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The Shinkansen Program: Transportation, Railway, Environmental, Regional, and National Issues

Straszak, A.

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CP–81–S2

THE SHINKANSEN PROGRAM

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THE SHINKANSEN PROGRAM

Transportation, Railway, Environmental, Regional, and National Development Issues

A. Straszak, Editor

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
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1981

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Hans Knop and A. Straszak, Editors, *The Bratsk-Ilimsk Territorial Production Complex: A Field Study Report*, RR-78-2, IIASA, Laxenburg, Austria, May 1978.

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Andrzej Straszak, Editor, *The Shinkansen Program: Transportation, Railway, Environmental, Regional, and National Development Issues*, CP-81-S2, IIASA, Laxenburg, Austria, 1981.

Y. Sawaragi and A. Straszak, Editors, *The Kinki Integrated Regional Development Program:* Status Report and Proceedings of a IIASA Workshop, June 1978, CP-81-S5, IIASA, Laxenburg, Austria, 1981.

PREFACE

During the period 1974-1979, multidisciplinary teams of scientists from the International Institute for Applied Systems Analysis (IIASA) examined four large-scale development programs: the Tennessee Valley Authority, a regional development program launched in 1934 by the government of the United States of America; the Bratsk-Ilimsk Territorial Production Complex, a regional development program launched in 1952 by the government of the USSR; the Shinkansen Program in Japan, which began in 1969; and the Kinki Integrated Regional Development Program, on which research work began in Japan in 1973. The first two of these studies have already been reported on [for the TVA study, see Knop (1976), and Knop (1979), and for the BITPC study, see Knop (1977) and Knop and Straszak (1978)]; and the extensive factual basis for the Shinkansen study has also been published [see Straszak and Tuch 1980)].

This volume discusses the issues that arose in the study of the Shinkansen Program in transportation, railway, environmental, regional, and national development. A final volume in this series on the work in the Kinki region of Japan is in preparation.

The investigation of the Shinkansen Program was supported and assisted by The Japan Committee for IIASA; the IIASA team is particularly grateful to Professors H. Arisawa, K. Miyasawa, and Y. Suzuki, Doctor S. Tamura, and A. Yamada. The extensive cooperation of the Japanese National Railways made the study possible; Dr. M. Nishida and the personnel of the JNR staff was especially appreciated.

The Shinkansen study used an approach developed within IIASA for the TVA and Bratsk-Ilimsk case studies, together with the approach elaborated by David Fischer (USA) and used by him in studies dealing with Canadian arctic and North Sea oil development. The initial procedure of analysis, originated by Hans Knop (GDR) was then combined with extensions proposed by other participating scholars, so that an overall approach evolved, whose implementation was made possible through formation of an interdisciplinary East-West team of researchers at IIASA.

The field study team consisted of these persons:

Professor A. Straszak (Poland)
Professor H. Knop (GDR)
Professor D. Fischer (USA)
Professor M. Albegov (USSR)
Dr. S. Ikeda (Japan)
Dr. D. von Winterfeldt (FRG)
Professor A. van Bilderbeeck (Netherlands)
Professor C. Law (Canada)
Mr. J. Harmon (USA Department of Transportation)
Mr. J. Owsinski (Poland)
Mr. R. Tuch (USA)

Professor H. Strobel (GDR) and Dr. R. Genser (Austria) joined the study group in preparing this volume. They had visited Japan earlier and played a key role in the conference with which the work began.

A. Straszak

CONTENTS

PART I

THE APPROACH

1. GENERAL INTRODUCTION

How to plan, manage, and organize large-scale development programs is a complex question that many governments, local authorities, and corporations face. It includes technological, economic, societal, and environmental aspects.

Retrospective case studies can play an important role in improving and transferring the understanding of the main issues of planning, management, organization, and impacts of large-scale development programs, and IIASA has conducted three of them: on the Tennessee Valley Authority, started in 1934; on the Bratsk-Ilimsk Territorial Production Complex, started in 1952 in the USSR; and on the Shinkansen Program, begun in Japan in 1969. The first two are large-scale regional development programs based on utilizing water and energy to attract industry; the third is a *large scale inter-regional development program based on utilizing a new technology to distribute industry through the entire country.*

All three programs are the products of the national development planning and were initiated directly or indirectly by national leaders. All of them have had some pre-history: scientists and experts worked out some preliminary aspects long before political, economic, and technical forces made organizational breakthroughs to establish them. None of them is completed. The first one likely to reach its final stage is the BITPC, while the Shinkansen Program will reach its first major stage of development not earlier than 1982 - five years after the previous schedule. Nevertheless, all of them have already contributed significantly to world development. Moreover, the billions of dollars invested in these programs have already been returned to the respective national economies.

IIASA large-scale development case studies follow an intensive multistage procedure proposed by Professor Hans Knop from the Economic University in Berlin during his leadership of management studies at IIASA (1974-76):

(1) Preliminary studies of candidate programs.

(2) Negotiations with selected IIASA National Member Organizations on the general feasibility of specific case studies.

(3) Preparation by NMO and IIASA of a format for presenting the case study at a IIASA conference, including papers by leading experts and scientists involved in the program and discussion papers prepared by IIASA scientists.

(4) A conference at IIASA including additional invited experts and scientists from NMO countries.

(5) Publication of the conference proceedings.

(6) Negotiations with the NMOs concerning the format and feasibility of a field study.

(7) Field study by IIASA, NMO, and other invited scientists and experts.

(8) Preparation of the field-study report.

(9) A status report meeting at IIASA to present the major findings.

(10) Publication of the field-study report.

Thus, the product of each case study consists of two publications: the conference proceedings, and the field-study report. While they are published separately, to obtain a comprehensive picture of each case study, they must be considered together.

2. MAIN FEATURES OF THE SHINKANSEN PROGRAM

While the Shinkansen Program may be considered to be an extension of the very successful Tokaido Shinkansen Project originated by the Japanese National Railways in 1956, it began formally in 1969, when the New Comprehensive National Development Plan stated:

> Thus with advanced information and a rapid transportation system with a higher degree of efficiency, we can expect that all of Japan, extending 2000 kilometers from north to south, will be integrated into a single unit [as shown in Figure 2.1].
>
> The new network will be established by combining the integrated central management functions which have been established already, fully utilizing data communication systems, jet airplanes, new high-speed trunk-line railway systems, highways, high-speed container ships, and other high-speed, high-efficiency distribution techniques, thus expanding development potential throughout the country. Specifically, the new network will be established by connecting the capital, Tokyo, with Sapporo, Sendai, Nagoya, Osaka, Hiroshima, and Fukuoka in a big agglomeration of central management functions with each other and then further connecting the network with regional hub cities to exert its effects throughout Japan through sub-networks in the primary living zone of each of these cities.

When, on 18 May 1970, Law number 71, the "Law for Construction of Nation-Wide High-Speed Railways" was adopted by the Diet, Article 1 of the law described the purpose of the Shinkansen Program:

> In view of the importance of the role played by a high-speed transportation system for the comprehensive and extensive development of the land, this Law shall be aimed at the construction of a nation-wide high-speed railway network for the purpose of promoting the growth of the national economy and the enlargement of the people's sphere of life.

Article 2 defined the term "high-speed railways":

> The term "high-speed railways" herein shall mean the trunk line railway, on the principal sections of which, operation of trains at high speeds over 200 km/h is possible.

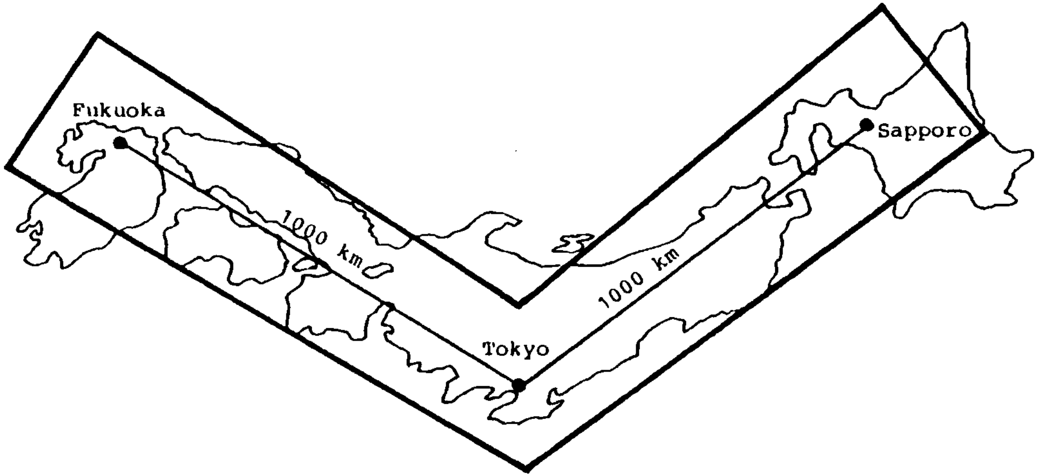


Figure 2.1 SCHEMATIC CONCEPTION OF THE SHINKANSEN PROGRAM

Article 3 supported the concept of a nation-wide network, which had been proposed by the new ten-year plan (see the Appendix to this chapter).

The Law designated the Minister of Transport as the person responsible for realizing the Shinkansen Program (see Figure 2.2 and Articles 5-10), and defined the roles of the Japanese Railways (JNR) and the Japan Railway Construction Corporation (JRCC), as well as punitive measures for violating the Law (Articles 16-18).

After the Law for the Construction of Nation-Wide High-Speed Railways was enacted, both the Tokaido Shinkansen and the Sanyo Shinkansen (the Shinkansen section between Osaka and Hakata, on which construction started before the enactment of the Law) were included in the Shinkansen network. The organizations involved in the decision-making process for the Sanyo Shinkansen are presented in Figure 2.3. Table 2.1 gives the main technical details of the Tokaido and the Sanyo Shinkansen lines. Table 1 in the Appendix gives the chronology of the New Tokaido Line. The successful completion of the Tokaido Shinkansen on October 1, 1964 was due to the President of the JNR, Mr. Sogo, as well as to Mr. Sima, the Chief Engineer of the JNR, and the Tokaido Shinkansen Task Force headed by Mr. Ohishu (former Director of the JNR Hokkaido region), including Mr. T. Endo, Mr. Y. Miyasawa, and others. The construction of the Sanyo Shinkansen was completed using the normal departmental structure of the JNR head office.

After the law for the construction of nation-wide Shinkansen lines, a new department called the Network Planning Department of the JNR was established; however, in 1977 this department was reorganized and became the Planning Division in the Shinkansen Construction Department of the JNR head office (see Chart 5.1).

The crucial issues of the Shinkansen Program are the geographical configurations of the network, as well as the total length of the network. Table 2.2 shows existing alternatives and Figures 2.4 and 2.5 give their network configurations.

The Basic Economic and Social Plan, proposed by the Economic Planning Agency and the Economic Council in 1972-71 and approved by the government in February 1973 as one of the targets to be reached, stated:

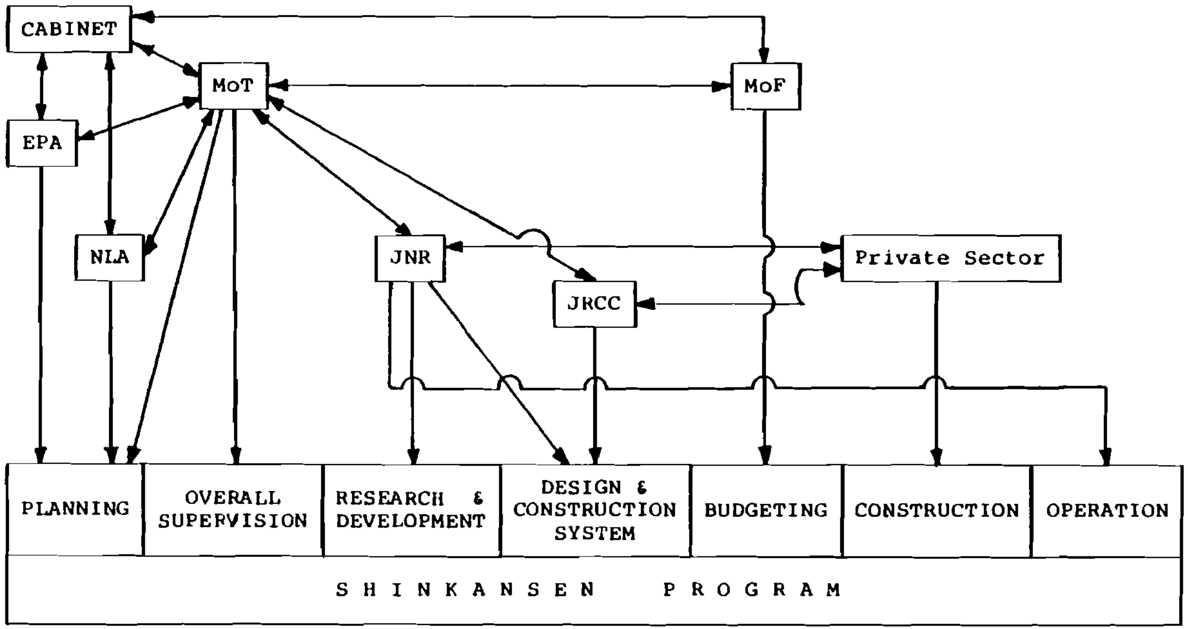


Figure 2.2 MULTILAYER AND MULTILEVEL STRUCTURE OF THE SHINKANSEN PROGRAM

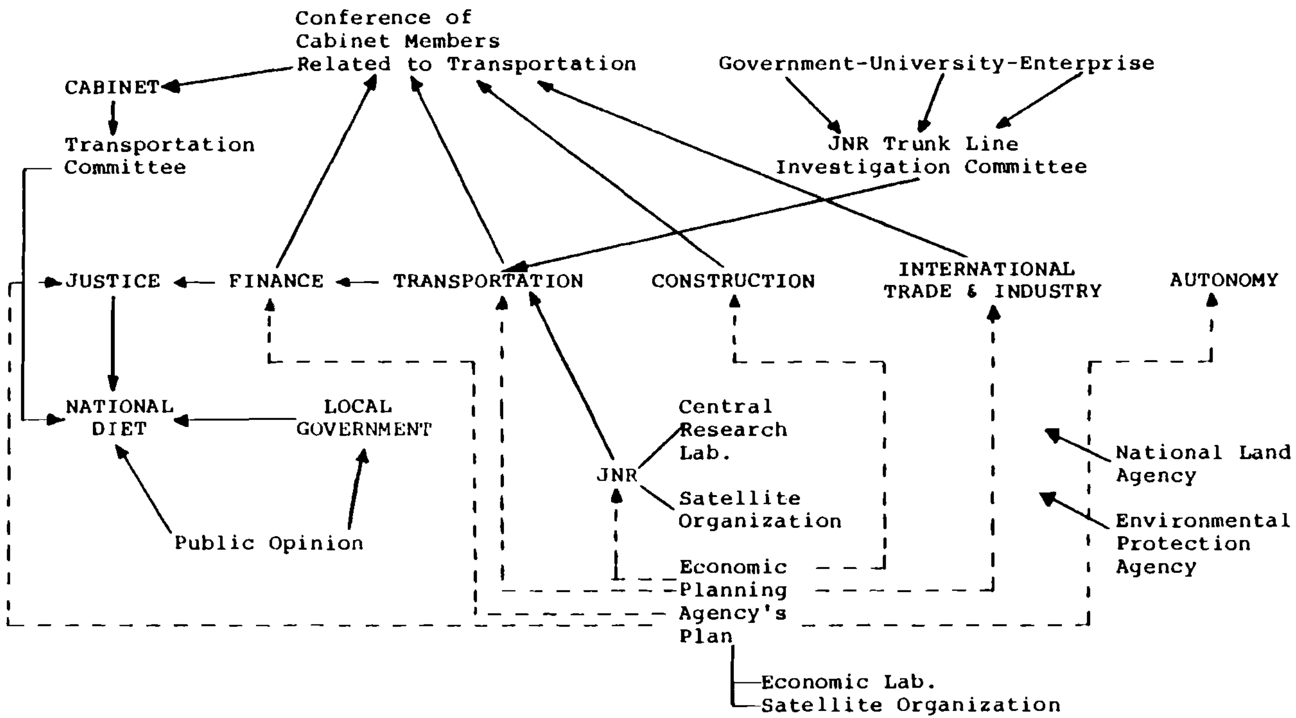


Figure 2.3 ORGANIZATIONS INVOLVED IN THE DECISION MAKING PROCESS FOR THE SANYO NEW TRUNK RAILWAY

Source: Y. Suzuki

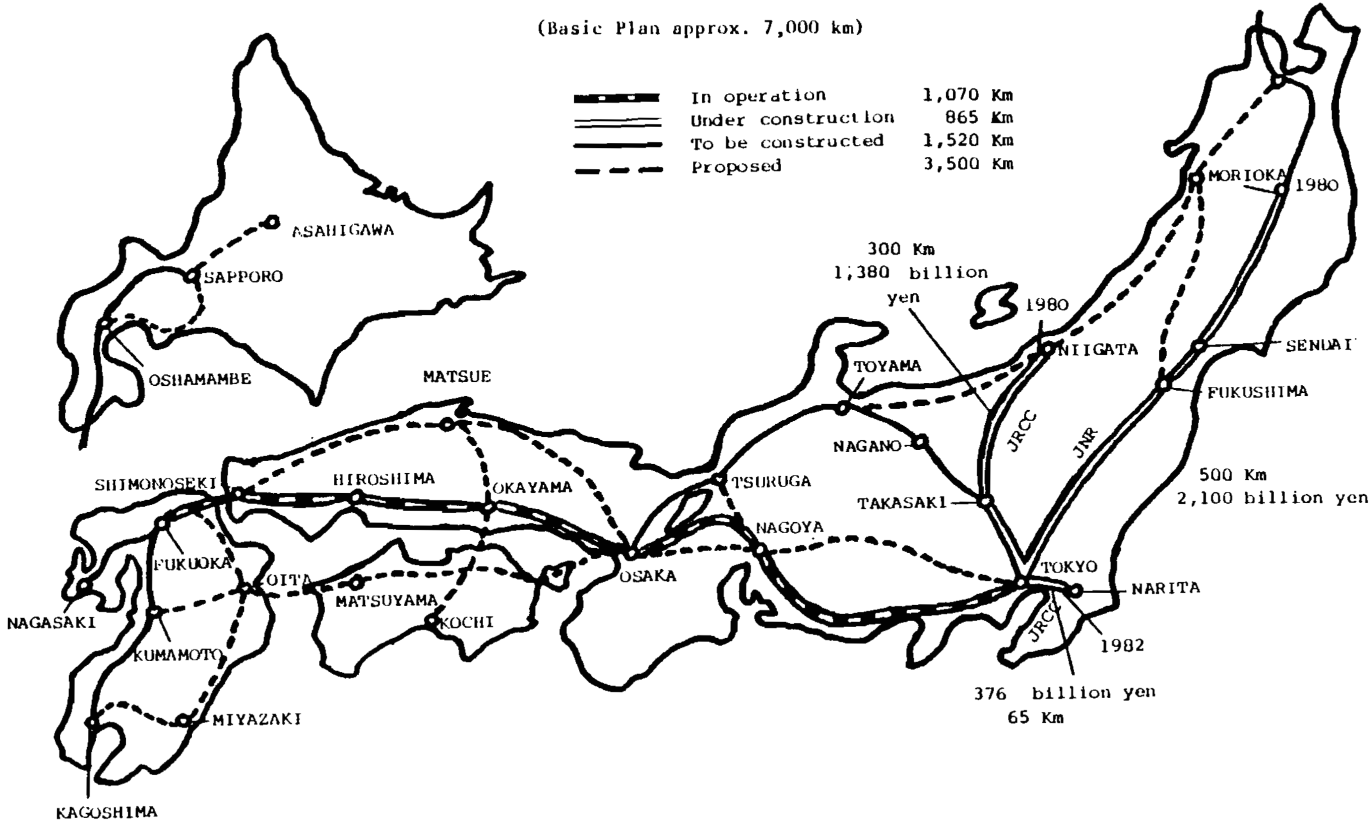
Table 2.1 Main Features of Shinkansen

ITEM	TOKYO - SHIN-OSAKA	SHIN-OSAKA - HAKATA
Route Length	515.4 km	553.6 km
Time Required	3 hr. 10 min.	3 hr. 42 min.
Maximum Speed	210 km/h	210 km/h
Scheduled Speed ..	162.8 km/h	149.6 km/h
Gauge	1,435 mm	1,435 mm
Grade	Max. 20/1,000	Max. 15/1,000
Curve radius	Min. 2,500 m	Min. 4,000 m
Rail	53.3 kg/m	60.8 kg/m
	1,500 m long welded rails	1,500 m long welded rails
Time control	ATC (Automatic Train Control)	
	CTC (Centralized Traffic Control)	
	COMTRAC (Computer aided Traffic Control)	
Power system	AC 25 kV 60 Hz, single phase CSC (Centralized Substation Control)	
	Booster-transformer feeding system	Auto-transformer feeding system
Construction period	5½ years	5 years (Shin-Osaka - Okayama)
		5 years (Okayama - Hakata)
Construction cost (millions of yen)	380,000	224,000 (Shin-Osaka - Okayama)
		718,000 (Okayama - Hakata)
Opening date	Oct. 1, 1964	Mar. 15, 1972 (Shin-Osaka - Okayama)
		Mar. 10, 1975 (Okayama - Hakata)

Source: JNR Facts and Figures 1976

Table 2.2 Shinkansen Alternatives

TOTAL LENGTH km	CONFIGURATION	OPENED OR SHOULD BE OPEN		SOURCES	REMARKS
		PROPOSED	REVISED		
515	Tokyo - Osaka	Oct. 1964	-		Completed. Figure 2.4
1,070	Tokyo - Hakata	Mar. 1975	-		Completed. Figure 2.4
1,935	Tokyo-Hakata Tokyo-Morioka Tokyo-Niigata	1977	1981	EPA, JNR MITI	Figure 2.4
3,500	Tokyo-Kagoshima, Nagasaki Tokyo-Sapporo Tokyo-Toyama-Osaka	1979	Unknown	JNR, MITI	Figure 2.4
7,000	Kyushu, Shikoku Honshu, Hokkaido	1985	Unknown	EPA, JNR MITI	Figure 2.4
9,000		Unknown			Liberal Democratic Party's Plan, Figure 2.5
4,000		Unknown		Newspapers	Debut in Japan October 1977



Source: MOT

Figure 2.4 SHINKANSEN ALTERNATIVES

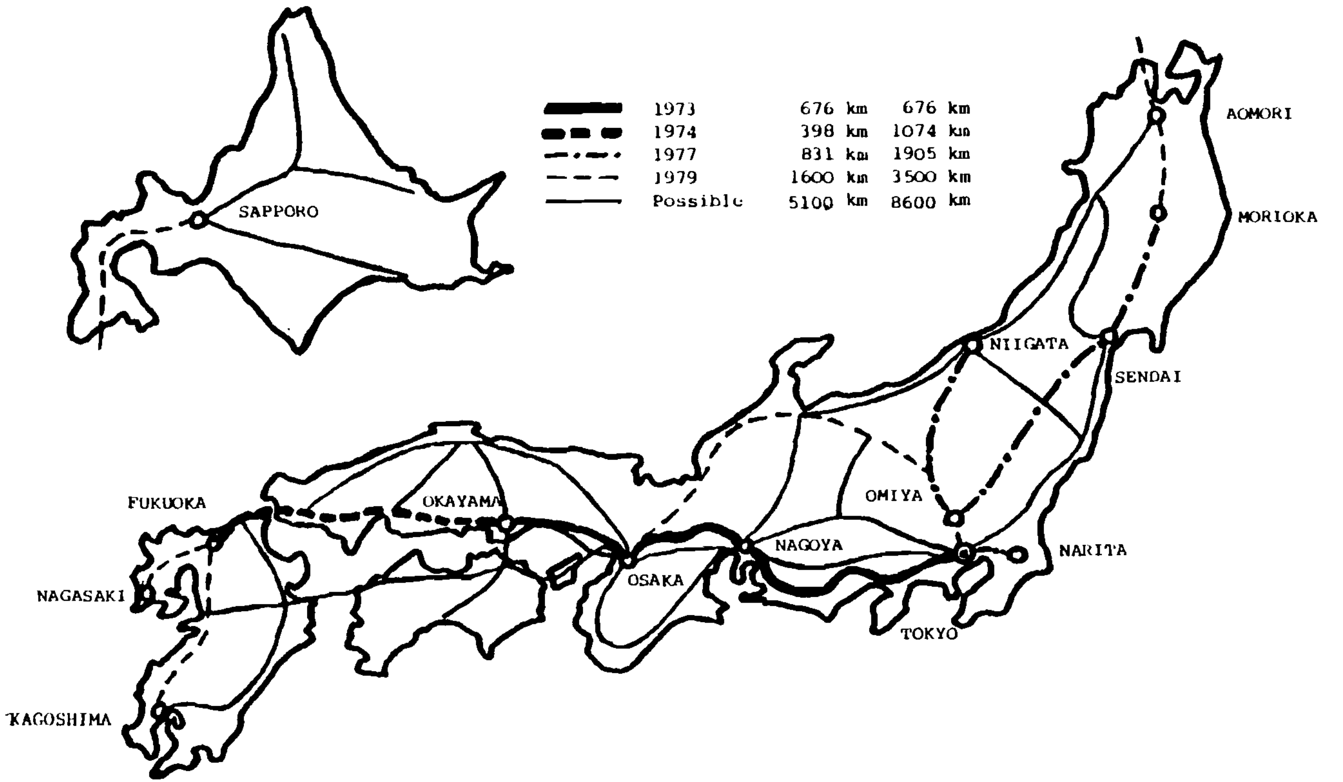


Figure 2.5 CONSTRUCTION OF TRACKS FOR NEW SUPER-EXPRESS TRAINS

Source: MITI, June 1970

> Regarding super-express railways (Shinkansen), with the aim of completing some 7000 km by FY 1985, it is intended to open the Tohoku, Narita and Joetsu Lines during the period of this plan (1973-77) and than make 1900 km available for use including lines currently in operation.

