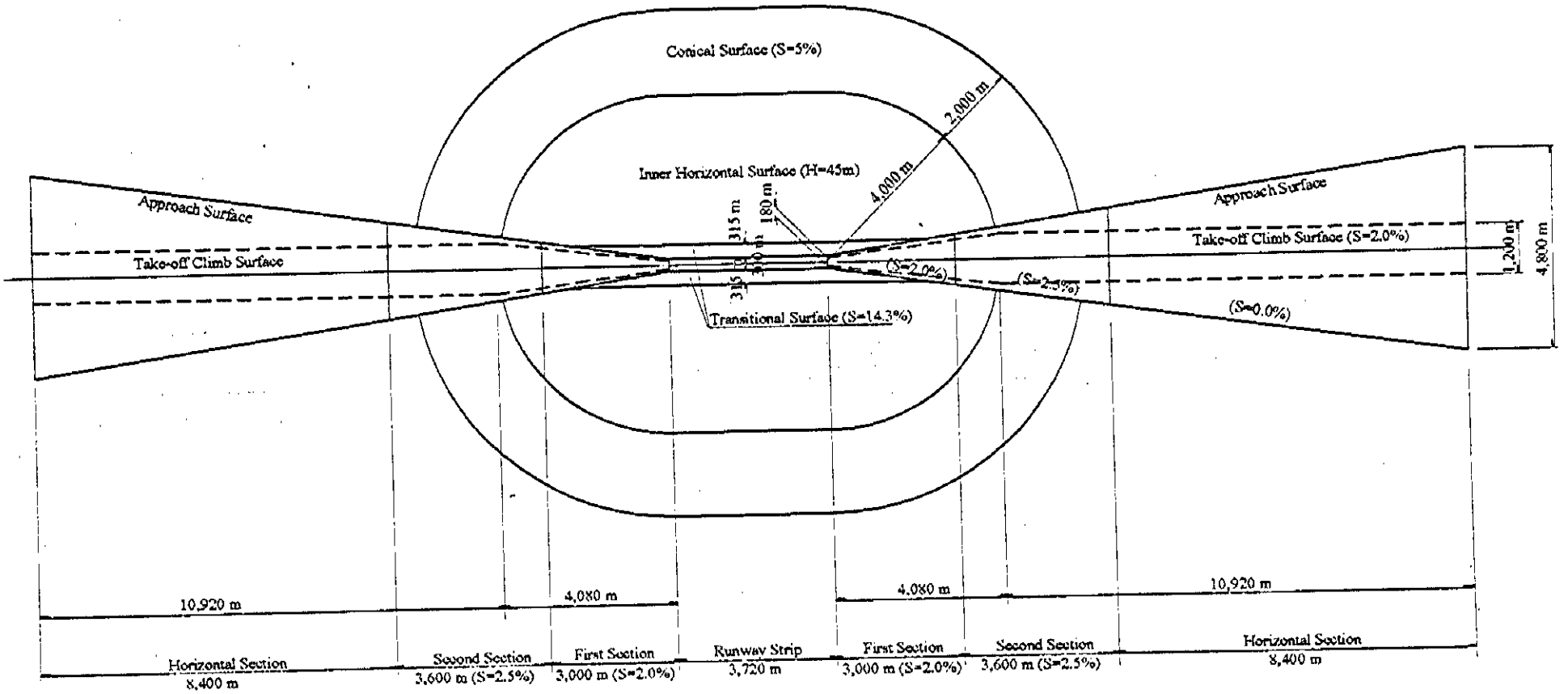

Figure 5.2.1 Obstacle Limitation Surfaces (1)

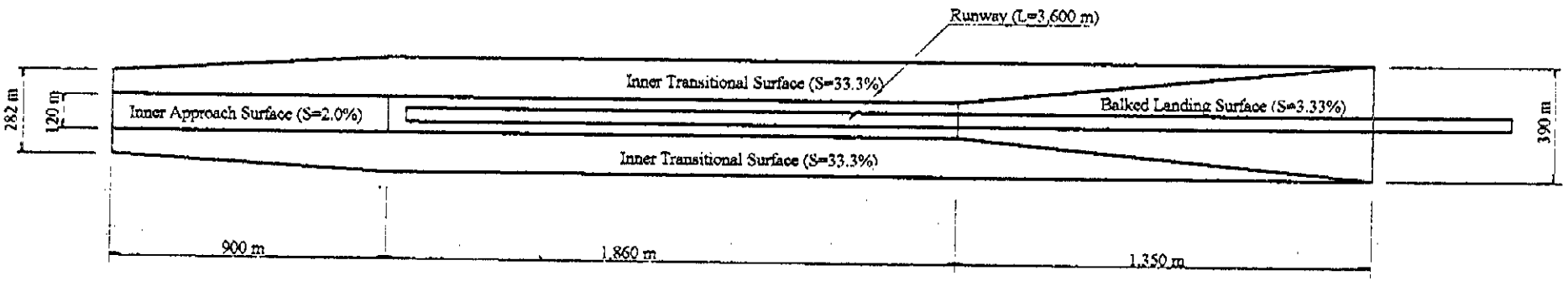

Figure 5.2.2 Obstacle Limitation Surfaces (2)