The procedure for considering any Shinkansen Line is shown in Figure 2.6.

At the moment, two long Shinkansen Lines are under construction [the Tohoku Line (500 km) between Tokyo and Morioka and the Joetsu Line (300 km) between Tokyo and Niigata] and one short line [(65 km) Tokyo and Narita]. The decision to construct these lines was made by the Ministry of Transport in 1971.

In November 1973 it was decided that five additional Shinkansen lines should be constructed: an extension of the Tohoku Line to Aomori (179 km); the Hokkaido Line (370 km) from Aomori to Sapporo; the Hokuriku Line (590 km) from Takasaki via Toyama to Osaka; and two Kyushu lines, one from Hakata to Nagasaki (120 km), and one from Hakata to Kagoshima (270 km).

Table 2.3 shows the expected construction costs of these lines as well as those of the Tokaido and Sanyo lines. Figure 2.7 shows the configuration of these lines and Figure 2.8 the traffic anticipated by the JNR.

In April 1977 the Cabinet discussed the situation of the Shinkansen network:

> The Government recently decided to start this year a full fledged survey into various aspects of the planned construction of five new Japanese National Railway (JNR) Shinkansen super-express lines including an environmental impact assessment.
>
> The decision made at the day's meeting of Cabinet Ministers concerned is taken to mean the first step toward the lifting of the three-year-old "freeze" on the five costly Shinkansen projects.
>
> The Shinkansen projects have been "on the shelf" since the 1973 oil crisis due to the Government's tight financial situation. The construction of the five new Shinkansen lines is estimated to cost the Government about ¥5.5 trillion.

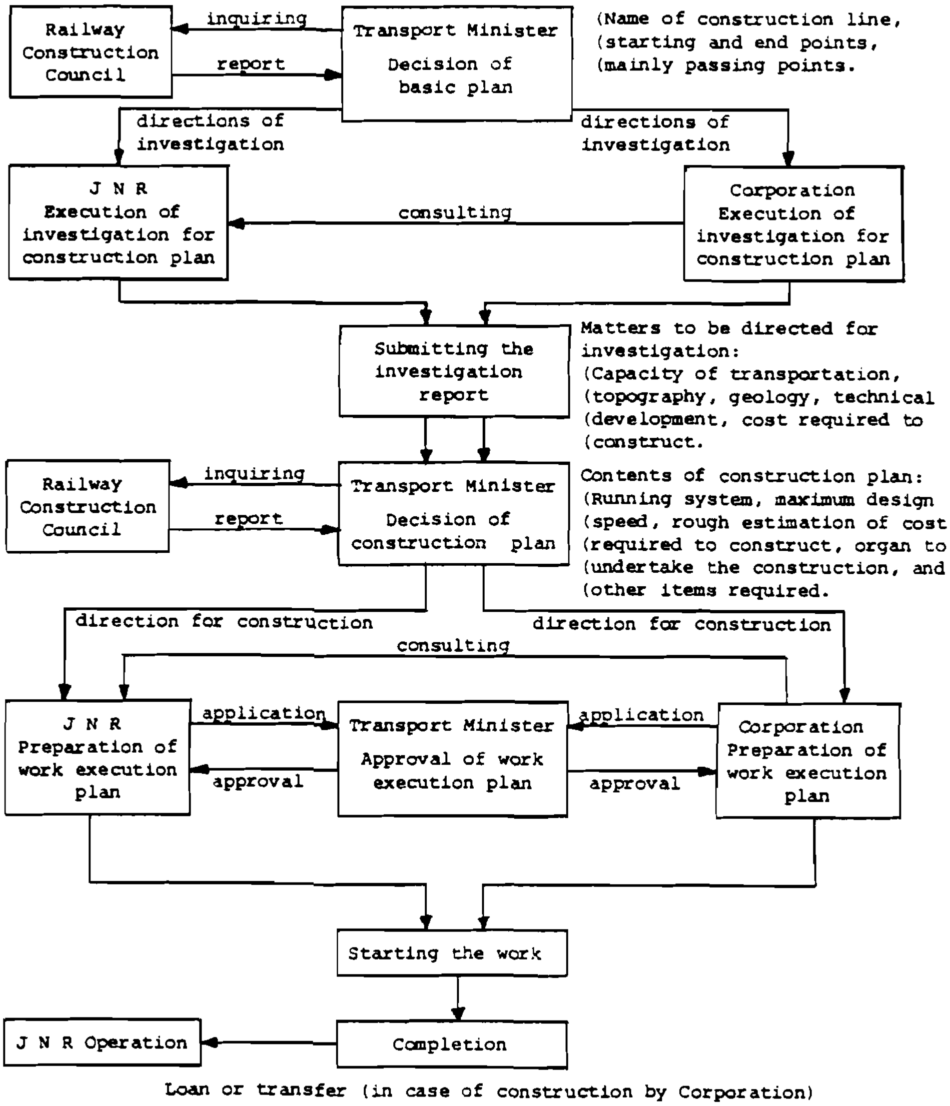


Figure 2.6 FLOW CHART OF THE PROCEDURE OF NATION-WIDE HIGH-SPEED RAILWAY PROJECT

Table 2.3 Shinkansen Construction Program — Source: JNR

LINE	SECTION	ROUTE LENGTH (km)	CONSTRUCTION COST (excl. rolling stock expense) ¥ hundred mil.	DECISION OF CONSTRUCTION PLAN	AUTHORIZATION OF CONSTRUCTION WORKS	REMARK
Under construction						
Tohoku	Tokyo - Morioka	500	21,000	Apr. 1 1971	Oct. 14 1971	Construction cost as of 1976
Joetsu	Tokyo - Niigata	300	13,800	"	(Omiya - Niigata) Oct. 14 1971	
Narita	Tokyo - Narita	65	3,760	"	Feb. 10 1972	
Subtotal		865	38,560			
Planned						
Tohoku	Morioka - Aomori	abt. 170	abt. 5,950	Nov. 13 1973		
Hokkaido	Aomori - Sapporo	abt. 370	abt. 12,950	"		
Hokuriku	Takasaki - Osaka	abt. 590	abt. 20,650	"		
Kyushu	Fukuoka - Kagoshima	abt. 270	abt. 9,450	"		
Kyushu	Fukuoka - Nagasaki	abt. 120	abt. 4,200	"		
Subtotal		abt. 1,520	abt. 53,200			

(For Reference)

LINE	SECTION	ROUTE LENGTH km	CONSTRUCTION COST ¥ hundred mil.		AUTHORIZATION OF ADDITIONAL TRACKING
In service					
Tokaido	Tokyo - Shinosaka	515	3,800		Apr. 13 1959
Sanyo	Shinosaka Okayama	160	2,300		Sep. 9 1965
Sanyo	Okayama - Hakata	395	7,200		Sep. 12 1969
Subtotal		1,070	13,300		

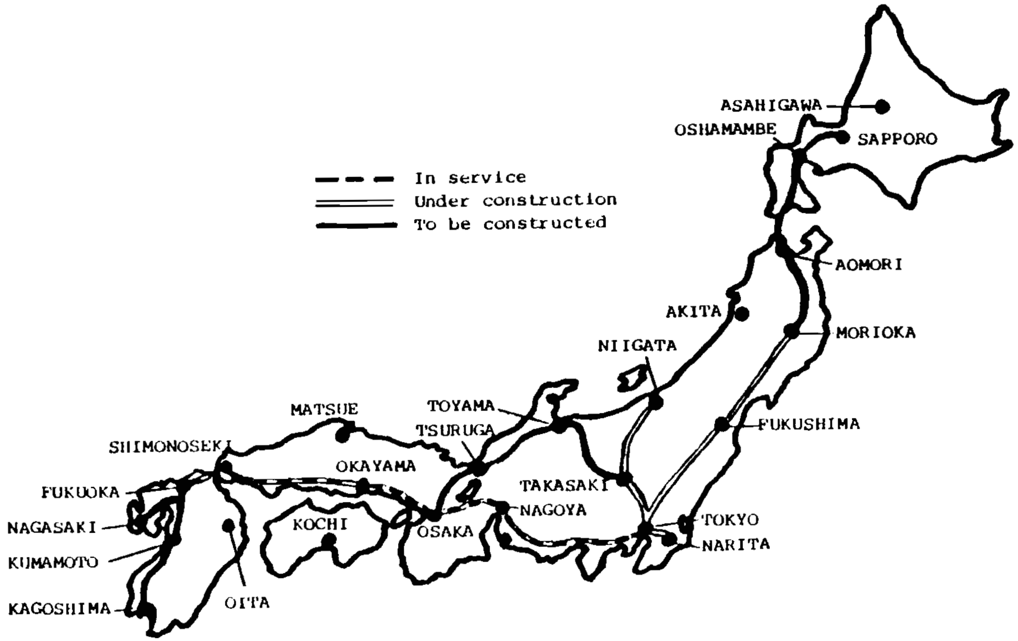


Figure 2.7 NATION-WIDE SHINKANSEN NETWORK

Source: JNR

Lines:	Tokaido (Tokyo - Shin Osaka)	Sanyo (Shin-Osaka - Hakata)	Tohoku (Tokyo - Morioka)	Joetsu (Tokyo - Niigata)	Tohoku (Morioka - Aomori)	Hokkaido (Aomori - Sapporo)	Hokuriku (Takasaki - Osaka)	Kyushu (Hakata - Kagoshima)	Nagasaki (Hakata - Nagasaki)
Route Length (km):	515	555	500	300	170	370	590	270	120
Construction cost (¥ hundred mil./Km):	7	17	42	46	about 35				

Figure 2.8 SHINKANSEN TRAFFIC (AVERAGE SECTIONAL TRAFFIC) AND CONSTRUCTION COST PER KM

The five Shinkansen lines in question are the Hokkaido Line from Aomori to Sapporo, the Tohoku Line from Morioka to Aomori, the Hokuriku Line from Takasaki to Osaka via Toyama, the Kyushu Line from Hakata to Kagoshima and the Nagasaki Line from Hakata to Nagasaki. Their total length is 1,520 kilometers.

The Government decision to start the survey of the five projects followed pressure by the ruling Liberal-Democratic Party (LDP), which is willing to meet the expectation of local residents toward the opening of bullet train services in the face of the House of Councillors' election set for this summer.

The LDP also hopes that the projects will be an effective incentive for the reactivation of the stagnant economy.

Leaders of both the Government and the LDP also took into special consideration the Nagasaki Prefectural Government's demand for the early opening of the Nagasaki Shinkansen Line in exchange for its planned acceptance of Japan's first nuclear-powered merchant vessel, the Mutsu, at Sasebo Port in the prefecture.

After the special Cabinet session, Chief Cabinet Secretary, Sunao Sonoda told reporters that the Government would appropriate ¥10 billion out of this year's fiscal budget for the survey of the Shinkansen projects. However, he said that it was still uncertain when the construction works would be launched.

Transport Minister, Hajime Tamura told the press that the results of the environmental impact assessment should be published to win public consent for the projects.

The day's Cabinet decision came as a rebuff to the Transport Ministry, which is taking a negative stance on the lifting of the "freeze" on the Shinkansen projects, according to sources at the Ministry.

This is because, the sources said, the JNR will have to operate the new Shinkansen lines at a deficit for a considerable period after their opening and this will worsen the financial position of the deficit-ridden JNR.

It is expected that a few years will be required to complete the environmental impact assessment of the Shinkansen projects, thereby delaying the start of the construction works, the sources added.

Under the Cabinet headed by Tanaka, advocate of the now defunct grand design to "remodel the Japanese Archipelago", it was decided to construct the five Shinkansen lines in question as well as an additional 12 lines with the target of extending the total length of Shinkansen lines to 7000 kilometers.

> But the Arab oil embargo in the fall of 1973 hit hardest Japan's economy and the policy makers were forced to shift the economic policies from those of a high-pitched growth to a stable one.
>
> Naturally, the Shinkansen projects were affected largely and no steps have been taken as to the promotion of the five Shinkansen projects.
>
> Currently, the construction of the Tohoku (from Tokyo to Morioka) and Joetsu (from Tokyo to Niigata) Shinkansen lines is under way.
>
> But the construction works for the two lines has been much delayed due to the financial strain, although both lines were originally expected to be opened this year.*

The government draft of the fiscal 1978 budget contains the decision made in December 1977 to increase funds for the new JNR Shinkansen lines (Table 2.4).

The IIASA field study team has been informed by representatives of the Ministry of Transport that the Joetsu and Tohoku Shinkansen lines should be completed in 1980; however, the JNR 1976 brochure stated:

> Decided for construction under the law are three Shinkansen lines: the Tohoku (Tokyo-Morioka), the Joetsu (Tokyo-Niigata) and the Narita (Tokyo-Narita Airport). The construction of these three lines is under way, mainly on the tunnels and long bridges at the present. The lines are expected to be completed at the earliest in 1981.

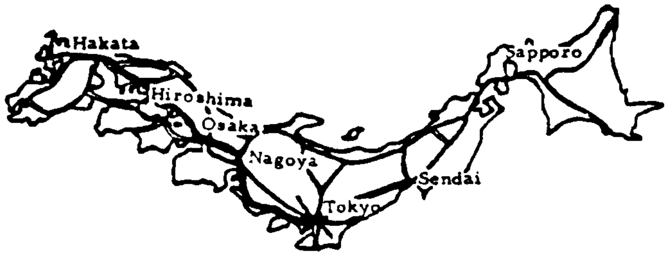
Of course complications concerned with this line will depend on the fiscal 1979 and 1980 budgets, due to the procedure of the Shinkansen Program's annual budget system as well as to other governmental programs; moreover, some societal problems should first be solved (see Chapters 6 and 7). The shrinking of the Japanese Islands in terms of time due to the Shinkansen Program is shown in Figure 2.9.

Table 2.4

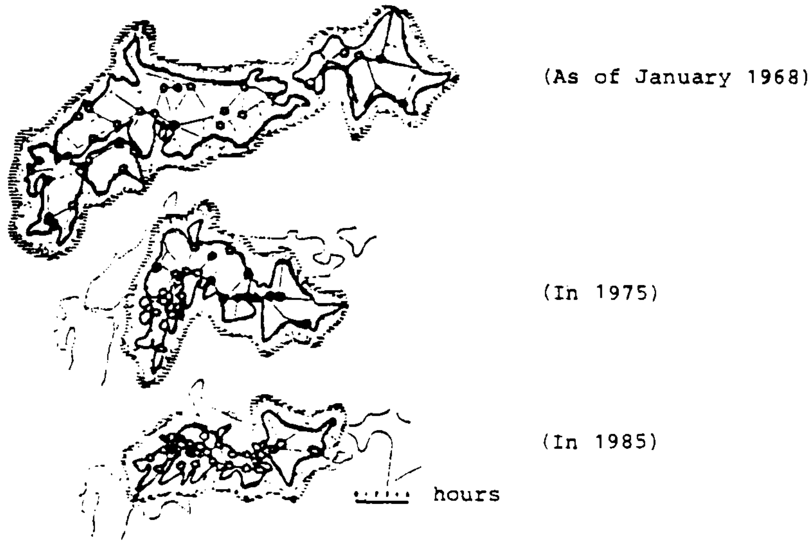
JNR SHINKANSEN LINES	FISCAL 1977	FISCAL 1978
Tohoku	¥260,000 million	¥340,000 million
Joetsu	¥165,000 million	¥215,000 million
Narita	¥ 10,000 million	¥ 10,000 million

* The Japan Times Weekly, April 27, 1977, p. 10.

The Nation-Wide High-Speed Railway Network as Planned



Source: JNR, 1971



Source: JNR, 1971

Figure 2.9 THE SHRINKING OF THE JAPANESE ISLANDS IN TERMS OF TIME

(Tokyo as the starting point)

APPENDIX

LAW FOR THE CONSTRUCTION OF NATION-WIDE HIGH-SPEED RAILWAYS

(Law No. 71, 18 May 1970)

Purpose - Article 1

In view of the importance of the role played by a high-speed transportation system for the comprehensive and extensive development of the land, this Law shall be aimed at the construction of a nation-wide high-speed railway network for the purpose of promoting the growth of the national economy and the enlargement of the people's sphere of life.

Definition - Article 2

The term "high-speed railways" herein shall mean the trunk line railways, on the principal sections of which, operation of trains at high speeds over 200 km/h is possible.

Routes of High-Speed Railways - Article 3

The routes of the High-Speed Railways shall be such as will be suited to forming a nation-wide trunk network and link nucleus cities of the nation in a most systematic and efficient way, so that the purpose given in Article 1 will be attained.

Construction and Operation of High-Speed Railways - Article 4

The construction of the High-Speed Railways shall be undertaken by the Japanese National Railways or the Japan Railway Construction Corporation, and the operation thereof, by the Japanese National Railways.

Basic Plan - Article 5

Taking into consideration the trends of transport demand on railways, the emphasized direction of land development and other matters for the effective implementation of the construction of the High-Speed Railways, the Minister of Transport shall, pursuant to the provisions to be set forth by Government Ordinance, decide upon a basic plan specifying the routes of High-Speed Railways, on which construction is to be started (hereinafter referred to as the "construction lines"). (This basic plan is hereinafter referred to as the "basic plan".)

2. The Minister of Transport, in deciding upon the basic plan pursuant to the provision of the preceding Paragraph, shall beforehand inquire the Railway Construction Council. The same shall apply when making changes in the basic plan.

3. The Minister of Transport, when he decides on the basic plan pursuant to Paragraph 1, shall make it public without delay. The same shall apply when making changes in the plan.

Instructions for Investigation on Construction Lines - Article 6

The Minister of Transport, when the basic plan is decided upon as prescribed in the preceding Article, shall instruct the Japanese National Railways or the Japan Railway Construction Corporation to conduct investigations necessary in constructing construction lines. The same shall apply when making changes in the basic plan.

Construction Plan - Article 7

Pursuant to the provisions to be set forth by Government Ordinance, the Minister of Transport shall decide upon a construction plan for the construction of construction lines provided in the basic plan (hereinafter referred to as the "construction plan").

2. The provision of Paragraph 2, Article 5 shall be applied mutatis mutandis when the construction plan is to be decided upon or amended.

Instructions for Construction of Construction Lines - Article 8

The Minister of Transport, when the construction plan is decided upon pursuant to the provision of the preceding Article, shall instruct the Japanese National Railways or the Japan Railway

Construction Corporation to undertake the construction of the construction lines in accordance with the construction plan. The same shall apply when making changes in the construction plan.

Work Execution Plan - Article 9

The Japanese National Railways or the Japan Railway Construction Corporation, in undertaking the construction of the construction lines under the instructions prescribed in the preceding Article, shall draw up, based on the construction plan, a work execution plan for the construction lines, indicating the name of the lines, sections to be constructed, work methods to be employed and other matters to be stipulated by Ministry of Transport Ordinance and submit it to the Minister of Transport for approval. The same shall apply when making changes in the work execution plan.

2. The work execution plan under the preceding Paragraph shall be accompanied by drawings indicating the location of the line and other documents to be stipulated by Ministry of Transport Ordinance.

3. The Japan Railway Construction Corporation shall beforehand consult the Japanese National Railways when it draws up or modifies a work execution plan prescribed in Paragraph 1.

4. The Japan Railway Construction Corporation, on receiving the approval prescribed in Paragraph 1, shall submit documents relevant to the work execution plan to the Japanese National Railways.

Designation of Acts Restricted Areas and Cancellation thereof - Article 10

The Minister of Transport may specify areas and designate the same as acts restricted areas when he deems that the restriction of the acts prescribed in Paragraph 1, Article 11 are necessary for the smooth execution of the construction of High-Speed Railways on the land prescribed by Government Ordinance and needed for the construction of High-Speed Railways approved pursuant to Paragraph 1 of the preceding Article.

2. The Minister of Transport, in designating acts restricted areas as provided in the preceding Paragraph, shall beforehand ask the opinion of the Japanese National Railways or the Japan Railway Construction Corporation (hereinafter referred to as the "executor of construction").

3. The Minister of Transport, when he deems it necessary in designating acts restricted areas pursuant to Paragraph 1, may require the executor of construction to submit necessary data.

4. The Minister of Transport, in designating acts restricted areas pursuant to Paragraph 1, shall make public the said acts restricted areas pursuant to the provisions to be set forth by Ministry of Transport Ordinance, and in addition, present the drawing thereof to public inspection.

5. The Minister of Transport, upon completion of construction work on High-Speed Railways in the acts restricted areas designated under the provision of Paragraph 1, shall promptly cancel the designation of the acts restricted areas and make public the cancellation pursuant to the provisions to be set forth by Ministry of Transport Ordinance; the same shall apply when he deems it no longer necessary to keep the area restricted of acts before the construction work is completed.

6. The provisions of Paragraph 2 shall be applied mutatis mutandis when cancelling the designation of acts restricted areas pursuant to the provision of the preceding Paragraph.

<u>Acts Restricted - Article 11</u>

In the acts restricted areas, designated pursuant to the provision of Paragraph 1 of the preceding Article, no one shall change the form and the constitution of land, or build, reconstruct or add any structure therein; provided that an exception may be made for the acts performed as emergency measures necessitated by an extraordinary disaster or other acts to be prescribed by Government Ordinance.

2. In case a person suffers a loss from the restriction of acts under the provision of the preceding Paragraph, the executor

of construction shall compensate for the loss the said person would normally incur.

3. The compensation for the loss referred to in the preceding Paragraph shall be negotiated between the executor of construction and the person sustaining the loss.

4. When no conclusion is reached in the negotiation referred to in the preceding Paragraph, the executor of construction or the person sustaining the loss may, in accordance with the provisions to be set forth by Government Ordinance, apply to the Land Expropriation Committee for arbitration provided for under Article 94 of the Land Expropriation Law (Law No. 219 of 1951).

Entry into or Temporary Use of Land Belonging to Other Persons - Article 12

The Japanese National Railways or the Japan Railway Construction Corporation, or a person commissioned thereby, may, when necessity compels in performing investigation, survey or work for the construction of High-Speed Railways, enter the land possessed by other persons or temporarily use the land of other persons when no special use is made of the said land, as a yard for placement of materials or as a work place, within the limit of necessity.

2. Those entering the land possessed by other persons by virtue of the provision of the preceding Paragraph shall beforehand notify the occupant to that effect; provided that this shall not apply in cases where it is difficult to give prior notice.

3. In case a person intends to enter the land possessed by other persons pursuant to the provision of Paragraph 1, where there is a building standing or a fence or a railing put up around, the person entering the land shall, in entering, notify the possessor of the said land to that effect beforehand.

4. No one shall enter the land prescribed in the preceding Paragraph before sunrise or after sunset without permission by the possessor of the land.

5. Those entering the land possessed by other persons pursuant to the provision of Paragraph 1 shall carry with them an

identification certificate and show it when requested by a person concerned.

6. Those intending to temporarily use as a yard for placement of materials or as a work place, the land beloning to other persons and not in use, pursuant to the provision in Paragraph 1, shall give the occupant and the owner of the land prior notice and ask their opinions.

7. The occupant or the owner of the land shall not, unless he has a just reason, refuse or obstruct the entry into or the temporary use of the land provided in Paragraph 1.

8. The provisions of Paragraph 1 through 4 of the preceding Article shall be applied mutatis mutandis, in regard to the compensation for a loss sustained by a person from the entry into or temporary use of land prescribed in Paragraph 1.

9. The form and other matters of the identification certificate provided in Paragraph 5 shall be decided by Ministry of Transport Ordinance.

Financial Measures and Others - Article 13

In view of the importance of the role to be played by High-Speed Railways in the comprehensive and extensive development of the land, in the growth of national economy and in the improvement of the people's life, and in view of the urgent need for construction of High-Speed Railways, the State shall arrange for the provision of aid for the funds needed for the construction thereof and take other necessary measures.

2. In view of the importance of the role which High-Speed Railways are to play in the development and progress of the localities and in the improvement of the life of the inhabitants thereof, local public bodies shall endeavor to take necessary measures with respect to financial aid needed for the construction of High-Speed Railways and lend their good offices for the acquisition of the land needed for the construction thereof.

Exception to Application of the Japanese National Railway Law - Article 14

[Omitted.]

Delegation of Power to Ministry of Transport Ordinance - Article 15

[Omitted.]

Punitive Provisions - Article 16

Any person falling under any of the following items shall be punished with a fine not exceeding 100,000 yen:

(1) A person who violates the provision of Paragraph 1, Article 11.

(2) A person who violates the provision of Paragraph 7, Article 12.

Article 17

When the representative of a juridical person, or a proxy, any of the employees, including servants, of a juridical person or a person, commits an offense of the preceding Article in connection with the business of the juridical person or the person, not only the actual offender but also the juridical person or the person concerned shall be punished with fine prescribed in the same Article.

Article 18

In case the Japanese National Railways or the Japan Railway Construction Corporation fails to seek approval in violation of the provision of Paragraph 1, Article 9, the officer of the Japanese National Railways or of the Japan Railway Construction Corporation having committed the offense shall be punished with a fine not exceeding 100,000 yen.

Table 1: CHRONOLOGY OF THE NEW TOKAIDO LINE

DATE	ITEM
May 10 1956	Investigation Committee for Enhancement of Traffic Capacity of Tokaido Line was established in the Head Office.
Aug 30 1957	Japanese National Railways Trunk Line Investigation Committee was established in the Ministry of Transportation by Cabinet decision.
Sep 11 1957	The first meeting of the said Committee was called.
Apr 8 1958	The New Tokaido Line Construction Standards Investigation Committee was organized in the Head Office.
Jul 7 1958	JNR Trunk Line Investigation Committee submitted its final report to the Transportation Ministry emphasizing the necessity of constructing a new line along the Tokaido route.
Aug 21 1958	The New Tokaido Line Investigation Office started aerial photographic survey.
Feb 17 1959	The New Tokaido Line Construction Standards Investigation Committee submitted an intermediate report to the President of JNR.
Mar 31 1959	Appropriation was made for the New Tokaido Line in the 1959 budget.
Apr 13 1959	The Transportation Minister approved construction of the New Tokaido Line. (A.C. electric traction was approved.)
Apr 18 1959	New Tokaido Line Construction Division was established at Tokyo.
Apr 20 1959	The ground breaking ceremony was held at the site of east portal of Tanna tunnel.
Nov 17 1959	The construction if nine intermediate stations (later revised to 10) on the New Tokaido Line was approved by the Transportation Minister.
Dec 16 1959	New Tokaido Line Construction Divisions were established at Shizuoka, Nagoya and Osaka.
Jan 27 1960	The sites of the terminal stations "Tokyo" and "Osaka" were approved by the Transportation Minister.
Feb 7-10 1960	Current collection in high speed operation was tested with continuous mesh catenary on the Tohoku Line.
Mar 14-17 1960	Performance of six-position automatic train control equipment was tested on the old Tokaido Line.

Apr 11 1960	New Tokaido Line General Department was set up in the Head Office organization.
May 5 1960	A mission from the International Bank for Reconstruction and Development came to Japan. They stayed in Japan for about one month, investigating economic and technical problems concerning the New Tokaido Line.
May 12 1960	Amendments to JNR Construction Regulation was approved by the Transportation Minister in connection with the New Tokaido Line.
May 19-26 1960	Current collection test of the continuous mesh catenary was carried out in the presence of the mission from the International Bank for Reconstruction and Development on the Tohoku Line (160 km/h).
Jun 20-25 1950	Performance test of electronic centralized traffic control system was carried out on the Tohoku Line.
Nov 13-22 1960	The current collection in high speed operation was tested with normal compound catenary, modified Y type compound catenary and composite type compound catenary system on the old Tokaido Line (175 km/h).
Nov 14-16 1960	Service test of test-manufactured pantograph was carried out by using catenary testing car on the old Tokaido Line.
Feb - Mar 1961	Wind velocity test at embankments.
May 1 1961	Contract for a loan of 80 million dollars was executed at Washington between JNR and the International Bank for Reconstruction and Development.
Jun 27-Jul 1 1961	Test on prevention of inductive interference to signalling and telecommunication.
Aug 3 1961	Principal items of construction standards of the New Tokaido Line were decided.
" " "	Adoption of Industrial frequency, 60 cps, was decided for the New Tokaido Line.
Sep 15 1961	Specifications for prototype electric car were laid down.
Sep 19-17 1961	Overall test of automatic train control equipment on the Hokuriku Line.
Oct 11-13 1961	Current collection of compound composite catenary in high speed operation was tested under various conditions on the Tohoku Line.
Oct 18 1961	The final route location was decided.
Nov 8 1961	Orders were given to five rolling stock manufacturers for prototype electric railcars.

Nov 13-Dec 12 1961	Electric wave propagation test for train radio telephone between Tokyo and Osaka.
Jan 26-27 1962	The anti-skid equipment test was carried out by the diesel railcar "KIHA 60" on the Narita Line.
Mar 1 1962	Standard Specifications and Designs for Construction of Electric Installations were established.
Mar 15 1962	Electric and track laying works started.
Jun 21 1962	Humamatsu workshop was chosen for workshop in charge of repair of rolling stock of the New Tokaido Line.
June 23 1962	Test-run section of the New Tokaido Line was partially completed and put into use for tests.
Jul 4 1962	High-speed track inspection car was completed and put into operation on the test-run section.
Jul 15-16 1962	The prototype train ran at 110 km/h.
Sep 20 1962	New Tanna tunnel bored through.
Oct 30 1962	The prototype train recorded 200 km/h.
Nov 11-13 1962	Overall test at the speed of 200 km/h by the prototype train.
Jan 14 1963	Airtightness test with prototype train.
Feb 28-Mar 1 1963	High speed test in respect of vibration, pressure, deformation and strain of embankment; stress and deflection of bridge; vibration of pier; vibration of hard rock ground; and train wind pressure and wind velocity along track and in tunnel.
Mar 11 1963	Test on passing each other of trains running at 200 km/h.
Mar 23 1963	JNR made a contract with the New Tokaido Line Electric Car Manufacturer's Union to manufacture 180 electric cars for commercial service.
Mar 30 1963	The prototype train ran at 256 km/h.
Apr 11 1963	UN ECAFE Study Week on the New Tokaido Line was begun.
May 21 1963	Total budget for construction of the New Tokaido Line was revised because of rise in land purchase price and compensation expense, and so on.
Jul 14-26 1963	Human engineering test for the crew of high speed train.
Aug 5 1963	Decision was made on construction of large-sized diesel locomotive for rescue service in case of emergency.

Oct 25 1963	UIC ORE party made test ride on the test run section.
Apr 1 1964	New Tokaido Line Regional Office was established to make preparation for opening of service.
Apr 28 1964	Test run began on the section between Maibara and Torigai.
Jul 1 1964	Rail laying was completed.
Jul 25 1964	Test run began on the whole line between Tokyo and Shin-Osaka.
Aug 15 1964	CSC and CTC equipments installed.
Aug 24 1964	Test run successfully made: five hours between Tokyo and Shin-Osaka.
Aug 25 1964	Test run successfully made: four hours between Tokyo and Shin-Osaka.
Oct 1 1964	The New Tokaido Line begins its commercial service.

3. THE FRAMEWORK OF ANALYSIS

This study assesses the Shinkansen Program as an example of large-scale development projects. The Second Comprehensive National Development Plan for Japan stated that:

> Large-scale development projects are construction projects to give impetus to regional development using new techniques and to encourage effective use of the national land.

The Shinkansen Program is an example of national development management of part of the national socio-economic system.

The forming of large-scale development programs is a new comprehensive and integrative tool for development. The State Plan of Electrification of Russia (GOELRO) in the Soviet Union, which began more than 50 years ago, and the TVA in the USA, which started more than 40 years ago, can be considered the first examples of large-scale development programs. However, widespread development of such programs occurred only 10-15 years ago as a result of recent economic and technological achievements and complexities. [1,2,5,6,7,9,11,12,14,15,18,20]

Large-scale development programs are becoming a universal tool in development processes in many developed as well as developing countries, and in centrally planned as well as market economies. Large-scale development programs are used at national, regional and sectoral levels by countries with different socio-economic systems as well as with different experience in management.

The past few years have shown that the question of how to manage and control development processes at almost all levels in socioeconomic societies (national, regional or sectoral) is not a trivial one.

Unfortunately, the accumulation of knowledge in the field of management and the ability to control development, especially the application of large-scale development programs, is still rather limited. [3,4,6,8,13,19]

Therefore, retrospective case studies of large-scale development programs are important, especially when interdisciplinary and international dimensions are also taken into consideration. It is too early to propose a holistic or fully systemic approach to studying such a complex system as a large-scale development program. Nevertheless, an analytic framework can be used for the analysis and evaluation of existing programs, as well as for the formation of new ones.

The analytic framework we used for the Shinkansen Program is shown in Figure 3.1.

The assessment is based mainly on an analysis of a societal process which leads to the definition of the program's issues. The process is seen as going through three modes: debate, policy, generation, and decision making. The development program, defined by the societal process, going through the three above modes, shapes finally the eco-techno-economic system, which is the object of the program's performance.

Any large-scale development program is imbedded in the socio-economic system, as is shown in Figure 3.2.

In the case of the Shinkansen Program, is is sufficient to consider the following as subsystems of the eco-techno-economic system: the national transport system, the national railway system, the national environmental system, the nation-wide regional system, and the national economic system (Figure 3.3). Each subsystem's analysis has the same general format (Table 3.1) and each subsystem has its own dynamic description and actor role involved, as well as in inter-relation matrix analysis.

Inter-relation analysis between issues, actors, and program phases (Figure 3.4) gives us an opportunity to specify the main advantages and disadvantages of the program, the main advocates and opponents, as well as the possible future of the program. The important part of the program analysis is that it also surveys the application of models for some subsystems, as well as for a whole program.

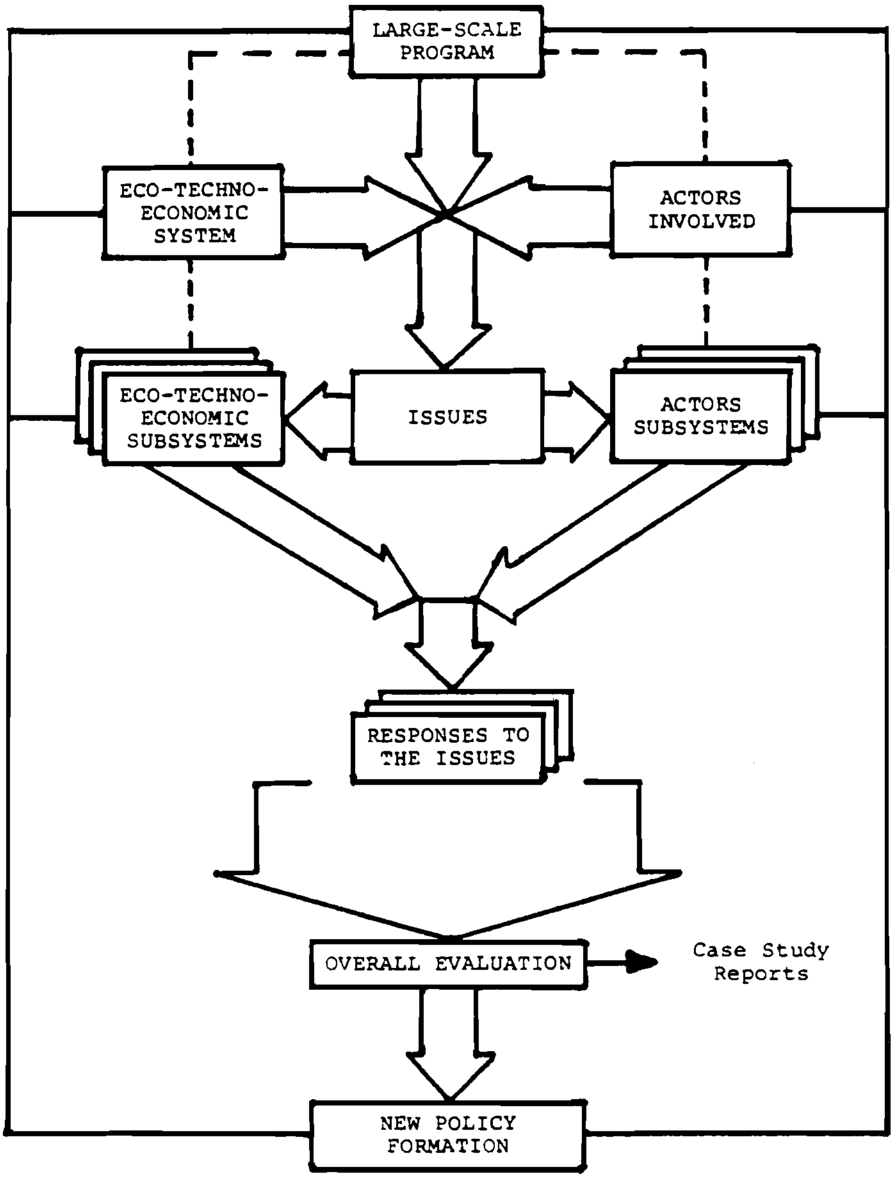


Figure 3.1 FRAMEWORK OF ANALYSIS FOR LARGE-SCALE PROGRAMS

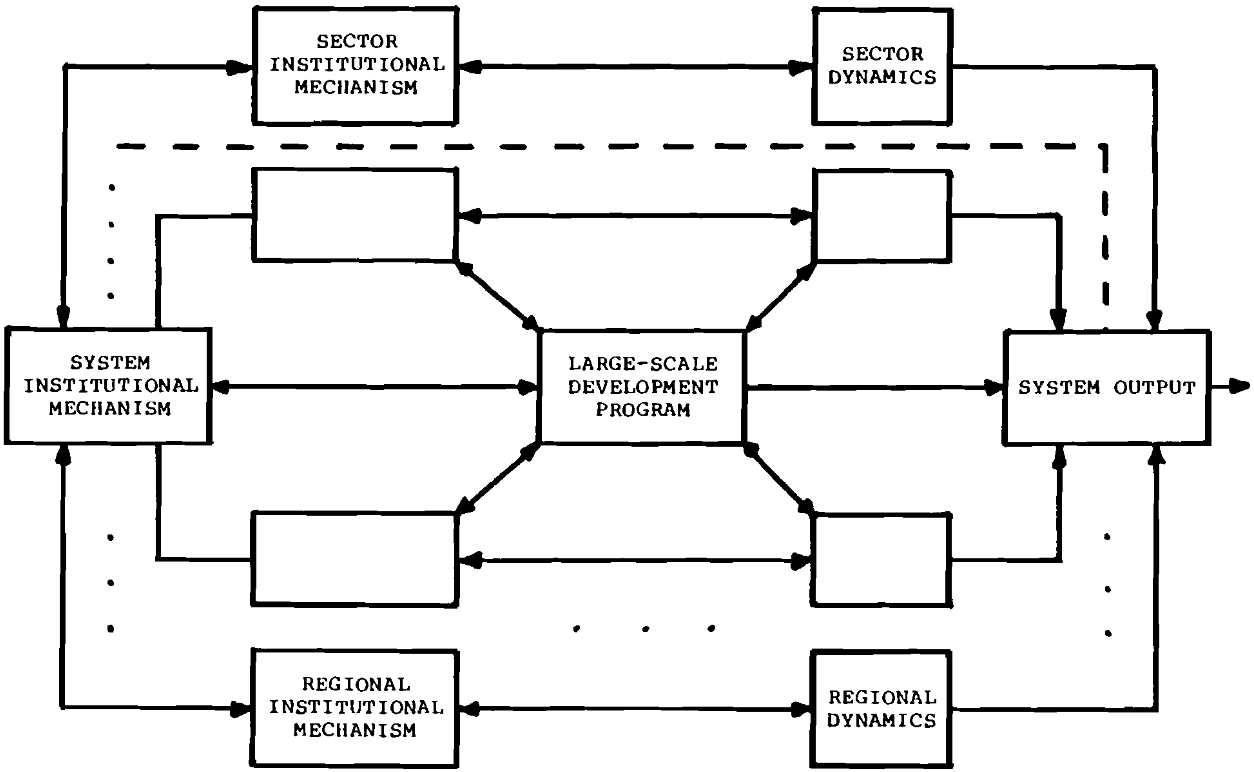


Figure 3.2 <u>SIMPLIFIED STRUCTURE OF THE SOCIO-ECONOMIC SYSTEM</u>

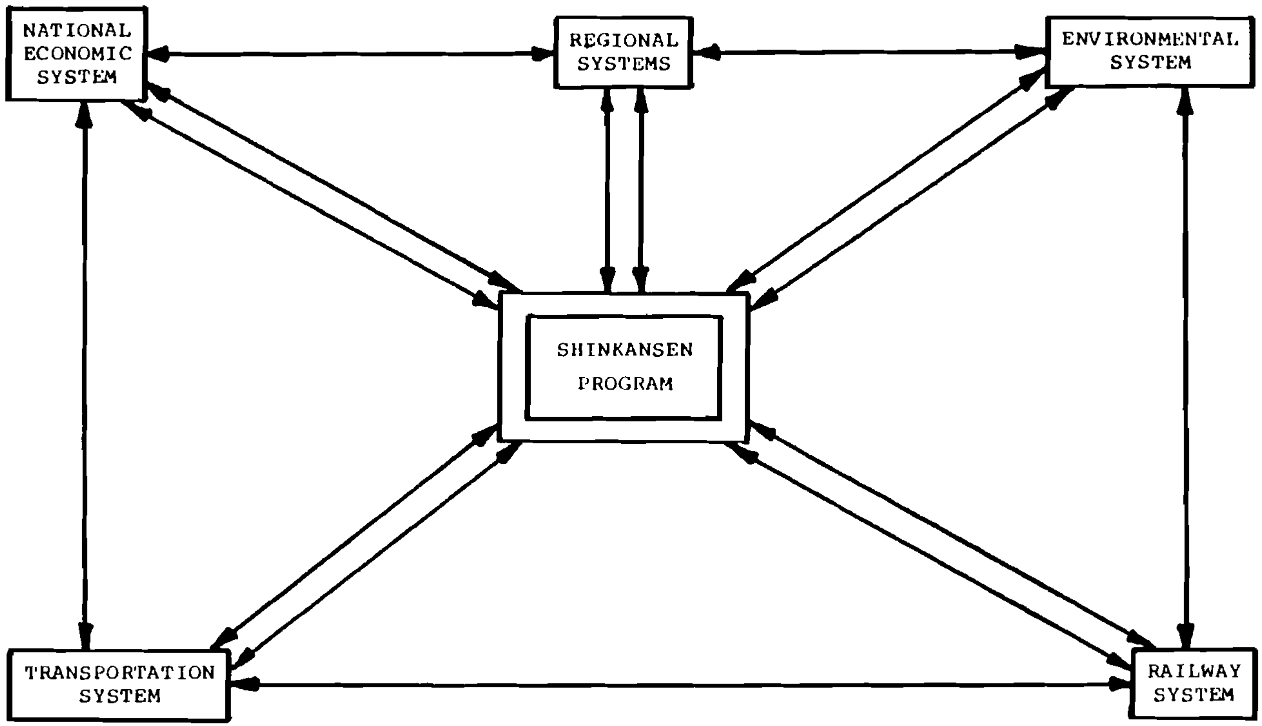


Figure 3.3 SHINKANSEN PROGRAM AND ITS MAIN SUBSYSTEMS

Table 3.1 FORMAT OF SUBSYSTEM ANALYSIS: THE SHINKANSEN AND SUBSYSTEM ISSUES

1. Main features of the subsystem in Japan:

   1.1 The situation prior to the construction of the Tokaido Shinkansen;

   1.2 The situation after the Tokaido Shinkansen was built;

   1.3 The present situation.

2. Main actors involved in the subsystem development:

   2.1 National government;

   2.2 Public corporation;

   2.3 Private sector of the economy;

   2.4 Local government;

   2.5 Citizens.

3. Main issues:

   1 Issue 1

   2 Issue 2

   3 Issue 3

   4 Issue 4

   5 Issue 5

4. Inter-relations.

5. Conclusions.

Appendix 1: Application of models, computer and systems analysis.

Appendix 2: Additional data.