Table 5.2.1 Aircraft Classification for Aircraft Parking Apron

Class	Aircraft Types	Design Aircraft	Wing Span	Overall Length	Clearance on Apron
NLA	Boeing NLA, A3XX	-	80 m	80 m	7.5 m
JJ	B747, A340	B747-400	64.9 m	70.7 m	7.5 m
LJ	DC-10, L1011, B767-300, A300	DC-10-40	50.4 m	55.4 m	7.5 m
MJ	B767-200, A310	B767-200	47.6 m	48.5 m	7.5 m
SJ	A320, B737	A320	34.1 m	37.6 m	4.5 m
TP	ATR72	ATR72	27.1 m	26.9m	4.5 m

Turnaround times are assumed for planning purpose as shown in Table 5.2.2.

Table 5.2.2 Aircraft Turnaround Time

Class	Domestic	International
JJ	60	105
LJ	60	90
MJ	50	75
SJ	45	60
TP	45	60

Table 5.2.3 summarises the calculation results of required number of stands.

Table 5.2.3 Required Number of Aircraft Stands

	Class	2000	2005	2010	2015
Dom.	JJ	0	2	3	4
	LJ	3	2	3	3
	MJ	0	1	1	2
	SJ	2	1	1	0
	TP	1	1	1	1
	Total	6	7	9	10
Int'l	JJ	2	3	4	5
	LJ	1	1	2	5
	MJ	1	1	1	1
	SJ	2	3	3	2
	TP	1	1	1	1
	Total	7	9	11	14

The minimum clearance between aircraft taxi-lane and object should be 42.5 m (or 51 m) for code E (or F).

5.3 PASSENGER TERMINAL BUILDING AND OTHER BUILDINGS

5.3.1 Passenger Terminal Building

The floor area required for the passenger terminal building was calculated by multiplying the number of peak hour passengers and unit floor area per passenger. Unit floor areas of 15 and 25 sq. m per peak hour passenger were adopted for domestic and international passenger terminals based on common planning practices in Vietnam and Japan. The results of the calculations are shown in Table 5.3.1.

Table 5.3.1 Required Floor Area of Passenger Terminal Building

	2000	2005	2010	2015
Domestic	16,500 m^2	25,200 m^2	35,600 m^2	45,200 m^2
International	23,300 m^2	32,500 m^2	45,800 m^2	62,500 m^2
Total	39,800 m^2	57,700 m^2	81,400 m^2	107,700 m^2

It is worthwhile noting that the total floor area may increase during the actual planning of the building, depending on the policy for provision of concession areas as well as the additional requirements of offices and other spaces within the terminal building.

5.3.2 Cargo Terminal Building

The floor area of the cargo terminal building was estimated based on the annual cargo volume and unit cargo handling capacity. A handling capacity of 10 to 15 ton per sq. m is normally achieved in Japan. For planning of NBIA, 7 ton per sq. m was adopted for international cargo handling assuming a lower mechanization of cargo handling than in Japan. For domestic cargo, 15 ton per sq. m was adopted, because there is no customs control and domestic cargo dwells for shorter periods than international cargo.

Table 5.3.2 Required Floor Area of Cargo Terminal Building

(sq. m)

	2000	2005	2010	2015
Domestic	2,900	4,800	7,800	11,400
International	2,800	6,200	12,300	21,500
Total	5,700	11,000	20,100	32,900

5.3.3 Control Tower, Administration and Operation Buildings

The control tower should be high enough to observe the surface of runway thresholds with an angle of depression not less than 35'. The approximate minimum eye level of controllers will be about 35 m above the runway elevation provided that the location is of the new control tower under construction. Floor area of tower cab should be about 110 sq. m to accommodate controllers for two runways, equipment, staircase, space for equipment replacement in future, etc.

The floor space required for administrative and operational functions will be about 2,800 sq. m as per the current practice at Japanese airports.

5.4 ROAD AND CAR PARK

5.4.1 Access Road

The required number of traffic lanes for the access road is determined by the volume of vehicular traffic. From the traffic survey results (refer to Appendix 5.4.1), unit demand of vehicular traffic (one way) per passenger was estimated to be 0.7 pcu[1] per passenger. It was assumed that the unit demand of vehicular traffic per passenger will remain at the same level in future, based on the following considerations:

a) unit demand in future may increase since more people, who use buses at present, will tend to use small cars due to the increased car ownership in the country; but
b) more convenient public mass transportation will be operated so as to reduce the number of motorcycles and bicycles; and
c) airport limousine bus services will be operated at NBIA.

The volume of vehicular traffic was estimated by multiplying this unit demand and number of air passengers as shown in Table 5.4.1. The number of lanes was estimated based on the following road capacities.

a)	Two lanes for two direction (carriage way width = 7.0m)	2,500 pcu / two direction / hr
b)	Multiple lane road	2,200 pcu / lane / hr

[1] Passenger Car Unit (pcu) : Unit for measurement of various types of vehicle traffic. Large cars, such as trucks and buses, and mortercycles are converted to equivalent number of small cars by the following formula.
pcu = Small Cars x 1.0 + Mortercycles x 0.5 + Large Cars x 2.0

Table 5.4.1 Volume of Traffic and Required Number of Lanes (One Way)

	2000	2005	2010	2015
Number of Traffic (pcu)	1,200	1,800	2,500	3,300
Number of Lanes	1	2	2	2

5.4.2 Car Park

The parking demand for vehicles was estimated based on the number of peak hour passengers (two ways) and unit parking demand per hourly passenger. Unit parking demand per passenger was calculated based on the survey results as follows.

Average Parking Demand / Average Hourly Air Passengers = 0.4 vehicles / pax

A unit space of 35 sq. m was adopted to estimate the required area for the car park. This unit space includes parking lot, driveways and islands within a car park. The results of the calculations are summarized in table 5.4.2.

Table 5.4.2 Number of Parking Lots and Space of Car Park

	2000	2005	2010	2015
Number of Parking Lots				
International	370	520	730	1,000
Domestic	440	670	950	1,200
Total	810	1,190	1,680	2,200
Space of Car Park (m^2)				
International	13,000	18,200	25,600	35,000
Domestic	15,400	23,500	33,300	42,000
Total	28,400	41,700	58,900	77,000

5.5 AIR NAVIGATION SYSTEMS

Modern air navigation systems to international standards, including radio navigation aids, aeronautical ground lighting systems, meteorological observation systems, Air Traffic Control (ATC) and aeronautical telecommunication systems (including power supply systems) should be provided to allow precision approach Category II operations, and to facilitate the safe, orderly and expeditious flow of air traffic in the Noi Bai area. Since the capacity of the existing non-radar approach control under the IFR is about 10 movements per hour, ATC radars are required from the year 2000. The introduction of radars will reduce the minimum longitudinal separation between aircraft from the current 10 minutes for non-radar separation to 3 to 5 NM (approximately 1.5 to 2.5 minutes). This will contribute significantly to increased runway capacity.

The following major equipment and systems are required for the Airport.

Radio Navigation Aids

a) Category II Instrument Landing System (ILS)/Microwave Landing System (MLS) for Runways 11R

b) Category I Instrument Landing System (ILS)/Microwave Landing System (MLS) for Runways 11L

c) VHF Omnidirectional Range (VOR)/Distance Measuring Equipment (DME)

d) Non Directional Beacon (NDB)

e) Navaids Monitoring and Control System

Aeronautical Ground Lights

a) Precision Approach Category II Lighting System (PALS Cat-II) for Runways 11R

b) Precision Approach Category I Lighting System (PALS Cat-I) for Runways 11L

c) Simple Approach Lighting System (SALS) for Runways 29R and 29L

d) Precision Approach Path Indicators (PAPI) for Runways 11L, 29R, 11R and 29L

e) Runway Edge Lights, Runway Threshold and Wing Bar Lights, Runway End Lights, Stopway Lights for both runways

f) Taxiway Edge Lights for all taxiways.

g) Runway Center Line Lights, Runway Touchdown Zone Lights, Taxiway Center Line Lights, Stop Bar Lights Taxi-holding Position Lights for Runway 11R and related taxiways.

h) Aerodrome Beacon, Apron Flood Lights, etc.

i) Aeronautical Ground Light Monitoring and Control System

Meteorological Observation System

a) Transmissometer (Runway Visual Range) and Ceilometer for Runways 11L and 11R

b) Automatic Weather Observation, Data Collecting, Recording and Display System

c) Communication Facilities for Meteorological Services, etc.