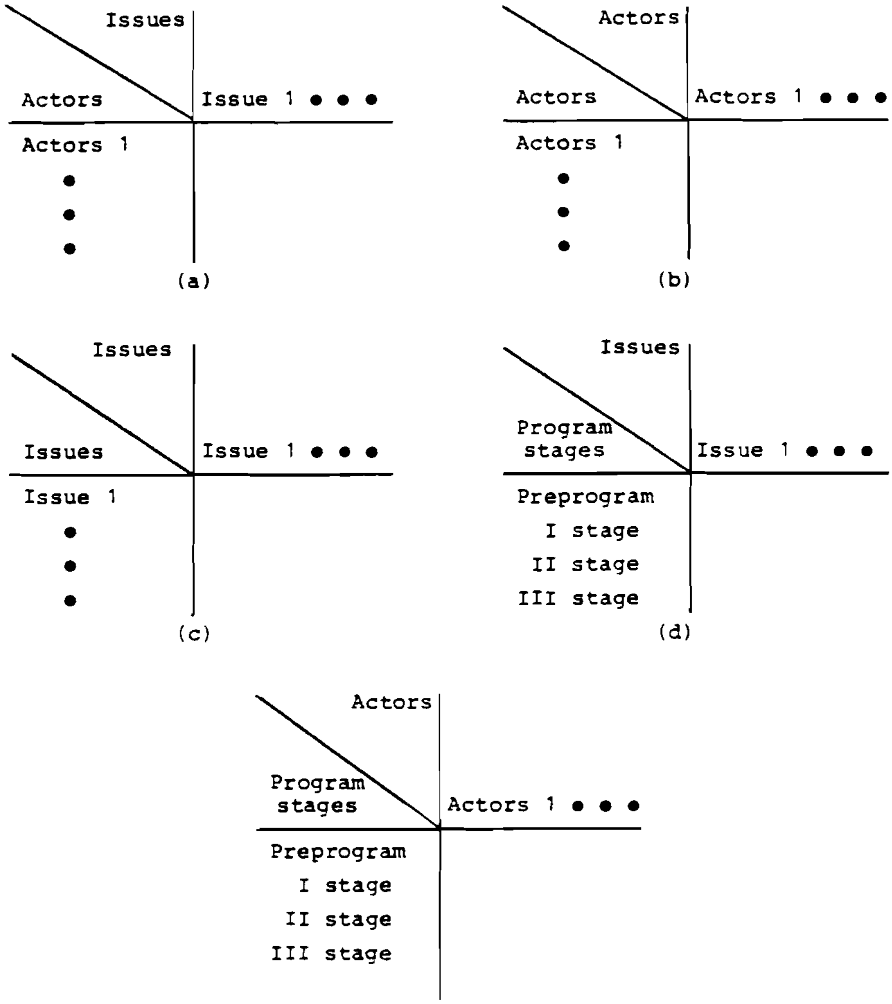


Figure 3.4 INTERACTION MATRIXES

The overall evaluation should be based on inter-relations as well as comparative analysis. The inter-relation between people, institutions, environment, and technology are essential for the evaluation of any large-scale development program, but they became crucial for the Shinkansen Program (Figure 3.5).

The framework for an analysis of large-sclae programs presented here may be used, not only for scientific purposes, but, to some extent, also for improving program supervision and management, as is shown, for example, in Figure 3.6.

The implementation of the development program, due to its interinstitutional character and strong interaction with the political, social, economic, and physical environments, comes under different pressures and disturbances, which make program changes necessary. Therefore, it is useful and sometimes necessary to evaluate the program in order to assess how successful it has been.

Periodic evaluation of the development programs may play an important role in improving their effectiveness. Evaluation of the development programs should also be included in the analytic framework.

Evaluation of the program can be considered a feedback mechanism (see Figure 3.6), including identification of program goals, evaluation criteria, and clientele groups or actors. The concept of clientele groups or actors should be construed broadly to include, not only those who are ultimately affected by a particular program, but also those who create and develop it.

Evaluation analysis requires a consideration of convergent and divergent interests, cooperative and competitive actions, values and motives, categorization of actors, relationship or linkage among actors, information bases, adequacy of information bases, relevance and accessibility of actors, types of decisions and their consequences, and the issues or problems that emerge.

The evaluation process should also include several comparisons:

(1) Comparison of program before and after;

(2) Time trend projection of pre-program data versus actual post-program data;

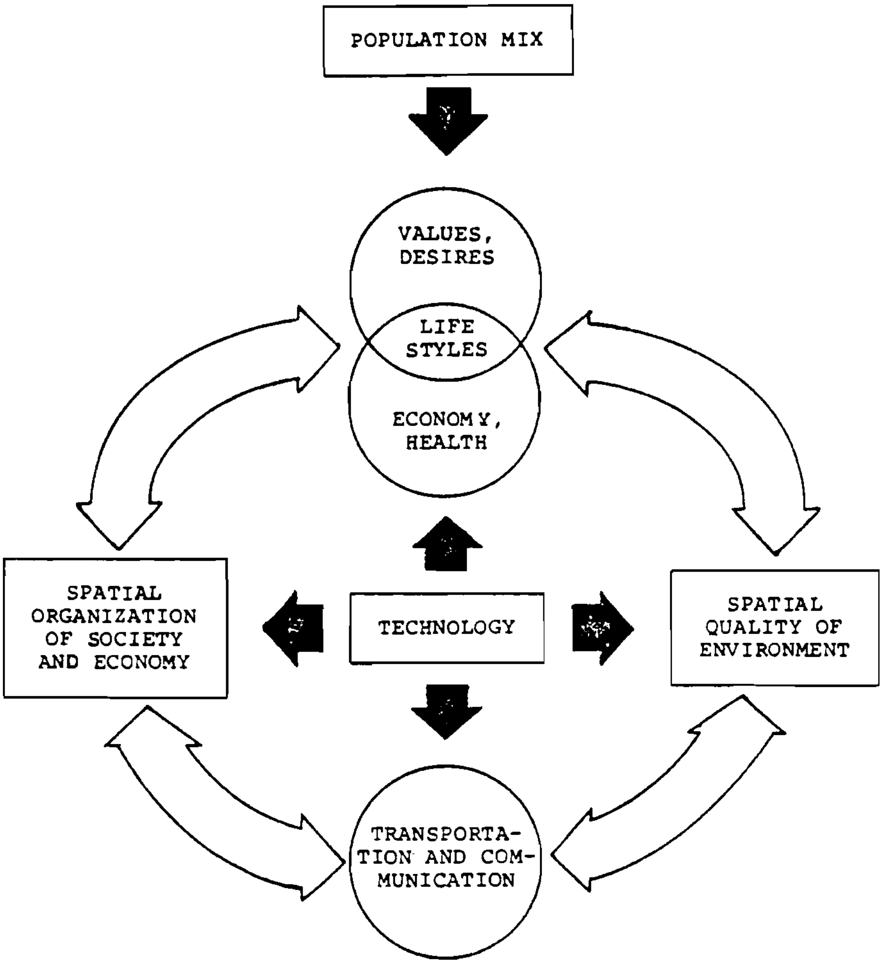

POPULATION MIX
VALUES, DESIRES
LIFE STYLES
ECONOMY, HEALTH
SPATIAL ORGANIZATION OF SOCIETY AND ECONOMY
TECHNOLOGY
SPATIAL QUALITY OF ENVIRONMENT
TRANSPORTA-TION AND COM-MUNICATION

Figure 3.5

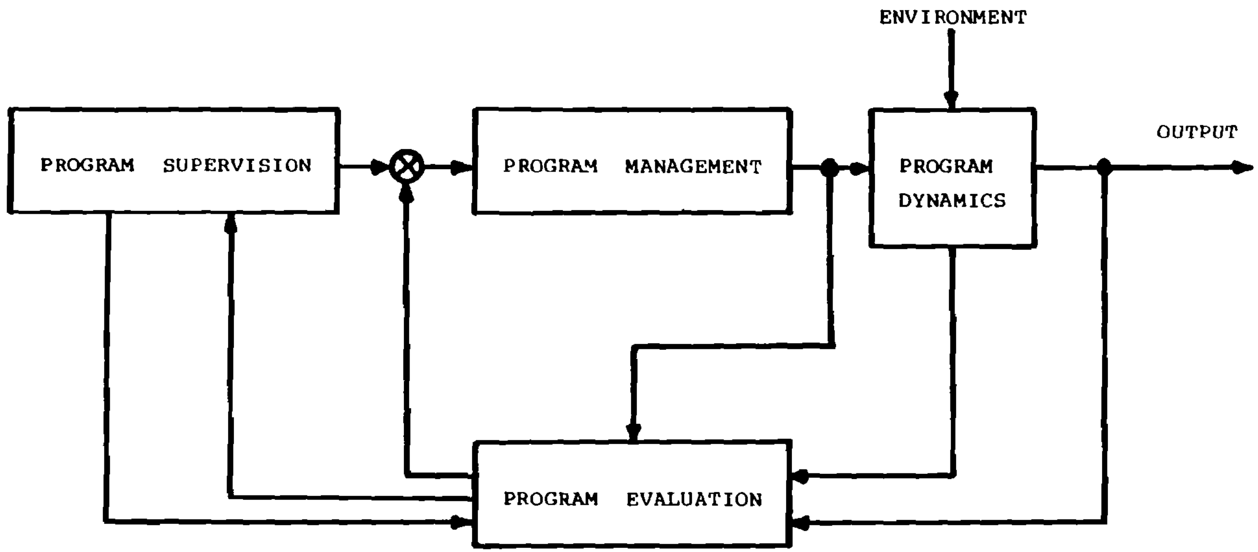


Figure 3.6 EVALUATION PROCESS LOOP

(3) Comparison with system segments not served by the program;

(4) Comparisons of planned versus actual performances.

Evaluating a development program can improve its effectiveness.

However, the purpose of this report is purely scientific; therefore, many simplifications, hypothesis, and paradigms have been introduced.

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PART II

SUBSYSTEM ANALYSIS

4. THE SHINKANSEN AND TRANSPORTATION

4.1 Introduction

For many developed countries in both the East and the West the creation of new--or the further development of existing--intercity passenger transportation systems represents one of the major future problems with great significance on a national and international scale. It is generally accepted that a new age of intercity transportation was heralded in Japan by the opening of the Tokaido-Shinkansen in 1964.

The success of the Japanese effort encouraged several nations to change their minds with regard to the role of railways in inter-city passenger transport. A so-called "railway renaissance" began in a number of nations. This development was characterized by comprehensive studies on the future of inter-city rail transport at speeds in the Shinkansen range, carried out, for example, in:

- The USA, especially with respect to the Northeast corridor between Boston and Washington;
- USSR for the Moscow - Leningrad connection;
- France for the Paris - Lyon line;
- Italy for the Direttissimo Rome - Florence;
- FRG, regarding the connection between Hannover and Würzburg, and others;
- And the UK with respect to the High Speed Train (HST) and Advanced Passenger Train (APT) Projects (along the east cost and for the connection between London, Edinburgh and Glasgow).

A small number of countries, among them France and the FRG, have already started to build high-speed trunk lines. Possibilities of a West-European high-speed ground transportation system covering the UK, France, the Netherlands, Belgium, FRG, Italy and Switzerland were studied by an international expert group of the OECD (1977).

This situation poses the question: What contribution can realistically be expected from systems analysis methods in the development of inter-city passenger transportation systems?

One way of dealing with this question consists in a retrospective analysis of the most advanced system that presently exists, i.e., the Japanese Shinkansen, from a transportation systems analysis point of view focusing on these questions:

- What lessons can be learned from the Japanese experience?
- What role did systems analysis play in the process of transportation systems planning?
- How can the future of the Shinkansen program be judged from a transportation point of view?

Transportation systems analysis is here understood as the retrospective investigation of the complex and complicated interrelations between the three basic components: DEMAND, SUPPLY, and ACTORS (see Figure 4.1).

Any transportation system is characterized by:

(1) Transportation demand
(2) Transportation supply
(3) The interaction between demand and supply, which concerns:
    - supply changes forced by requirements of demand, and
    - a feedback from supply improvements to the demand situation via the attractiveness of the individual modes, i.e., via modal-split changes and inducement of new traffic demand.

The status and development of traffic demand and transport supply depend on two types of factors:

DEMAND FACTORS such as

- ECONOMIC PARAMETERS (level and spatial distribution of economic activities)
- POPULATION (growth and spatial distribution)
- AUTOMOBILE OWNERSHIP
- SOCIAL-POLITICAL ASPECTS (social costums)

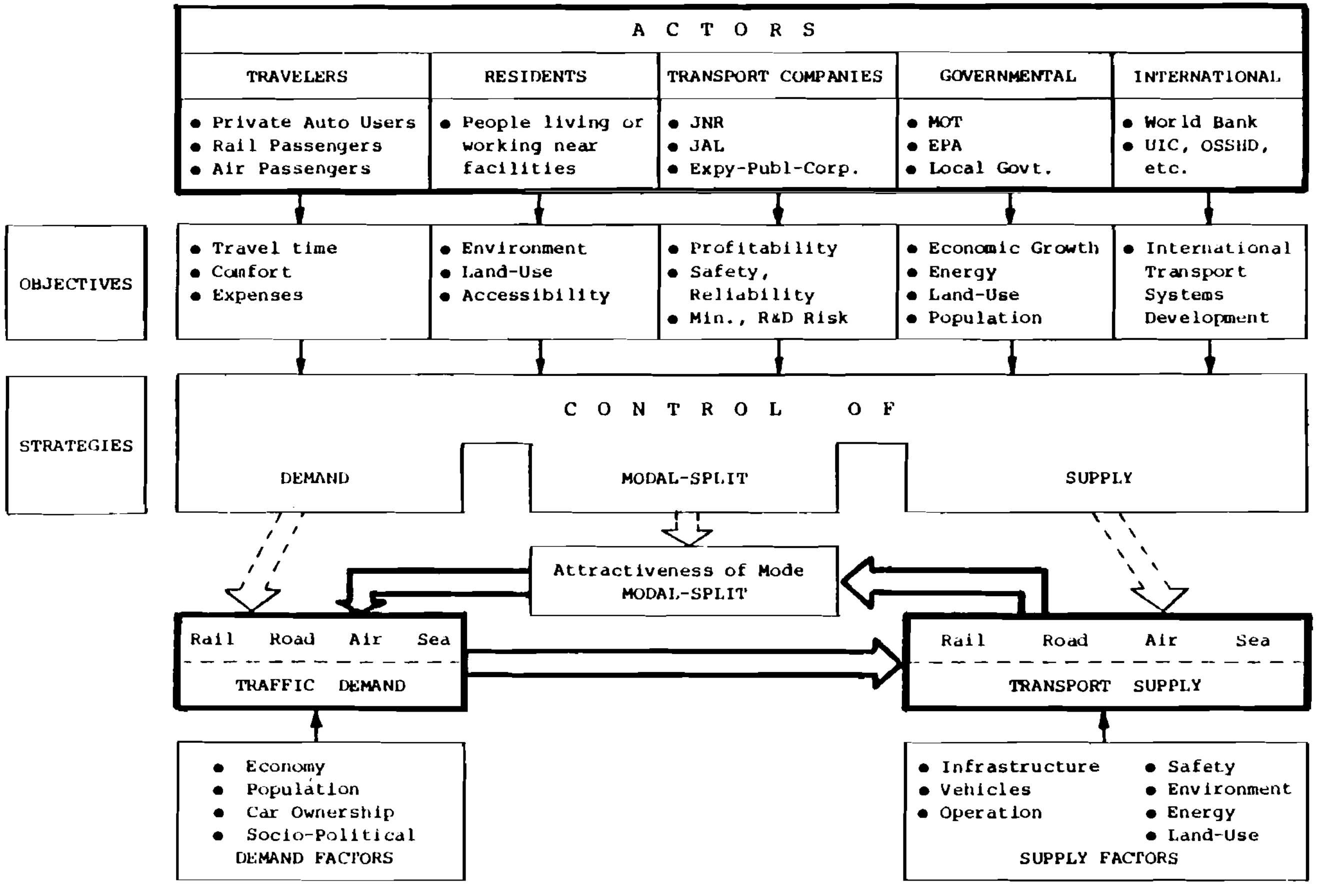


Figure 4.1 THE "DEMAND-SUPPLY-ACTORS" FRAMEWORK USED FOR ANALYZING THE SHINKANSEN

SUPPLY FACTORS, which are characterized by

- the available INFRASTRUCTURE, VEHICLES and OPERATION TECHNOLOGIES for the individual transport modes, and
- certain IMPACTS on
  (a) safety,
  (b) mobility,
  (c) environment,
  (d) resources in terms of energy and land consumption.

Moreover, the indirect impact of transport supply factors on the above-mentioned demand factors has to be taken into account (Figure 4.1).

Besides the socio-economic technological factors mentioned here, demand and supply are influenced by different categories of human actors. These are:

(1) The TRAVELLERS, i.e., the users of the transportation system; their decisions to use private cars, trains or planes, respectively, influence directly the modal split and the equilibrium supply and demand.

(2) The RESIDENTS, i.e., the people who are living or working near the transport facilities and therefore can experience an endangering of their living and working environment.

(3) The TRANSPORT COMPANIES which are operating and constructing the individual transport systems.

(4) GOVERNMENTAL INSTITUTIONS like the Cabinet, the Diet, the Ministries.

(5) INTERNATIONAL ACTORS supporting the development of national transportation systems economically, technically, or morally (e.g., World Bank, international transportation organizations like the International Union of Railways (UIC), the Organization of Economic Cooperation and Development (OECD), the Council for Mutual Economic Assistance (CMEA), and the Association of Railways of the CMEA countries (OSSHD).

Each of these actors is concerned about certain classes of objectives, which may differ from each other remarkably. These objectives, or at least some of them, influence the policies or strategies for the future development of the transport system.

Here three basic alternatives have to be taken into account:

(1) CONTROL (change, enlarge, improve) TRANSPORT SUPPLY concerning STRUCTURE, CAPACITY and OPERATION;

(2) CONTROL DEMAND, i.e., change its SPATIAL DISTRIBUTION, VOLUMES, and TIME DISTRIBUTION;

(3) CONTROL, i.e., change MODAL SPLIT.

The feasibility of these transport development concepts depends on economic, technological, political, and other constraints which may differ from country to country and change over time.

From a systems analysis point of view it is interesting to find answers to the question:

What roles did the different components shown in Figure 4.1 play in the creation of the Shinkansen and how can their present and future roles be judged?

This question has been chosen as the subject of this chapter where special attention will be paid to the relations between the different modes of transportation and the interrelations between:

- DEMAND FACTORS
- SUPPLY FACTORS
- ACTORS.

The considerations will be carried out for the three characteristic time periods:

- The Pre-Shinkansen transportation age in Japan (until 1964)
- The First Decade of the Shinkansen (1965-1975)
- The Future of the Shinkansen Program.

4.2 The Pre-Shinkansen Age

This paragraph aims to find answers to the following questions:

- What socio-economic (demand and supply) factors were the main driving forces that led to the decision to construct the Shinkansen?
- What actors played the key role in the decision-making process?
- As what type of transportation development policy can the creation of the Shinkansen be classified?

Before dealing with these questions it will be useful to present some background information on the history of transportation in Japan:

4.2.1 Historical Background

The history of land transportation in Japan started as in other parts of the world with the construction of roads about 2,000 years ago.

During the Tokugawa era (1603-1868) the so-called "Five Roads", i.e., Tokai-do, Nakasen-do, Nikko-Kaido, Kosku-Kaido and Oshu-Kaido radiated from Tokyo, then called Edo, the center of Japan.

Tokaido became during those days the name of both the region and the road along the Pacific Coast connecting Edo, the seat of the Shogunnate government, and Kyoto, then capital of Japan (see Figure 4.2).

The history of railways in Japan dates back to the year 1872, when the first line commenced public service between Tokyo and Yokohama.

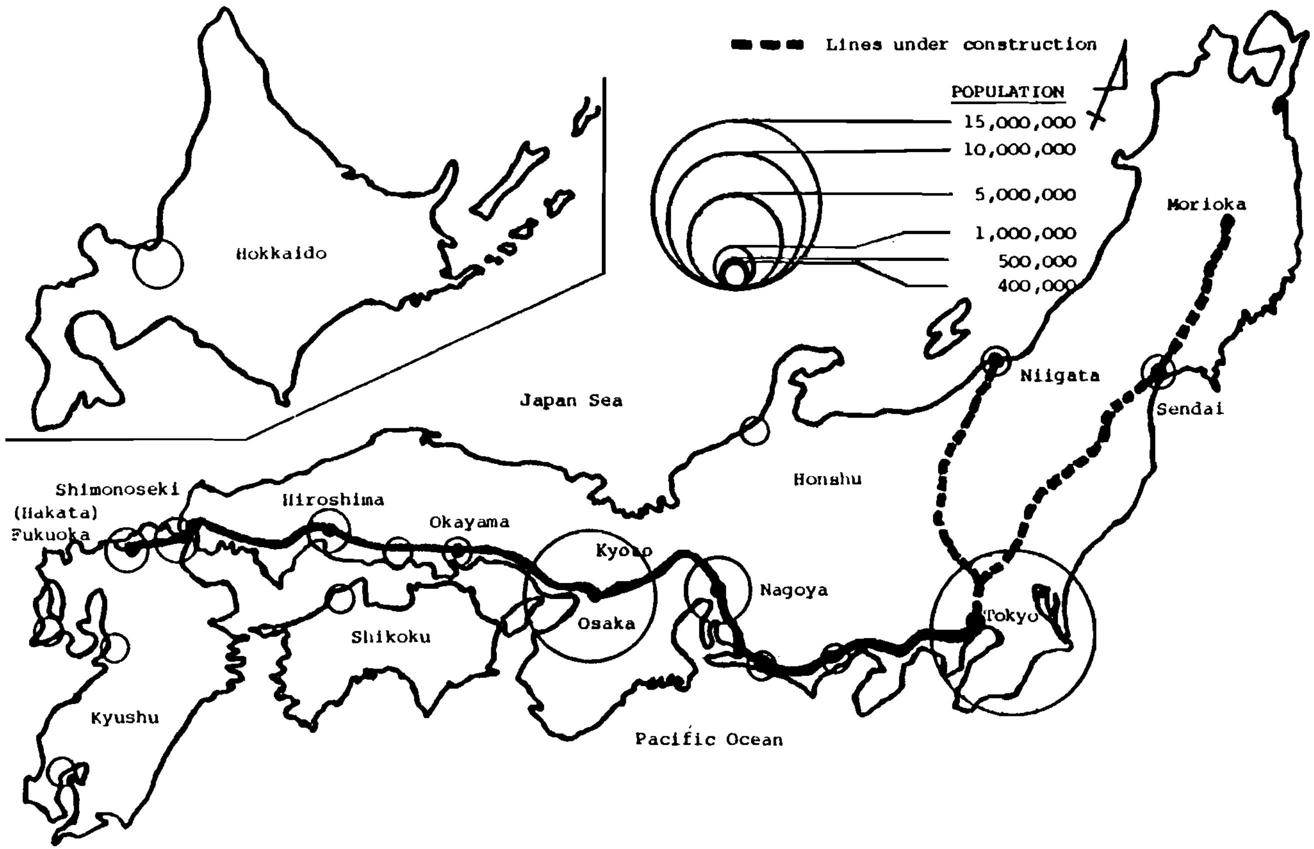


Figure 4.2 THE TOKAIDO (TOKYO-OSAKA) AND SANYO (OSAKA-FUKUOKA) SHINKANSEN AND MAJOR AGGLOMERATION CENTERS

Source: Tokagi, 1978

Figure 4.3 shows that, up until World War II, the railway system grew continuously to a network with a length of about 20 thousand kilometers. Railways became the main mode for both passenger and freight transport, as can be seen from Figure 4.4a (compare modal split for the years up until 1959). The average speed of scheduled trains increased from 30 km/h in 1890 to about 80 km/h in 1964 (Figure 4.4b). The future role of rail passenger transportation became questionable on an international scale after World War II when:

- Expressway systems were created, permitting travel speeds in a range of about 70 to 100 km/h;
- Inter-city air passenger transport systems were introduced on a large scale.

Thus railways were for many trip purposes no longer considered as the fastest and most convenient passenger transport mode. This development tendency was leading to a so-called Railway-Downfall Theory which goes like this (cf. Nashida, 1977):

> Just like horse-drawn carriages and sailing ships were taken over by trains and steamships in the beginning of the 19th century the latter half of the 20th century is the age of automobiles and airplanes, and now the railway is on the road to decline and extinction.

As a proof of this theory the development of the USA inter-city passenger transport system was considered. Figure 4.5 shows that already before World War II and shortly after World War II about 80 to 90 percent of inter-city trips (expressed in passenger miles) were made by the private auto and by the end of the 1950's the air traffic system accumulated more passenger-kilometers than the rail system.

The result of this was that the "Railway Downfall Theory" became popular in Japan, when civil aviation reopened in Japan (1951) and superhighway construction plans began to be talked about. Therefore the Tokaido Shinkansen project, planned during

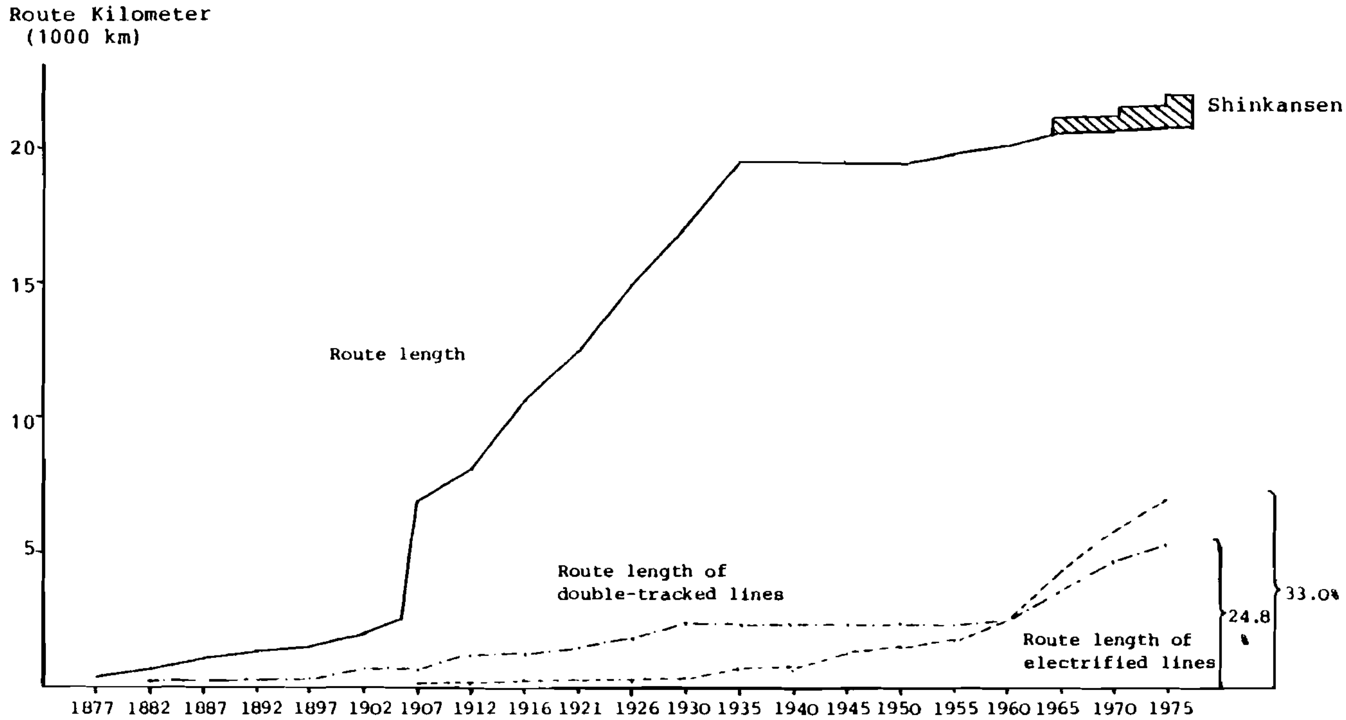


Figure 4.3 JNR LINES; PROGRESS IN DOUBLE-TRACKING AND ELECTRIFICATION

Source: Takiyama

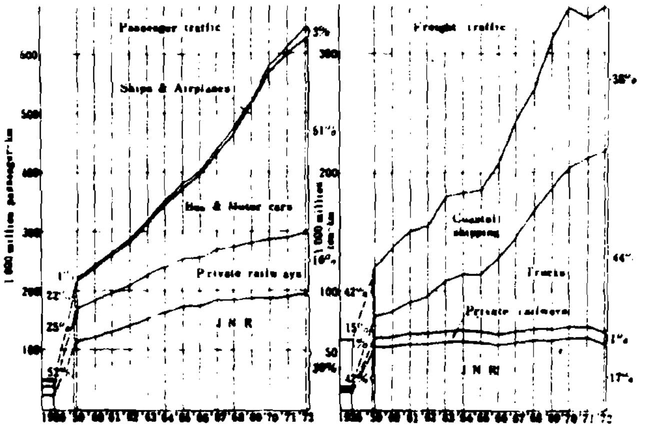


Figure 4.4a SHARE OF VARIOUS MODES OF TRANSPORT

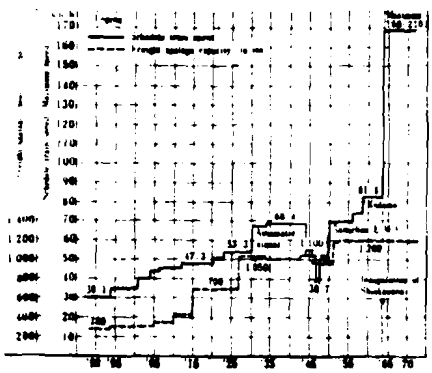
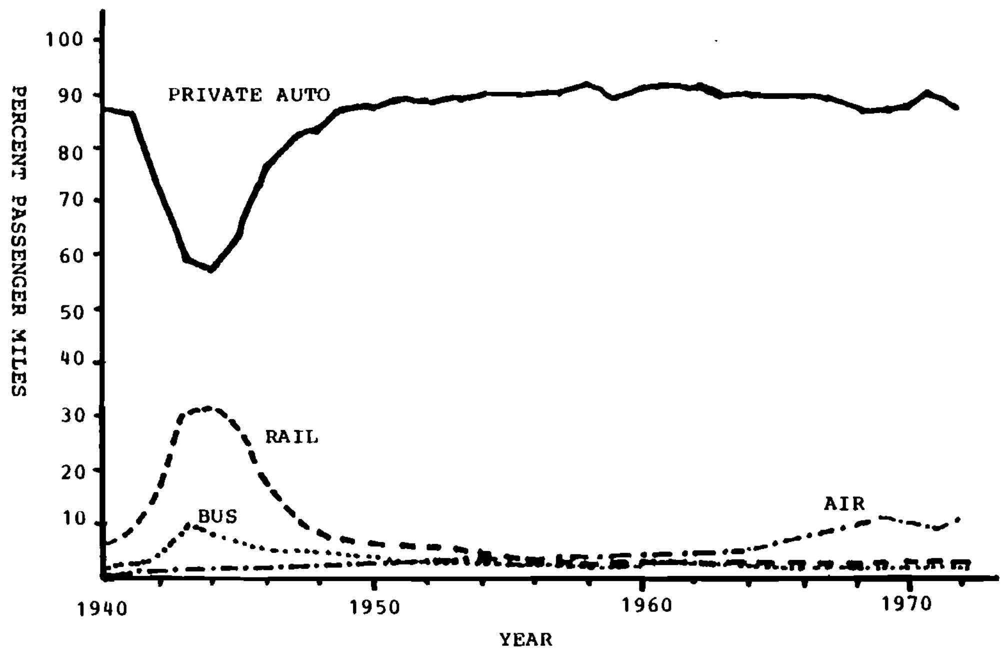


Figure 4.4b CHANGE OF SCHEDULE TRAIN SPEED AND HAULAGE CAPACITY IN TOKAIDO LINE

Source: Takiyama



Source: Transportation Association of America, Transportation Facts and Trends

Figure 4.5 PERCENTAGE OF INTER-CITY PASSENGER TRAVEL BY EACH MODE IN THE USA (Ward, 1977) the second half of the 1950's, became the subject of severe criticism: the undertaking was cited as one of the three huge but useless projects of the world (cf. Sanuki, 1977):

First.....The Great Wall (China)
Second....Battleships Yamato and Musashi (Japan)
Third.....Tokaido Shinkansen (Japan)

It has been reported by Sanuki (1977) that among the most critical were university professors and present-day politicians, who claimed "that it was not understandable why the three should all be in Asia, with two in Japan to make matters worse".

Japan adapted many aspects of the "American Way of Living" during the occupation by the US Army. Why should Japan not then follow the USA example with regard to the development of her inter-city passenger transport systems?

To deal with this question the corresponding demand factors will be analyzed first.

4.2.2 Demand Factors

4.2.2.1 Economic Growth

Travel demand is closely related to economic growth. This is indicated by Figure 4.6 for the relations between the development of the GNP and the Railway passenger traffic volume during the last 100 years. There exists a close connection between the relative traffic volume expressed in passenger km per capita per year and the per capita national income. Figure 4.7 clarifies the increase of the per capita national income from $227 in 1955 to $735 in 1965, i.e., by a factor of 3.2, resulted in an increase of the per capita traffic volume from about 1900 to about 3900 passenger-km per year, corresponding to a gain factor of about 2.

4.2.2.2 Population

The area along the Tokaido Line (590 km from Tokyo to Kobe) corresponds to 16% of the total area of Japan. This area, however, includes three of the four great industrial zones of Japan and seven of the ten large cities of one million or more in population.

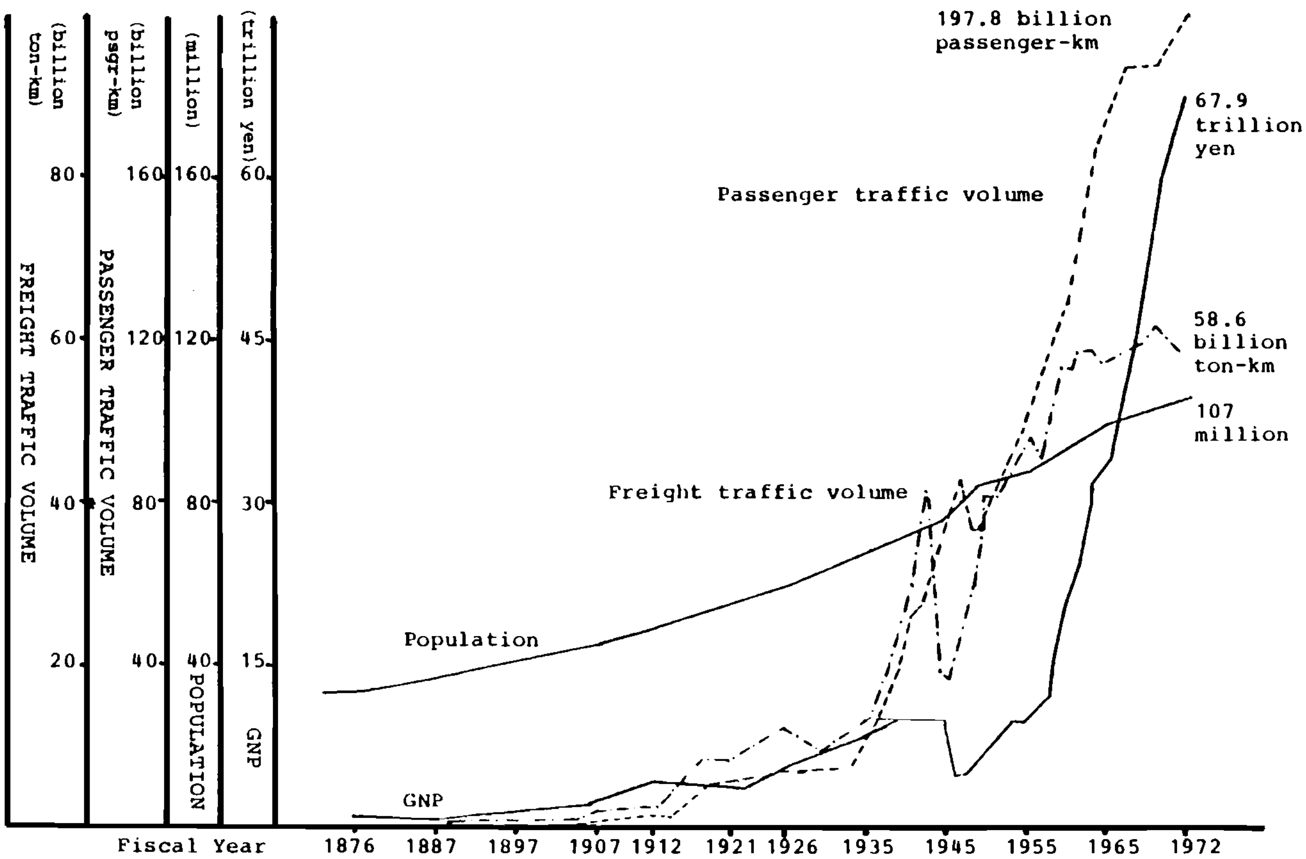


Figure 4.6 RELATION BETWEEN RAILWAY TRAFFIC VOLUME AND GROSS NATIONAL PRODUCT

Source: M. Takiyama

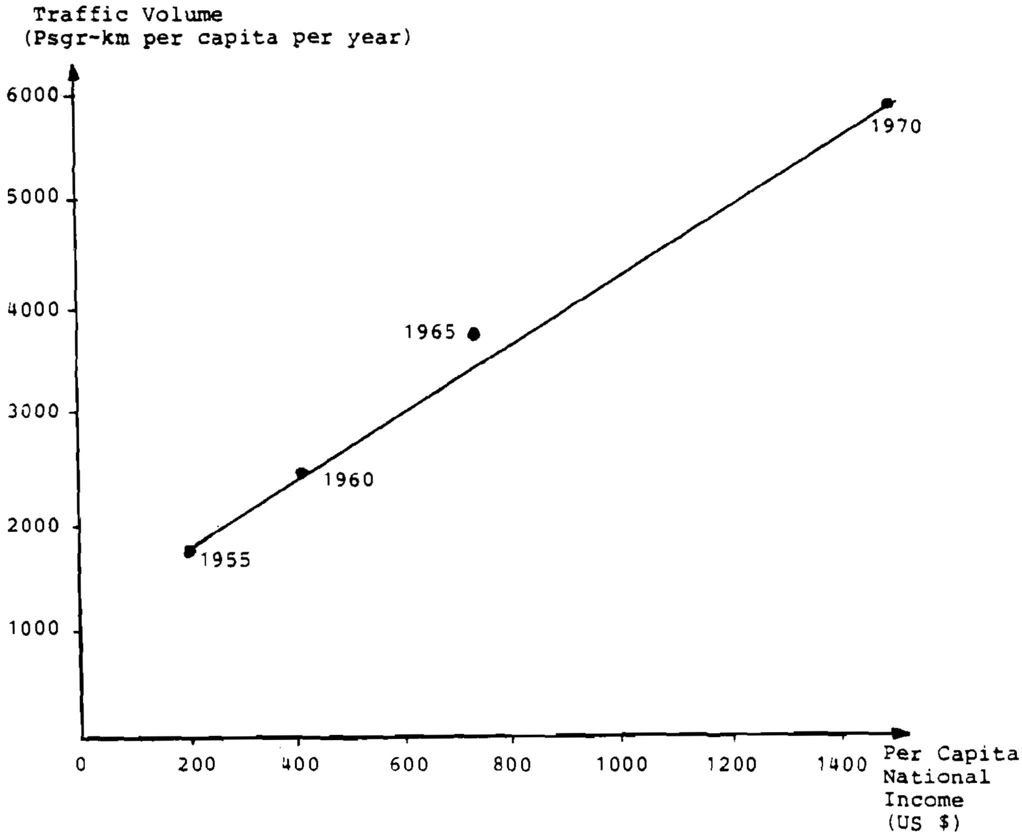


Figure 4.7 <u>RELATION BETWEEN TRAVEL DEMAND AND PER CAPITA NATIONAL INCOME</u>

(Sanuki, 1977 and MOT, 1977)

The population density in this area is 2.6 times larger than that of the national average. The population accounted for 34% of the national population in 1950. In 1965 42.8% of the national population lived in that region (Figures 4.8 and 4.9).

Tokyo and Osaka and their metropolitan areas, i.e., the so-called Minami-Kanto and Keihanshin regions have shown enormous net net in-migration continuously (Figures 4.9 and 4.10). in other words Tokyo and Osaka have been bifocal growth points which absorbed tremendous population from all other local regions in the country during the last 50 years (Figure 4.10 and Kuroda, 1977). It is well known that the volume of interregional traffic flow increases with the number of people living in the corresponding regions; there exists, so to speak, a gravitational force which generates traffic.

During the 1950's this population concentration together with the rapid economic growth generated a tremendous inter-city demand along the corridor between Tokyo and Osaka. Therefore it is understandable that this region became the first candidate for a new high-speed passenger transport system.

As the second candidate, the coastal area from Osaka to Fukuoka was considered, since it accounted for about 20% of Japan's population and 33% of her industrial output (Figures 4.2 and 4.9).

4.2.2.3 Car Ownership and Modal Split

The availability of the private car has great influence on the overall travel demand. Car ownership is, of course, closely correlated to economic growth, as is illustrated in Table 4.1 taken from a paper by Sanuki (1977).

The figures in Table 4.1 illustrate that people became very much concerned about achieving car ownership during the 1960's. Figure 4.11 shows that up until the year 1965 the number of registered automobiles per 10 inhabitants in Japan was much lower than in the USA and the West European countries and even smaller than in some East European countries. Consequently, auto traffic demand did not play a dominating role during the period in which the Tokaido Shinkansen was planned and constructed. This is shown by Figures

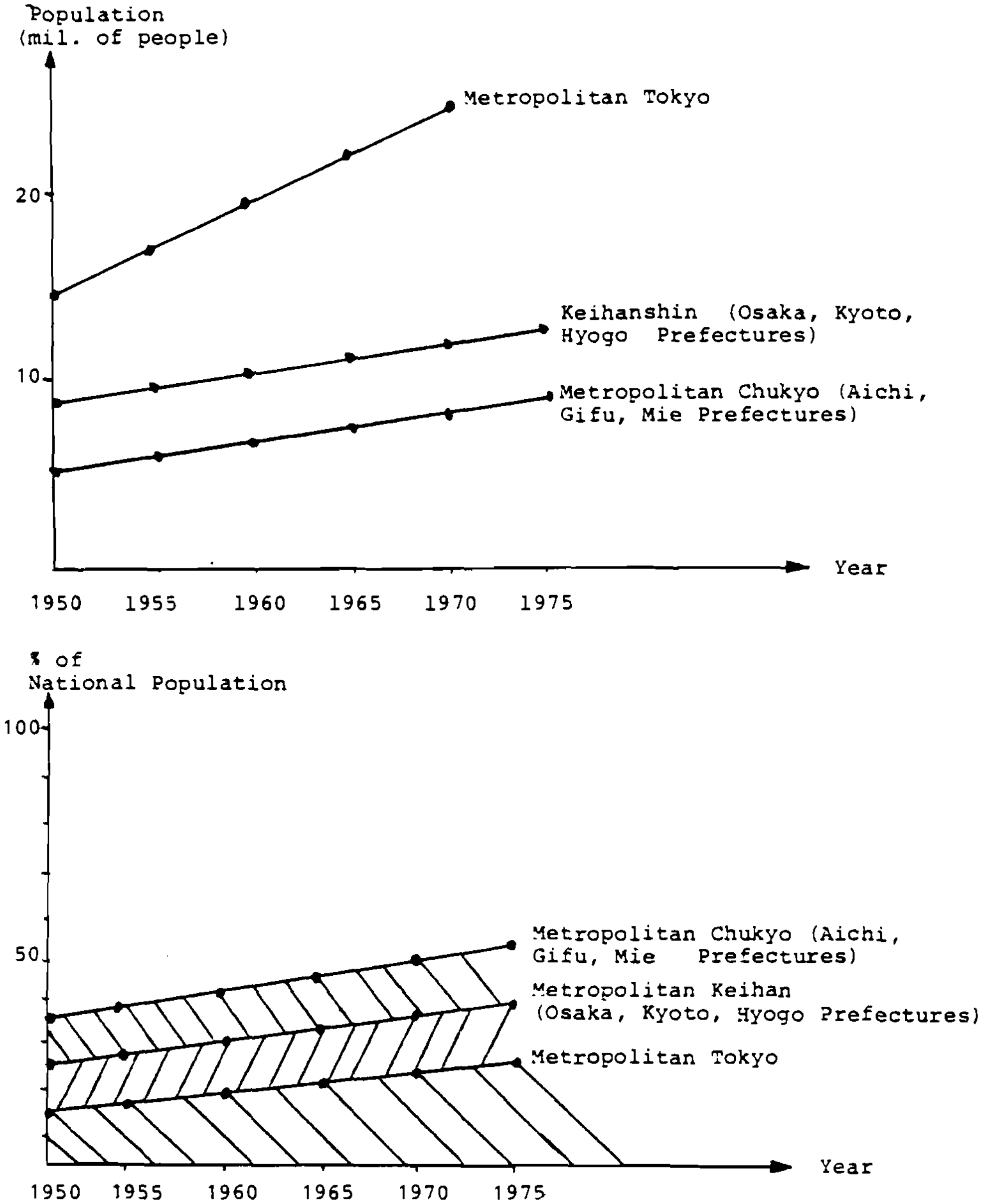


Figure 4.8 POPULATION GROWTH WITHIN THE REGIONS ALONG THE TOKAIDO SHINKANSEN

(Kuroda, 1977 and Figure 4.9)