ATC and Aeronautical Telecommunication System

a) Priority 1:

VHF Air / Ground Radio Communication Facilities for Aerodrome (Local) Control, Ground Control, and Emergency; UHF Radio Communication Facilities; Intercom for ATC Direct Speech between the tower and Hanoi AACC; ATC Consoles for Local Control, Ground Control,

and Flight Data; Multi Channel Magnetic Tape Recorder; Airport Surveillance Radar (ASR); Secondary Surveillance Radar (SSR); and Precision Approach Radar (PAR).

b) Priority 2:

Automatic Terminal Information Services (ATIS) Facilities; and Automated Radar Terminal System (ARTS); Daylight Radar Display.

c) Priority 3:

VHF Air / Ground Radio Communication Facilities for IFR Clearance Delivery; ATC Console for Clearance Delivery; and Airport Surface Detecting Equipment (ASDE).

5.6 AIRPORT UTILITIES

The demands for airport utilities were estimated based on the average unit demands of airports in Japan shown in Table 5.6.1.

Table 5.6.1 Unit Demands for Utilities

Utilities	Unit Demand	
Electricity	Passenger Terminal Building :	100 VA / m^2
	Cargo Terminal Building :	60 VA / m^2
	Administration Building and Others :	80 VA / m^2
Water / Sewage	Passenger Terminal Building :	0.023 ton / m^2 / day
	Cargo Terminal Building :	0.003 ton / m^2 / day
	Administration Building and Others :	0.010 ton / m^2 / day
Solid Waste	Passenger Terminal Building :	0.072 kg / m^2 / day
	Cargo Terminal Building :	0.144 kg / m^2 / day
	Administration Building and Others :	0.144 kg / m^2 / day
Telephone	Passenger Terminal Building :	0.005 extension / m^2
	Cargo Terminal Building :	0.005 extension / m^2
	Administration Building and Others :	0.025 extension / m^2
	Trunk Line:	1 trunk line / 10 extensions

Electric power requirements for air navigation systems were estimated to be approximately 400 kVA, and included in the total power requirement. Airport utilities should be sufficient for the estimated demand in Table 5.6.2 (estimates do not cover the demands of military area, fuel supply facility, aircraft maintenance area, airport hotel, culture center, staff housing, etc.).

Table 5.6.2 Estimated Demands for Utilities

Item	2000	2005	2010	2015
Electricity (kVA)	5,000	7,100	10,000	13,400
Water (ton/day)	1,000	1,400	2,000	2,500
Sewage (ton/day)	1,000	1,400	2,000	2,500
Solid Waste (ton/day)	4.2	6.2	9.2	13.0
Telephone				
Extension	310	430	590	790
Trunk Line	31	43	59	79

5.7 RESCUE AND FIRE FIGHTING SERVICES

The level of protection for rescue and fire fighting was determined based on the dimensions of the aircraft using the airport, as adjusted for their frequency of operations, in accordance with "Airport Service Manual Part 1 Rescue and Fire Fighting" (ICAO). The aerodrome category for a B747, which is the largest aircraft anticipated for scheduled services, is category 9. Since number of operations of B747 class aircraft will be more than 700 in the busiest consecutive three months after the year 2005, the level of protection for rescue and fire fighting should meet the requirements for aerodrome category 9 after the year 2005. In the year 2000, the minimum level of protection will be category 8. The minimum requirements of categories 8 and 9 are:

-	Airport Category :	9	(8)
-	Extinguishing Agents (Performance Level B)		
	Water for Protein Foam Production :	24,300 litter	(18,200 litter)
	Discharge Rate :	9,000 litter	(7,200 litter)
	Dry Chemical Powder :	450 kg	(450 kg)
-	Fire Fighting Vehicles :	3	(3)
-	Fire Station :	600 sq. m	(600 sq. m)

5.8 OTHER FACILITIES

5.8.1 Aviation Fuel Supply System

Fuel consumption was estimated by multiplying the assumed trip fuel and the number of departing flights for each aircraft type. The required fuel storage capacity was based on the requirement that the airport has a storage capacity sufficient for provided with seven days of consumption. The tank capacity was planned to be 1.25 times that of the storage requirement.

Table 5.8.1 Estimated Weekly Fuel Consumption and Tank Capacity

Years	2000	2005	2010	2015
Weekly Fuel Consumption (kl)	3,000	6,200	10,900	17,100
Tank Capacity (kl)	3,800	7,800	13,600	21,400
Land Area (sq. m)	10,400	21,000	27,000	33,000

The land area required for the fuel storage and supply facilities was based on Japanese experience.