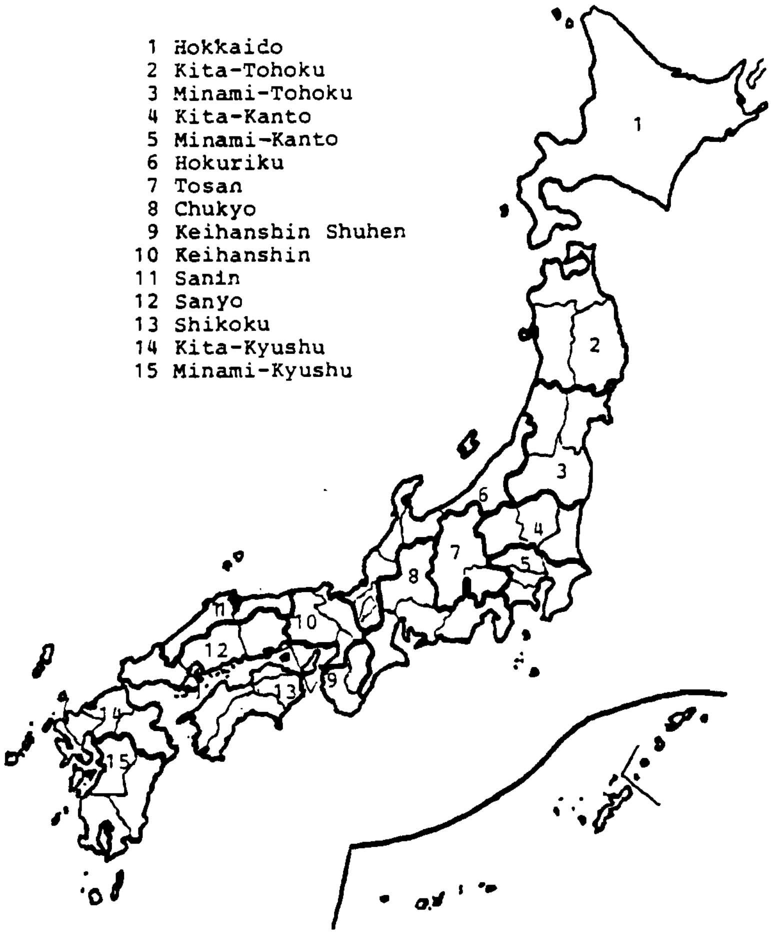


Figure 4.9 <u>MAJOR REGIONS OF JAPAN</u>
(cf. with Figure 4.10)

Source: Kuroda, 1977

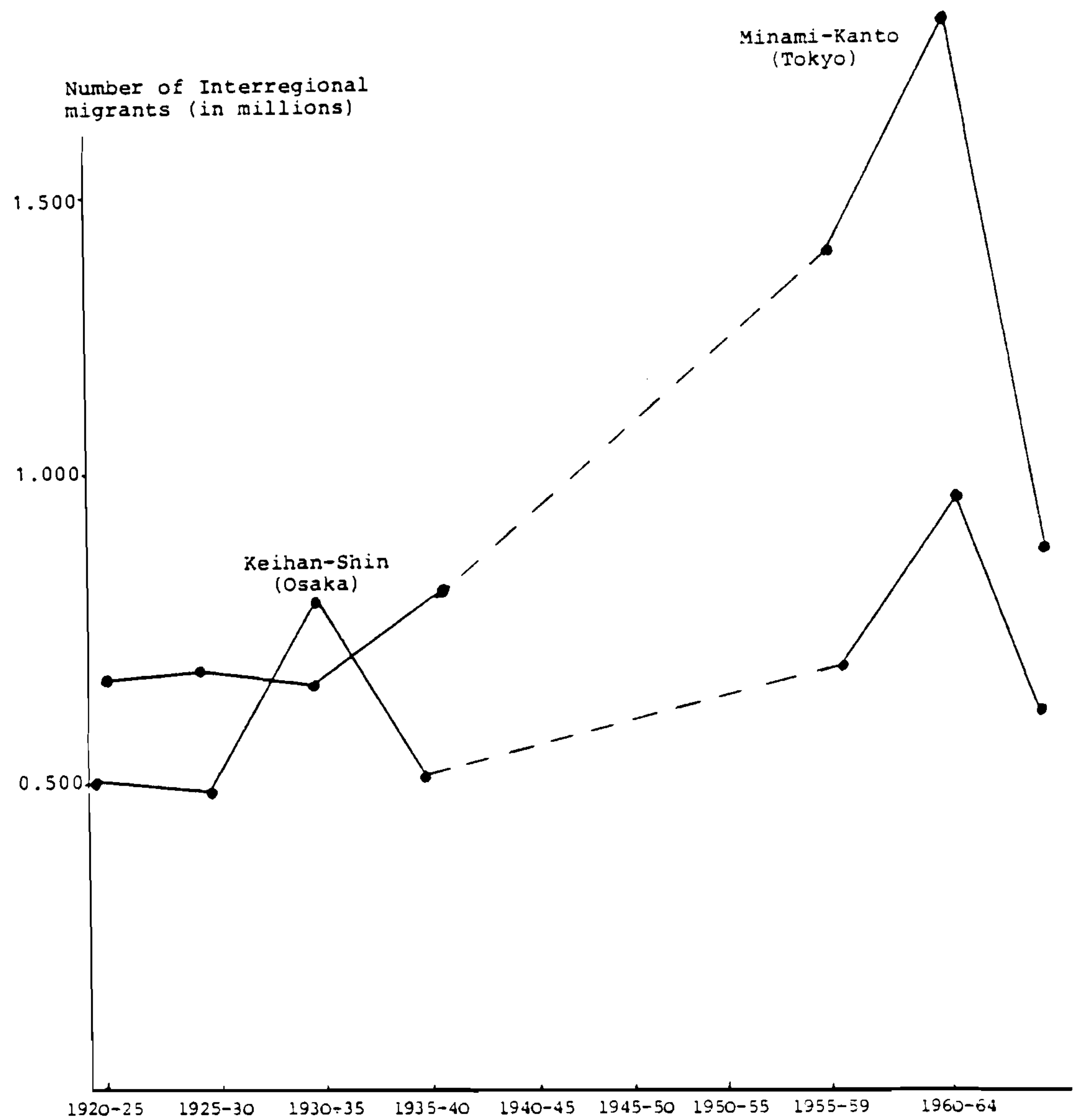


Figure 4.10 <u>INTERREGIONAL NET MIGRATION IN QUINQUENNIAL PERIODS FOR THE TWO REGIONS: MINAMI-KANTO (Tokyo, Kanagawa, Saitama, Chiba Prefectures), AND KEIHANSHIN (Osaka, Kyoto, Hyogo Prefectures)</u>

(cf. Figure 4.9 and Kuroda, 1977)

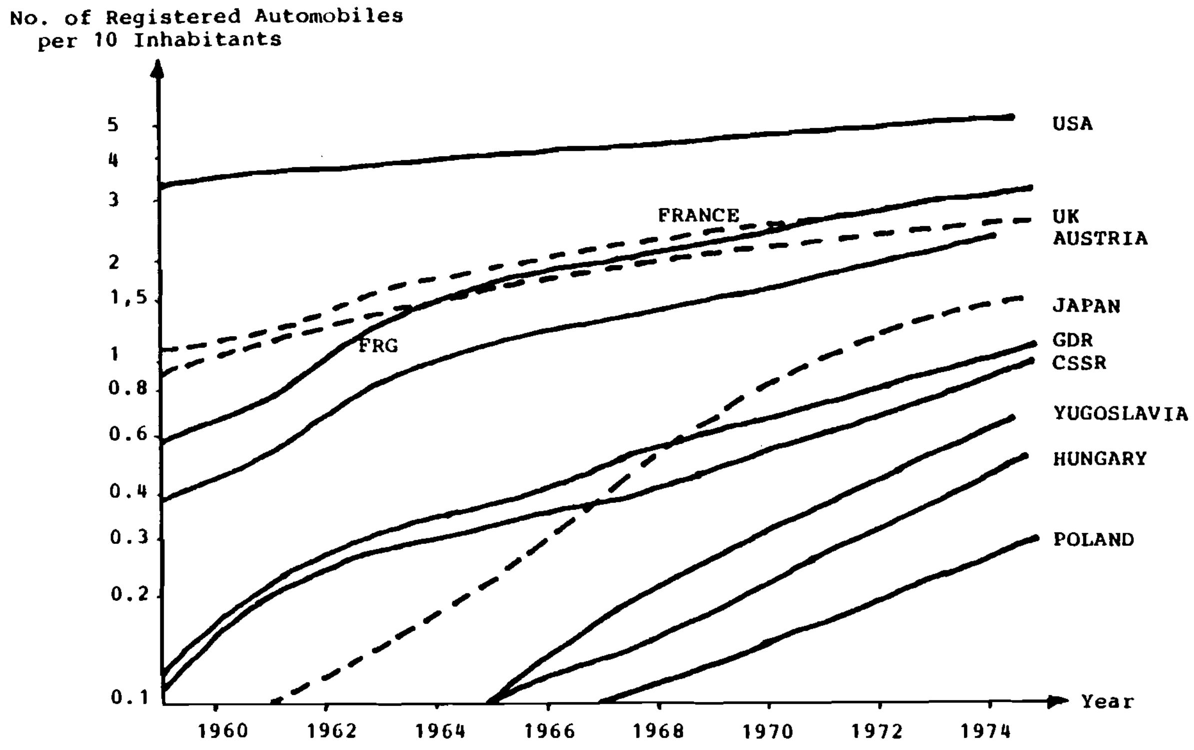


Figure 4.11 <u>TIME-DEPENDENT DEVELOPMENT OF THE NUMBER OF REGISTERED AUTOMOBILES</u>
(cf. ECE, 1976)

Table 4.1

YEAR	PER CAPITA NATIONAL INCOME	COMMODITIES IN WHICH PEOPLE BECAME MOSTLY INTERESTED
1955	$ 227 (1.00)	Black and white television, refrigerator, washing machine
1960	$ 395 (1.74)	Car
1965	$ 735 (3.24)	Car, color television, cooler
1970	$1,560 (6.87)	Car, cottage, cooker (electronic range)
1975	$3,394 (14.95)	Quality of life

4.4a and 4.12, as well as by Tables 4.2 and 4.3 showing the modal split parameters. In 1955 passenger cars accounted only for 2.5% of all passenger traffic volumes expressed in passenger kilometers; all motor vehicles (buses plus automobiles) accumulated about 16 percent of all passenger kilometers (Figure 4.12). Passenger traffic by airplanes and passenger vessels was negligible (≈0.1% or 1.2%, respectively). Railways carried about 70% of all passengers (JNR: 27.3%) and accumulated 83% of passenger kilometers (JNR: 55%).

All modes of transport showed a remarkable increase of ridership during the ten years before the opening of the Tokaido Shinkansen, i.e., from 1955 to 1964. Figure 4.13 shows that air traffic demand increased by a factor of 1300, automobile traffic by 970, bus traffic by 345 and rail traffic by 231. It is important to consider that the traffic demand along the Tokaido corridor showed a remarkably large increase than other railway lines of JNR (see Table 4.4). Between 1950 and 1957 the passenger traffic demand of the Tokaido Main Line increased by 158% and the freight traffic demand by 186%.

In 1957 the Tokaido Main Line was accounting for 24% of JNR's freight traffic. Further, the Tokaido line lies in the center of the JNR network playing the role of a main artery of national transportation. If this main pipe should become deadlocked, there would directly arise the possibility of a country wide transportation paralysis. But the maximum number of trains that could be

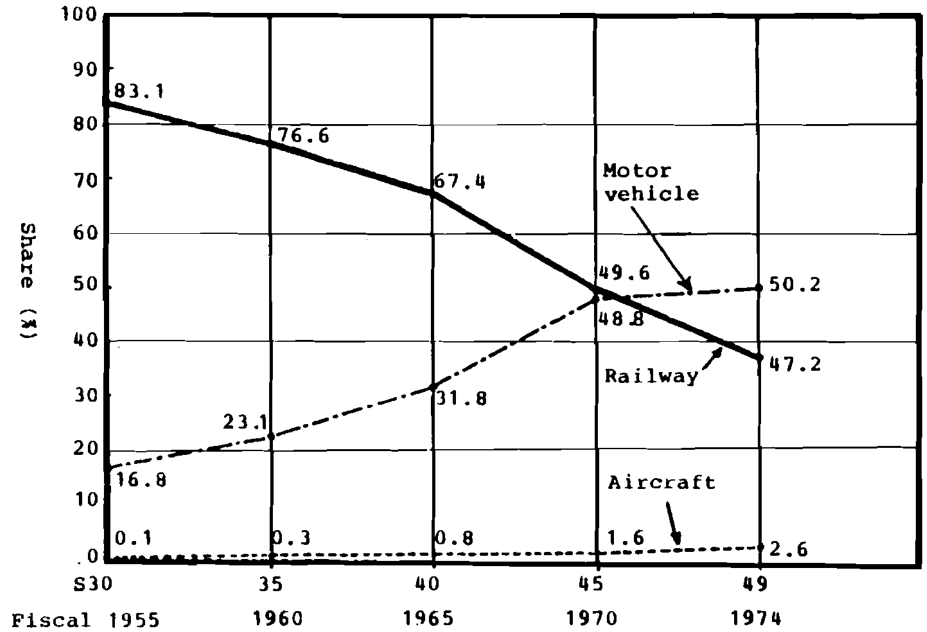


Figure 4.12 <u>CHANGE IN SHARE OF DOMESTIC TRAFFIC BY MODE OF TRANSPORT</u>
(cf. MOT, 1977 and Table 4.2)

Table 4.2 VOLUME OF DOMESTIC PASSENGER TRANSPORT AND SHARES BY VARIOUS MODES OF TRANSPORT

DIVISION	NUMBER OF PASSENGERS (1 Million Passengers)								PASSENGER-KILOMETERS (1 Million Passenger-km)							
MODE OF TRANSPORT / FISCAL YEAR	TOTAL VOLUME OF TRANSPORT	JNR	JNR: Of which new trunk lines	PRIVATE RAILWAYS	BUSES & COACHES	PSGR CARS	REGULAR AIR TRANSPORT	PSGR VESSELS	TOTAL VOLUME OF TRANSPORT	JNR	JNR: Of which new trunk lines	PRIVATE RAILWAYS	BUSES & COACHES	PSGR CARS	REGULAR AIR TRANSPORT	PSGR VESSELS
1955	14,117 (100.0)	3,849 (27.3)	- (-)	5,932 (42.0)	3,556 (25.2)	706 (5.0)	0 (0.0)	74 (0.5)	165,736 (100.0)	91,239 (55.0)	- (-)	44,873 (27.1)	23,230 (14.1)	4,180 (2.5)	218 (0.1)	1,996 (1.2)
1960	20.291 (100.0)	5,124 (25.3)	- (-)	7,166 (35.3)	6,291 (31.0	1,610 (7.9)	1 (0.0)	99 (0.5)	243,274 (100.0)	123,983 (51.0)	- (-)	60,357 (24.8)	43,999 (18.1)	11,531 (4.7)	734 (0.3)	2,670 (1.1)
1965	30,793 (100.0)	6,722 (21.8)	31 (0.1)	9,076 (29.5)	10,557 (34.3)	4,306 (14.0)	5 (0.0)	126 (0.4)	382,477 (100.0)	174,014 (45.5)	10,651 (2.8)	81,370 (21.3)	80,134 (21.0)	40,622 (10.6)	2,935 (0.7)	3,402 (0.9)
1970	40,606 (100.0)	6,534 (16.1)	85 (0.2)	9,850 (24.3)	11,812 (29.1)	12,221 (30.1)	15 (0.0)	174 (0.4)	587,172 (100.0)	189,726 (32.3)	27,890 (4.7)	99,090 (16.9)	102,893 (17.5)	181,335 (30.9)	9,314 (1.6)	4,814 (0.8)
1972	43,275 (100.0)	6,724 (15.5)	110 (0.3)	10,061 (23.3)	11,711 (27.1)	14,572 (33.7)	19 (0.0)	188 (0.4)	648,188 (100.0)	197,829 (30.5)	33,835 (5.2)	102,469 (15.8)	108,211 (16.7)	220,346 (34.0)	12,663 (2.0)	6,670 (1.0)
1973	44,563 (100.0)	6,871 (15.4)	128 (0.3)	10,185 (22.9)	11,390 (25.6)	15,922 (35.7)	24 (0.1)	171 (0.4)	673,765 (100.0)	208,097 (30.9)	38,989 (5.8)	104,831 (15.6)	111,713 (16.6)	225,732 (33.5)	16,033 (2.4)	7,359 (1.1)
1974	45,080 (100.0)	7,113 (15.8)	133 (0.3)	10,476 (23.2)	11,206 (24.9)	16,105 (35.7)	25 (0.1)	155 (0.3)	693,286 (100.0)	215,564 (31.1)	40,671 (5.9)	108,460 (15.6)	115,776 (16.7)	228,400 (32.9)	17,636 (2.5)	7,450 (1.1)
1975	46,176 (100.0)	7,048 (15.3)	157 (0.3)	10,540 (22.8)	10,731 (23.2)	17,681 (38.3)	25 (0.1)	151 (0.3)	710,447 (100.0)	215,289 (30.3)	53,318 (7.5)	108,511 (15.3)	110,063 (15.5)	250,804 (35.3)	19,138 (2.7)	6,642 (0.9)

Note: (1) The figures of buses and coaches and passenger cars in fiscal 1955 were corrected to match the new statistics after fiscal 1960.
(2) The figures in the parentheses show the percentage share.

Source: (MOT, 1977)

Table 4.3 VOLUME OF DOMESTIC CARGO TRANSPORT AND SHARES BY VARIOUS MODES OF TRANSPORT

DIVISION	TONS (1 Million tons)					TON-KILOMETERS (1 Million ton-kilometers)				
MODE OF TRANSPORT / FISCAL YEAR	TOTAL VOLUME OF TRANSPORT	JNR	PRIVATE RAILWAYS	MOTOR VEHICLES	COASTAL SHIPPING	TOTAL VOLUME OF TRANSPORT	JNR	PRIVATE RAILWAYS	MOTOR VEHICLES	COASTAL SHIPPING
1955	832 (100.0)	160 (19.2)	33 (4.0)	569 (68.4)	69 (8.3)	81,787 (100.0)	42,564 (52.0)	690 (0.8)	9,510 (11.6)	29,022 (35.5)
1960	1,533 (100.0)	195 (12.7)	43 (2.8)	1,156 (75.4)	139 (9.1)	138,900 (100.0)	53,592 (38.6)	923 (0.7)	20,802 (15.0)	63,579 (45.8)
1965	2,625 (100.0)	200 (7.6)	52 (2.0)	2,193 (83.5)	180 (6.9)	186,346 (100.0)	56,408 (30.3)	890 (0.5)	48,392 (26.0)	80,635 (43.3)
1970	5,259 (100.0)	199 (3.8)	57 (1.1)	4,626 (87.9)	377 (7.2)	350.644 (100.0)	62,435 (17.8)	988 (0.3)	135,916 (38.8)	151,243 (43.1)
1972	5,877 (100.0)	182 (3.1)	57 (1.0)	5,203 (88.5)	434 (7.4)	389,109 (100.0)	58,561 (15.1)	963 (0.2)	153,610 (39.5)	175,873 (45.2)
1973	5,716 (100.0)	176 (3.1)	53 (0.9)	4,912 (85.9)	575 (10.1)	407,098 (100.0)	57,405 (14.1)	932 (0.2)	140,979 (34.6)	207,648 (51.0)
1974	5,085 (100.0)	158 (3.1)	48 (0.9)	4,377 (86.1)	501 (9.9)	375,768 (100.0)	51,583 (13.7)	869 (0.2)	130,770 (34.8)	192,406 (51.2)
1975	5,030 (100.0)	142 (2.8)	43 (0.9)	4,393 (87.3)	452 (9.0)	360,779 (100.0)	46,579 (12.9)	770 (0.2)	129,701 (36.0)	183,579 (50.9)

Notes: (1) The figures of motor vehicles in fiscal 1955 were corrected to match the new statistics after fiscal 1950.
(2) The figures of coastal shipping in fiscal 1955 and fiscal 1960 and those in fiscal 1970-73 were corrected to match the new statistcs after fiscal 1963 and in fiscal 1976, respectively.
(3) The transport by aircraft is included in the total transport volume.
(4) The figures in the parentheses show the transport share (%).

Source: (MOT, 1977)

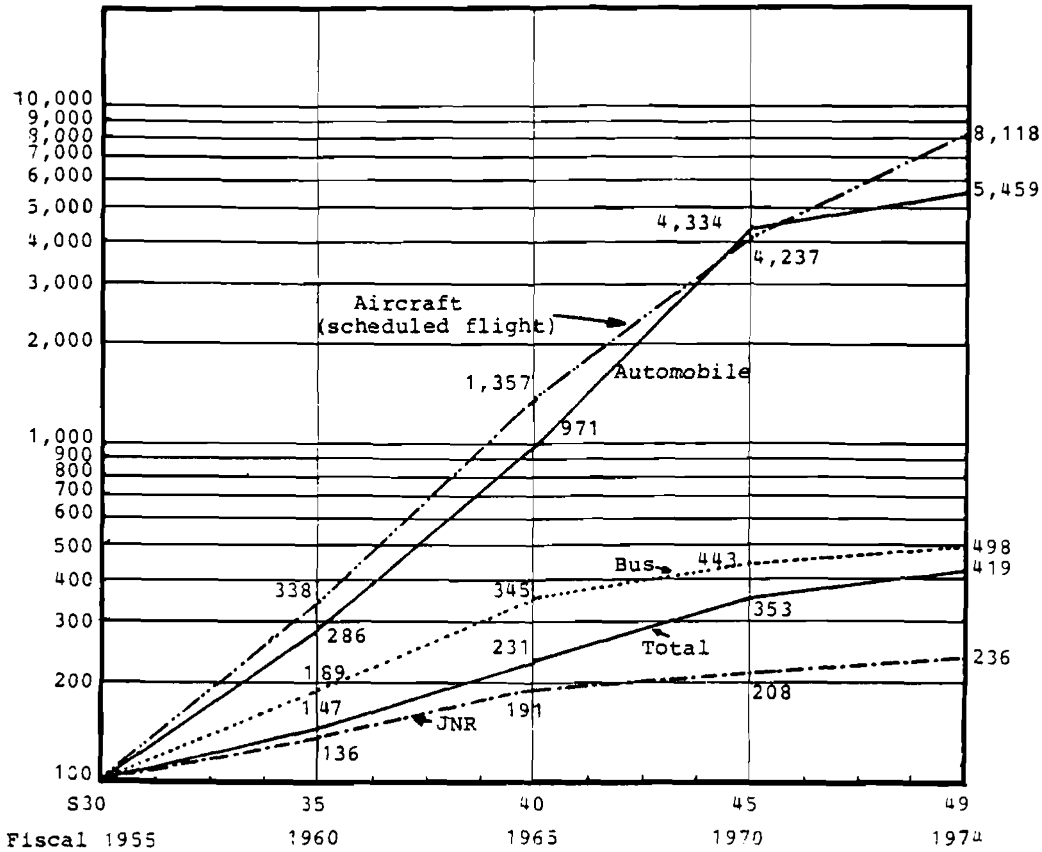


Figure 4.13 GROWTH OF PASSENGER TRAFFIC BY DIFFERENT MEANS OF TRANSPORT

(cf. Sanuki, 1977)

Table 4.4 TRAFFIC ON THE TOKAIDO MAIN LINE PRIOR TO THE OPENING OF THE SHINKANSEN

FISCAL YEAR	PASSENGER TRAFFIC					FREIGHT TRAFFIC					NUMBER OF DOWN TRAINS BETWEEN NUMAZU AND SHIZUOKA		
	JNR (a)		TOKAIDO MAIN LINE (b)		RATIO (b/a)	JNR (a)		TOKAIDO MAIN LINE (b)		RATIO (b/a)			
	Psgr-km (mil.)	Index	Psgr-km (mil.)	Index	(%)	Ton-km (mil.)	Index	Ton-km (mil.)	Index	(%)	Psgr. trains	Freight trains	Total
1950	69,100	100	15,300	100	22.2	33,300	100	5,900	100	17.7	31	27	58
1951	79,000	114	17,400	113	22.0	39.900	120	7,600	128	19.1	-	-	-
1952	80,500	117	18,700	122	23.2	39,300	118	8,500	143	21.6	-	-	-
1953	83,600	121	19,500	127	23.3	41,000	123	9,000	151	22.0	38	38	76
1954	87,000	129	20,300	132	23.3	39,900	120	8,700	147	21.8	40	40	80
1955	91,200	132	21,400	140	23.5	42,600	131	9,500	160	22.3	41	43	84
1956	98,100	142	23,300	152	23.7	46,900	141	10,700	183	22,8	46	47	93
1957	101,200	146	24,100	158	23.8	48,200	145	11,000	186	22.8	53	52	105

Source: (Okaba, 1977)

operated one way per day on a double-tracked railway was 120 when passenger trains and freight trains were mixed in operation and where trains of different speeds were operated. The situation of the Tokaido line in 1956 was coming to the brink of this maximum limit.

4.2.3 Supply Factors

Since the status of the Japanese railway system is analyzed in a special chapter, this paragraph will restrict itself to the following topics:

- the status of the road and air transport systems;
- selected supply impacts.

4.2.3.1 The Status of the Road Transport System

(1) Infrastructure. It was in the 1950's that the construction of highway networks started to meet the increasing demand. In fiscal 1954, the first Five Year Road Improvement Program was started followed by six further Five Year Programs with remarkably increasing funds (Figure 4.14).

The first step toward the national expressway development in Japan was marked in October 1957 when the construction of the 190 km long Nagoya-Kobe Expressway was started. After that the constructions of the 93 km long Tokyo-Fujiyoshida Expressway and the 346 km long Tokyo-Nagoya Expressway were also started in 1962 and 1963 respectively. Among them the Nagoya-Kobe Expressway and the Tokyo-Nagoya Expressway constitute the most important arterial roads in Japan, linking up the three largest economic regions, that is, Tokyo, Nagoya and Osaka, with one another. These three expressways were opened to traffic by May 1969, leaving only an unopened portion of 8 km.

Road development in Japan is carried out in accordance with certain laws. The most important ones are:

- Road Law (Law No. 180 of 1952)
  This Law is the basic one relating to roads. The Law stipulates the procedures for classification, designation,

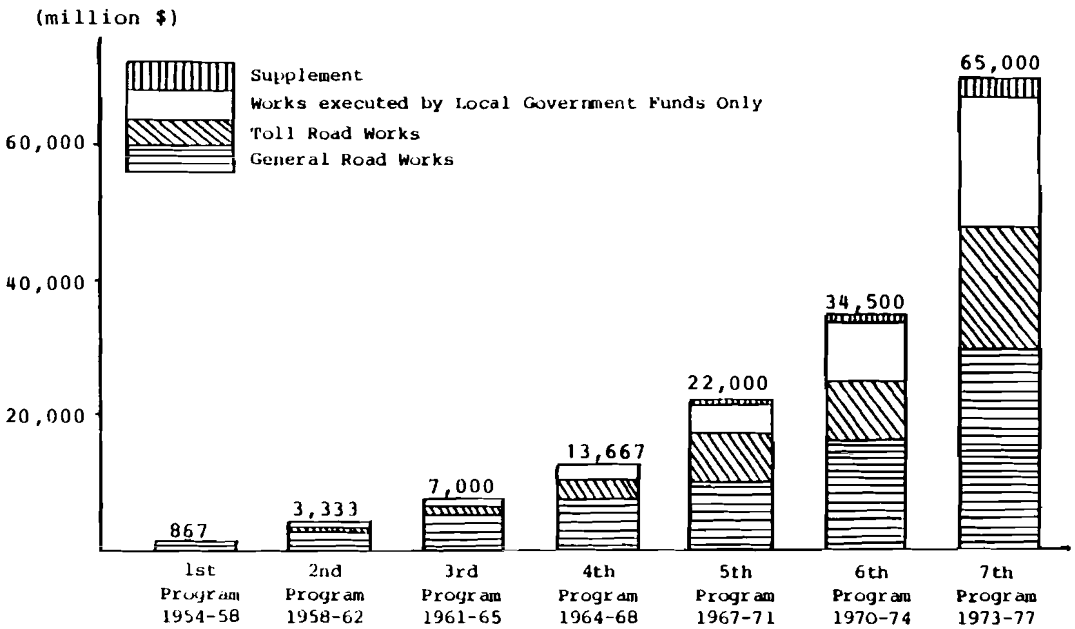


Figure 4.14 THE TREND OF FIVE-YEAR ROAD IMPROVEMENT PROGRAMS

Source: MOC, 1977

definition, etc., of roads, and clearly defines the road administrative system. Furthermore, the Law stipulates regulations necessary for the exclusive use and maintenance of roads so that roads can perform their own functions, and also stipulates how to share expenses required for road administration.

- National Expressway Law (Law No. 79 of 1957)
  In addition to the provisions of the Road Law, this Law stipulates matters relating to the route designations, improvement programs, administration, construction, maintenance, etc., of national expressways. This is the basic law for national expressways.

- National Development Arterial Expressway Construction Law (Law No. 68 of 1957)
  The purpose of this Law is to establish provisions for accelerating the construction of a 7600 km long national expressway system.

Table 4.5 shows the history of the issue of construction orders and Table 4.6 shows the status of the road network in operation in 1965.

Table 4.5 HISTORY OF FIRST STEPS IN THE DEVELOPMENT OF A NATION WIDE EXPRESSWAY NETWORK

DATE OF ISSUE OF CONSTRUCTION ORDER		LENGTH	EXPRESSWAY
October	1957	190	Nagoya-Kobe Expressway
May	1962	93	Tokyo-Fujiyoshida Expressway
May	1962	162	Tokyo-Nagoya Expressway (Tokyo-Shizuoka Section)
September	1962	77	Tokyo-Nagoya Expressway (Toyokawa-Komaki Section)
October	1963	107	Tokyo-Nagoya Expressway (Shizouka-Toyokawa Section)

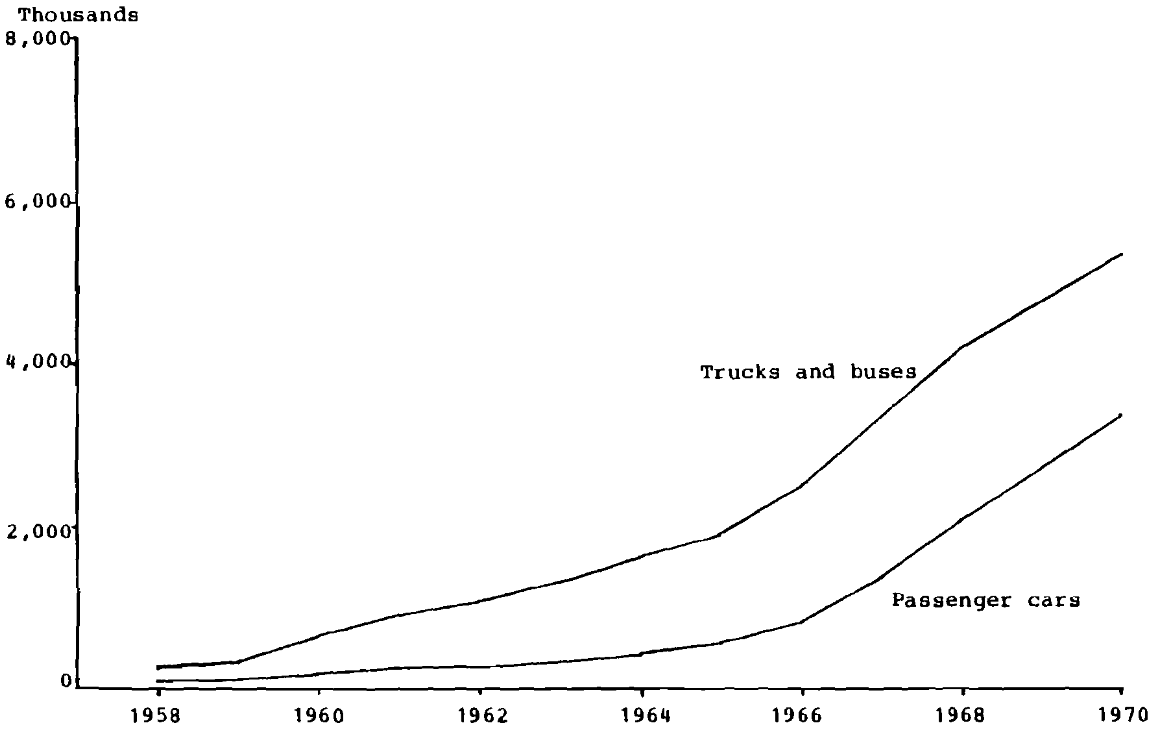
Table 4.6 STATUS OF THE JAPANESE ROAD NETWORK IN 1965 (MOC, 1977)

CATEGORY OF ROAD	LENGTH (km)	IMPROVED (%)	PAVED (%)
National Expressways	181	100	100
National Highways	27,858	60.4	51.1
Prefectural Roads	120,593	30.7	13.5
Municipal Roads	836,382	11.4	3.7
TOTAL	984,934	16.1	7.5

(2) Vehicles. One very important supply factor represents the growth of the Japanese automobile industry. Figure 4.15 shows that in the middle of the 1960's the number of produced trucks, buses and passenger cars increased very rapidly. Japan jumped up to the second largest automobile producer in 1967 as is shown by Figure 4.16. However, during the time period of planning and constructing Tokaido Shinkansen the status of the road transportation system did not permit the automobiles to be a competitor of the train in inter-city passenger traffic.

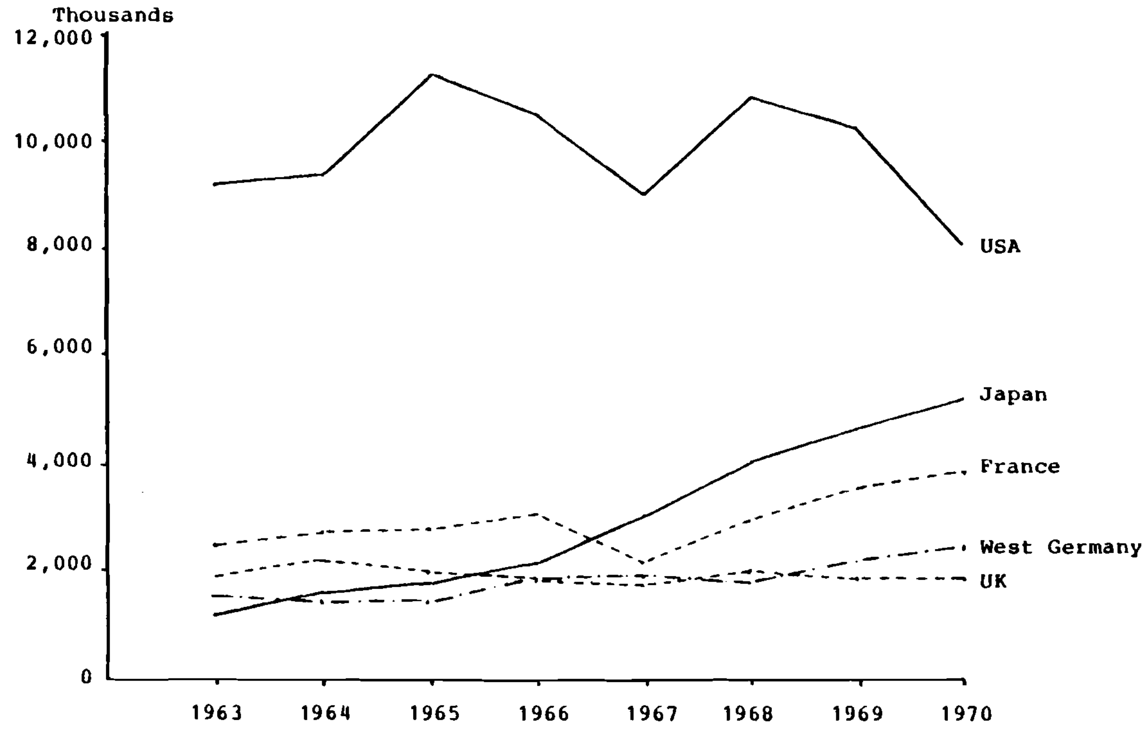
4.2.3.2 Status of the Air Traffic System

By the end of World War II, civil air transportation service had been interrupted. In 1951 a new era of air transportation was started by the founding of Japan Air Lines (JAL). But at that time JAL was operating only four aircraft . In spite of the steep increases of traffic volume shown in Figure 4.13, inter-city air transportation did not play a substantial role until 1965.



Note: Tricycles are excluded.

Figure 4.15 JAPAN'S AUTOMOBILE PRODUCTION



Note: Four-wheelers only.

Figure 4.16 PRODUCTION OF AUTOMOBILES IN SELECTED COUNTRIES

4.2.3.3 Supply Impacts

During the pre-Shinkansen period supply impacts in the form of endangering the environment and ineffective energy consumption did not play an important role with respect to the development of new transportation systems. Safety impacts, on the other hand, represented a major aspect in the further development of the rail system, though most of the safety problems were resulting from the road traffic system. In 1965, 12,400 human beings were killed in street accidents. This figure was very high with respect to the number of registered motor vehicles, i.e., 15.8 fatalities occurred per 10,000 vehicles. On the other hand, the number of fatalities per 10^4 inhabitants and per 100 km road length was, and still is, much lower than in the USA and the West European countries, as is shown by Figure 4.17. In the USA and the West European countries 2 to 3.5 human beings per 10^4 inhabitants were killed per year from 1962 until 1974. The same figure reached in Japan in 1965 a value of 1.27 lying in the same order as those valid for most of the East European countries (Figure 4.17).

In conclusion one may state that:

- The improvement of railway traffic safety was a major concern in the development of the Shinkansen.
- Road traffic safety, on the other hand, did not play a central role with respect to a coordinated road-rail transportation systems development.

4.2.4 Actors

Now let us turn to the question: What role did the individual actors shown in Figure 4.1 play in the development of the Shinkansen project?

4.2.4.1 Travelers and Residents

Only very little could be found regarding the involvement of the citizens in the decision process. Prospective passengers appreciated the idea of a fast train connection and residents during that time were not yet so sensitive about environmental

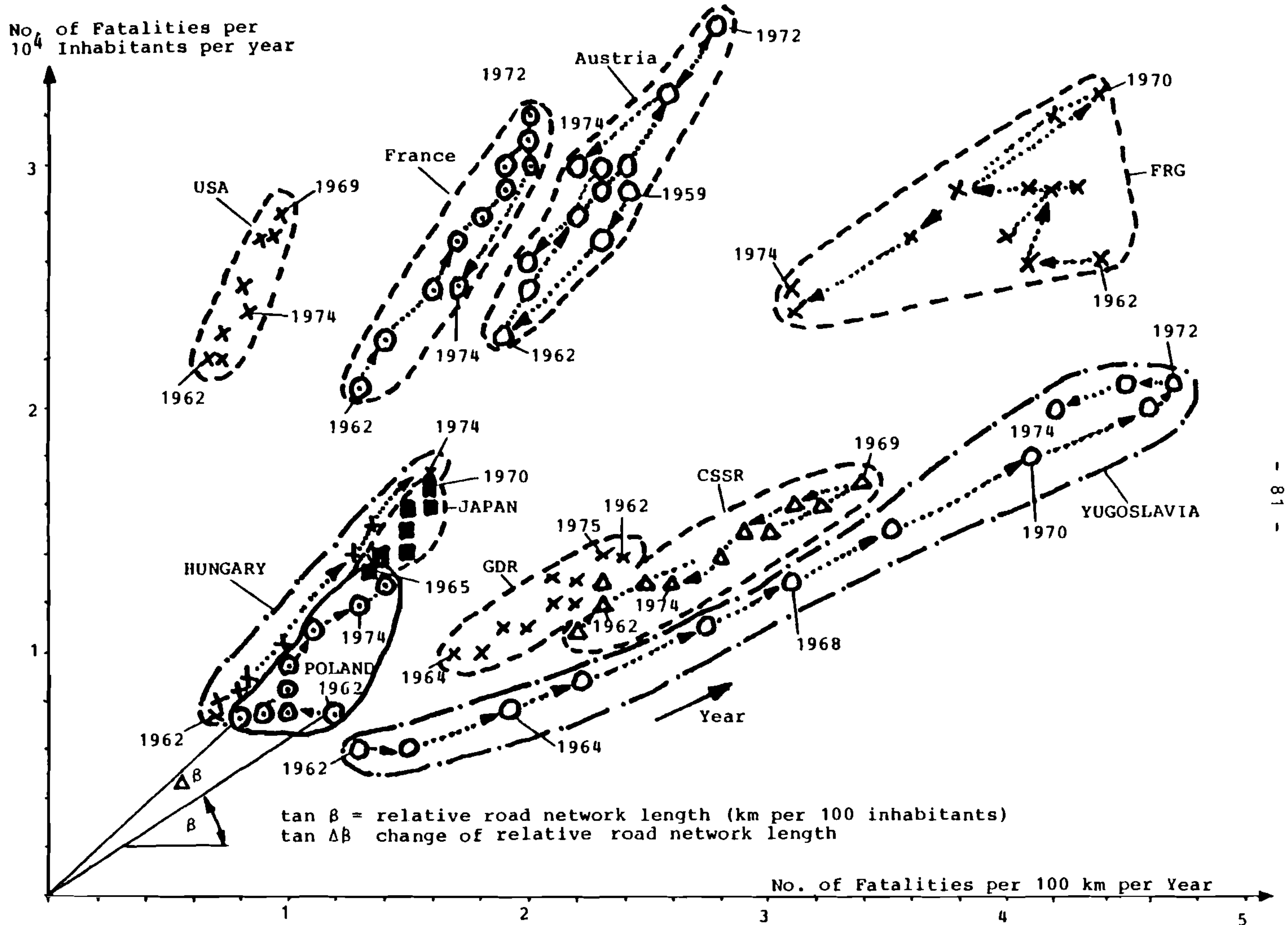


Figure 4.17 THE NUMBER OF FATALITIES PER YEAR RELATED TO THE NUMBER OF INHABITANTS AND THE ROAD NETWORK LENGTH FOR SELECTED COUNTRIES AND THE TIME PERIOD 1962-74
(ECE, 1976:IRF,1976)

impacts. What remains is the opposition of certain "experts" (university professors, politicians) already mentioned in 4.2.1, who believed in the "railway downfall theory".

4.2.4.2 Transportation Companies and Government Actors

JNR played the key role in the formation of the Shinkansen Project, i.e., the Railway Technical Research Institute and several outstanding leaders of the JNR top management and especially the then President of JNR, Mr. Shinji Sogo.

As illustrated by Figure 4.18 the first step was taken by the Railway Technical Research Institute when a public lecture on "High Speed Railway in the Future" was presented in commemoration of its 50th anniversary in May 1957. The lecture presented the following conclusion:

> In view of the results obtained from the technological studies in rolling stock, track, electric facilities and other aspects, it is possible for JNR to cover the distance of 550 km between Tokyo and Osaka in three hours by electric train, at a maximum speed of 250 km/h.

The publication was really an epoch-making event considering the international railway common sense in those days. In July 1957, President Sogo requested the government to study the betterment of transport capacity of the Tokaido Line. The Minister of Transport, accepting this request, established the JNR Trunk Line Investigation Commission in August 1957, which consisted of permanent vice-ministers of the Ministries concerned, college professors, heads of Commerce and Industry Chambers along the railway line, presidents of city banks, newspaper editorial writers and the President and Vice-President of JNR.

The items studied by the Commission were:

(1) Necessity of a new line
- transport demand on the Tokaido Line
- plans for various modes of transport namely:
  - superhighway between Tokyo and Kobe
  - coastal shipping
  - airlines
- the time of the Tokaido Line service coming to stalemate.

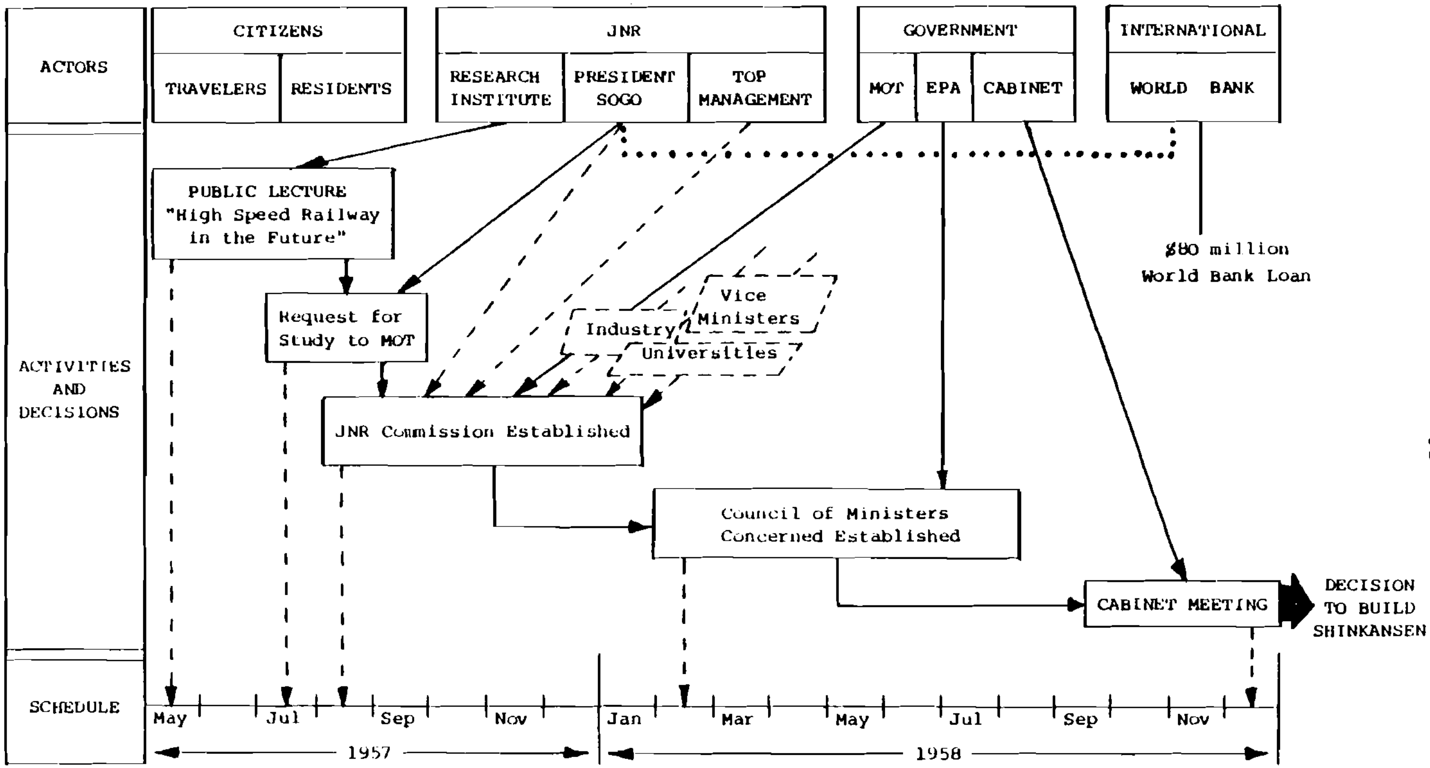


Figure 4.18 INVOLVEMENT OF DIFFERENT ACTORS IN THE DECISION PROCESS REGARDING THE CONSTRUCTION OF THE TOKAIDO SHINKANSEN

(2) The form of the New Line (narrow, standard gauge, etc.)

(3) Funds needed for construction work and operation of the new line.

The commission developed these findings (Nishida, 1977):

- The most conservative estimate disclosed that the passenger traffic in 1957 would almost double in 1975 and the freight traffic would increase 2.3-fold during the same period and that the traffic would continue increasing thereafter.

- Superhighway between Tokyo and Kobe: The superhighway between Tokyo and Kobe has to do with the Tokaido Line. So, in estimating the traffic to divert to it from the Tokaido Line, the two plans for the construction of the Chuo and the Tokaido superhighways had been studied carefully in detail. As the result, it was estimated that about 10 to 19 percent of passengers and 4 to 5 percent of freight would divert to the Tokaido Superhighway, when its Nagoya-Kobe section would open in 1962 and the rest of the way between Nagoya and Tokyo in 1965.

- Coastal Shipping: The traffic by coastal shipping along the Tokaido areas was increasing year after year, but freight had diverted from coastal shipping to land transport during and after the war. That is, the share in traffic by coastal shipping had largely dwindled. It was assumed, therefore, that the freight traffic diverted from railway to coastal shipping would not reach so much as to call for consideration unless drastic changes take place in tariff rates or in the economic situation.

- Airlines: The growth of traffic by airplanes had been spectacular of late years and further growth was expected. Nevertheless, the traffic by airplane was extremely small as compared with that by railway. It was assumed, therefore, that the traffic diverted from railway to it might be somewhat qualitatively affected, but it would be negligible as far as the absolute quantity was concerned.

- The stalemate year of the Tokaido Line was calculated by subtracting the traffic diverted to other modes of transport from the transport demand on the Tokaido Line.
- As the result, it was concluded that the transport capacity of the Tokaido Line would most likely reach its saturation point in 1961 or 1962, even when the maximum traffic to divert was considered in the light of the minimum transport demand.
- As the result of deliberations, it was concluded that a new line had to be constructed on the Tokaido corridor as soon as possible.

Along with the progress of deliberation by the JNR Trunk Line Investigation Commission set up in the Ministry of Transport, it had become mandatory to look into the necessity of the Shinkansen in connection with the plans for expressway construction. Therefore, a council of ministers concerned in transportation was set up in the Economic Planning Agency in February 1958. This commission reviewed again the items investigated by the JNR commission and came up with the following conclusions:

- The transport capacity of a superhighway is far below that of a double-track railway line (40,000 motor cars a day on a four-lane expressway at an average speed of 70 km/h) and, besides, the former requires more than twice as much land.
- The traffic to divert from the old Tokaido Line to the new expressway would presumably be about 10 percent in passenger traffic and about 5% in freight.
- Both a new railway line and a new expressway are needed; it would not do to strengthen either one of them alone in meeting the increasing transport demand.

Thus the Tokaido Shinkansen construction plan was approved at a cabinet meeting in December 1958.

4.2.4.3 International Actors

The following international aspects of the Shinkansen project should be mentioned:

- There was in the beginning a lot of skepticism among members of the international railway community because of the "railway downfall theory". Thus, the Shinkansen project only obtained moral support from the high-speed train test runs of the French railways.
- A World Bank loan of $80 million offered substantial economic support.

4.2.5 Findings

The results of what we have seen so far may be summarized as follows:

- The Tokaido Shinkansen was not created to compete with the airplane and the automobile in luxury and speed, but to meet the traffic demand, qualitatively and quantitatively; the question of competition between different transport modes--which is presently very important--did not play an important role in Japan during the end of the 1950's.
- Thus the applied transportation system development strategy could be classified as a straightforward supply strategy (Figure 4.1) which followed the target to develop as fast as economically feasible all modes of transport, especially rail, air, and road traffic systems. One may consider this as a lack of integrated transport planning. But under the specific Japanese conditions discussed in the previous paragraphs there existed no degree of freedom to take fundamentally different decisions. Because of the previously mentioned danger of a deadlock of the Tokaido Main Line it was a must to construct a new line; otherwise drastic negative economic impacts would have occurred. A certain flexibility for alternative decisions existed obviously with regard to the form of the new line (narrow gauge, standard gauge, routing, etc.).

- It is clear that the Tokaido Shinkansen was not realized on techno-economic growth grounds alone, but that, to a considerable degree, it has to be credited to the outstanding role of JNR, especially of its then President Sogo. Thus, JNR and the corresponding government institutions played the key roles in the decision process. There was little involvement of the citizens, i.e., of the people whose living environment was later heavily influenced by unexpected environmental impacts.

4.3 <u>The First Decade of the Shinkansen Age</u>

The installation of the Shinkansen provided a unique opportunity to check the correctness of various theories on the future role of high-speed rail inter-city passenger traffic systems.

Therefore this section aims to analyze the <u>demand-supply interrelations</u> and <u>supply impacts</u> that resulted from opening the Shinkansen service between Tokyo and Osaka (in 1964) as well as between Osaka and Fukuoka (in 1975). The development in the regions served by Shinkansen will be compared with the general development of inter-city passenger transport in Japan. Finally, the role of the actors mentioned in Figure 4.1 will be discussed with respect to the formulation of new transportation systems development plans.

4.3.1 <u>Supply-Demand Inter-relations</u>

First of all, we shall analyze to what extent the Shinkansen was capable of meeting the expectations of its founders. Of special interest is, as discussed in the preceding paragraph, avoiding a deadlock of the "old" Tokaido Line.

4.3.1.1 Rail Transport Demand Impacts

It has already been mentioned that the growth of JNR passenger traffic was relatively low compared with the growth of air and road traffic (Figure 4.13). Also notable is the fact that the share of the railway and the motor vehicle traffic reversed in the beginning of the 1970's (Figure 4.12). In spite of this general trend, the passenger traffic by the Shinkansen grew 5.1 times during the first decade of its existence, showing a much higher and different pattern of growth compared with the other lines of JNR. Particularly outstanding is the fact that this growth far exceeded that of GNP and per capita national income as is shown in Figure 4.19 (Sanuki, 1977).

The traffic demand that one could have expected from the opening of the Shinkansen was estimated by gravitational models and other known methods taking into account the close relation between traffic volume and national income (Figure 4.7). Figure 4.20 shows that the actual traffic volumes remarkably exceeded the predicted values.

The interregional origin-destination (OD) structure of the Shinkansen traffic shown in Table 4.7 reveals the following characteristics:

- The Shinkansen is fulfilling its function as a high-speed mass transportation means in the Tokaido megalopolis, linking the three great metropolitan areas of Tokyo, Nagoya and Kyoto-Osaka-Kobe.
- Shinkansen serves as a traffic artery between the Tokaido megalopolis and the four regions of Chugoku, Shikoku, Kyushu and Hokuriku.
- Shinkansen is mainly being used for travels in the 150 km to 60 km range. In recent years, a rapid increase is seen in the 70 km to 100 km range.
- The second basic impact of the Shinkansen consists of the fact that it created a margin in the capacity of the Tokaido Line by absorbing most of the daytime and nighttime ordinary expresses and all of the daytime limited expresses (Kamada, 1977). This is illustrated by Figure 4.12 showing the number and kinds of trains on the "old" Tokaido Main Line before and after inauguration of the Tokaido Shinkansen.*

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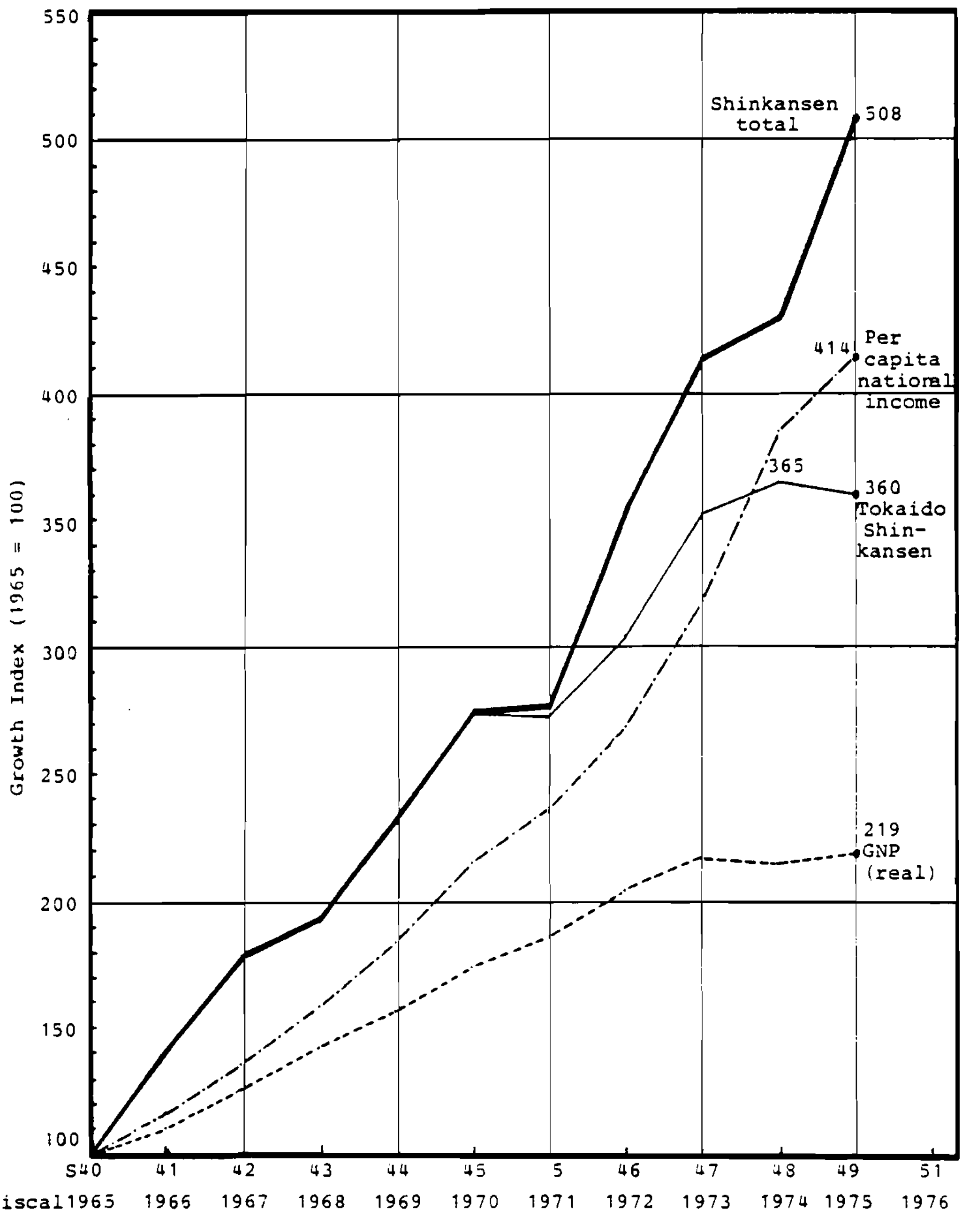
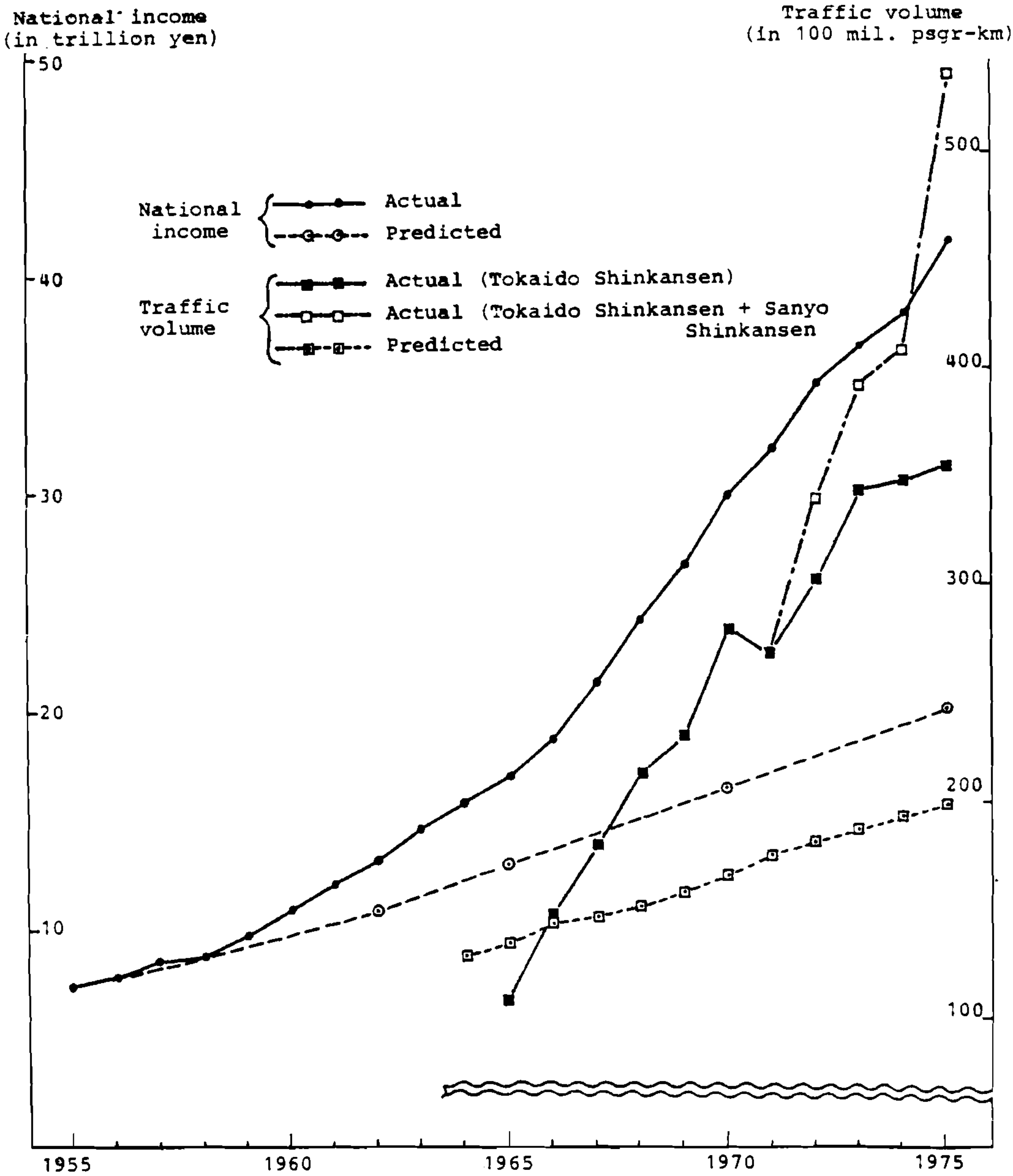
* A detailed discussion of further railway-typical impacts will not be presented here (see Chapter 5).



Source: (Sanuki, 1977)

Figure 4.19 ECONOMIC GROWTH AND SHINKANSEN TRAFFIC



Source: (Okabe, 1977)

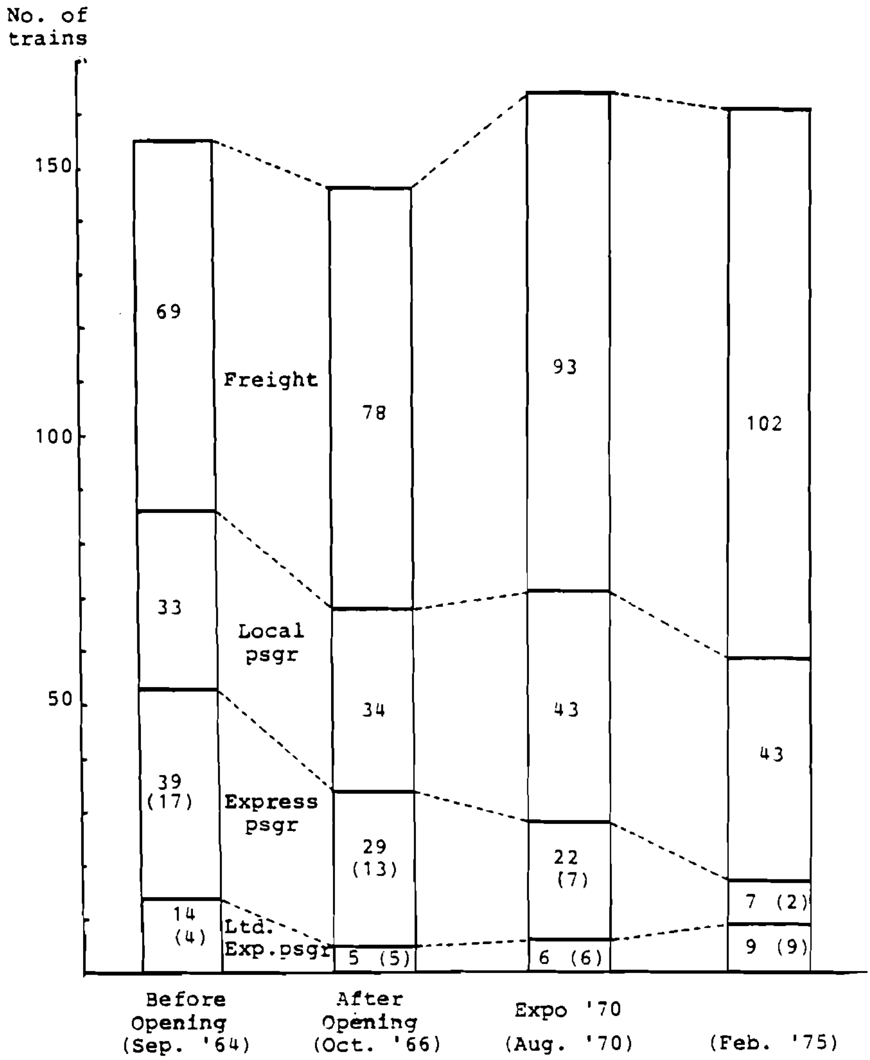
Figure 4.20 <u>PREDICTED AND ACTUAL TRAFFIC VOLUME ON THE SHINKANSEN</u>

Table 4. 7 INTERREGIONAL OD STRUCTURE OF SHINKANSEN PASSENGER TRAFFIC (FISCAL 1975)

(Unit: 1,000 persons)

O / D		TOKYO METRO-POLITAN SPHERE	IZU-HAKONE TOURISM SPHERE	SHIZUOKA-HAMAMATSU CITY SPHERE	NAGOYA CITY SPHERE	HOKURIKU TRANSFER BASE	KYOTO-OSAKA-KOBE CITY SPHERE	SANYO MEGAL-OPOLIS	KYUSHU SPHERE	TOTAL	INTER-SPHERE COEF-FICIENT
Tokyo metropolitan sphere		324	5,739	3,209	6,646	1,092	11,413	3,246	1,447	33,126	0.990
Izu-Hakone tourism sphere		7,076	485	973	1,644	253	2,312	301	129	13,172	0.965
Shizuoka-Hamamatsu city sphere		3,226	963	915	1,721	156	1,746	225	84	9,036	0.899
Nagoya city sphere		6,799	1,309	1,953	669	686	6,096	2,186	1,221	20,919	0.968
Hokuriku transfer base		1,186	233	174	469		741	62	34	2,930	1.000
Kyoto-Osaka-Kobe city sphere		11,885	1,634	1,406	7,801	715	3,197	9,695	2,621	38,958	0.918
Sanyo megalopolis		3,167	199	199	1,533	85	10,504	8,278	3,183	27,124	0.695
Kyushu sphere		1,438	86	102	784	47	3,112	3,447	2,938	11,954	0.754
TOTAL		35,104	10,643	8,932	21,265	3,034	39,112	27,471	11,656	157,218	0.893
Inter- & intra-sphere structure	Intra-sphere coefficient	0.009	0.046	0.102	0.031	0.000	0.082	0.301	0.252	0.107	-
	Inter-sphere coefficient	0.991	0.954	0.892	0.969	1.000	0.918	0.699	0.748	0.893	-

Source: (Sanuki, 1977)



Notes: 1. Up trains only between Shizuoka and Hamamatsu daily.
2. Parenthesized are sleeper trains, included in total.

Source: (Kamada, 1977)

Figure 4.21 <u>TOKAIDO LINE TRAINS BEFORE AND AFTER OPENING OF THE SHINKANSEN</u>

4.3.1.2 Modal-Split Impacts

The influence of the Shinkansen of the traffic demand for other modes of transport is shown by Figure 4.22. The numbers were obtained by on-board investigation after the opening of Shinkansen to Hakata.

One observes that 30% of Shinkansen traffic demand resulted from a diversion of traffic from other transport means, where the greatest impact occurred with regard to air traffic. Only 4% of the traffic demand was caused by a diversion of motor car traffic. About 6% of Shinkansen traffic resulted from an inducement of new travel demand.

The impact of the Shinkansen on air traffic demand is shown in more detail by Figure 4.23 and Tables 4.8 and 4.9. Figure 4.22 shows that the decrease of air traffic volume was very remarkable for operating distances up to 500 km. Here the travelling time by Shinkansen is shorter than that by airplane if one includes the access time.

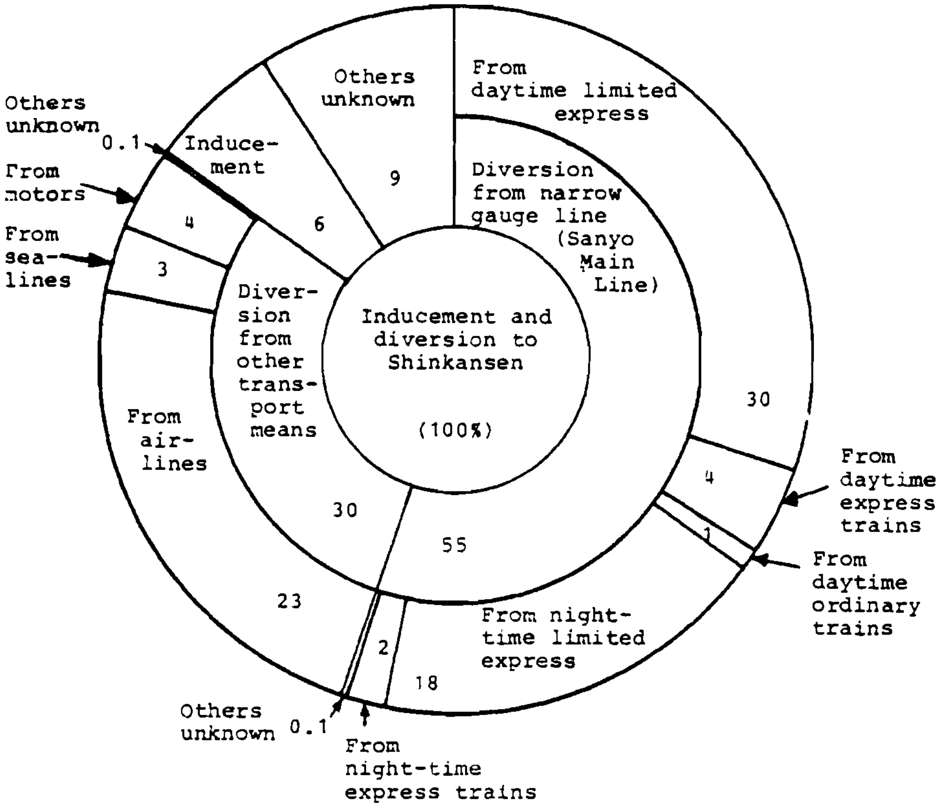
The results shown in Tables 4.8 and 4.9 and Figure 4.22 may be considered as practical proof of results obtained in sociological studies in other parts of the world regarding the main motivations of a traveller to choose this or that transport means. According to these results, the traveller will mainly make his decision on the basis of a comparison of the travel times.

4.3.2 Supply Factors and Impacts

4.3.2.1 Growth of the Individual Transport Systems

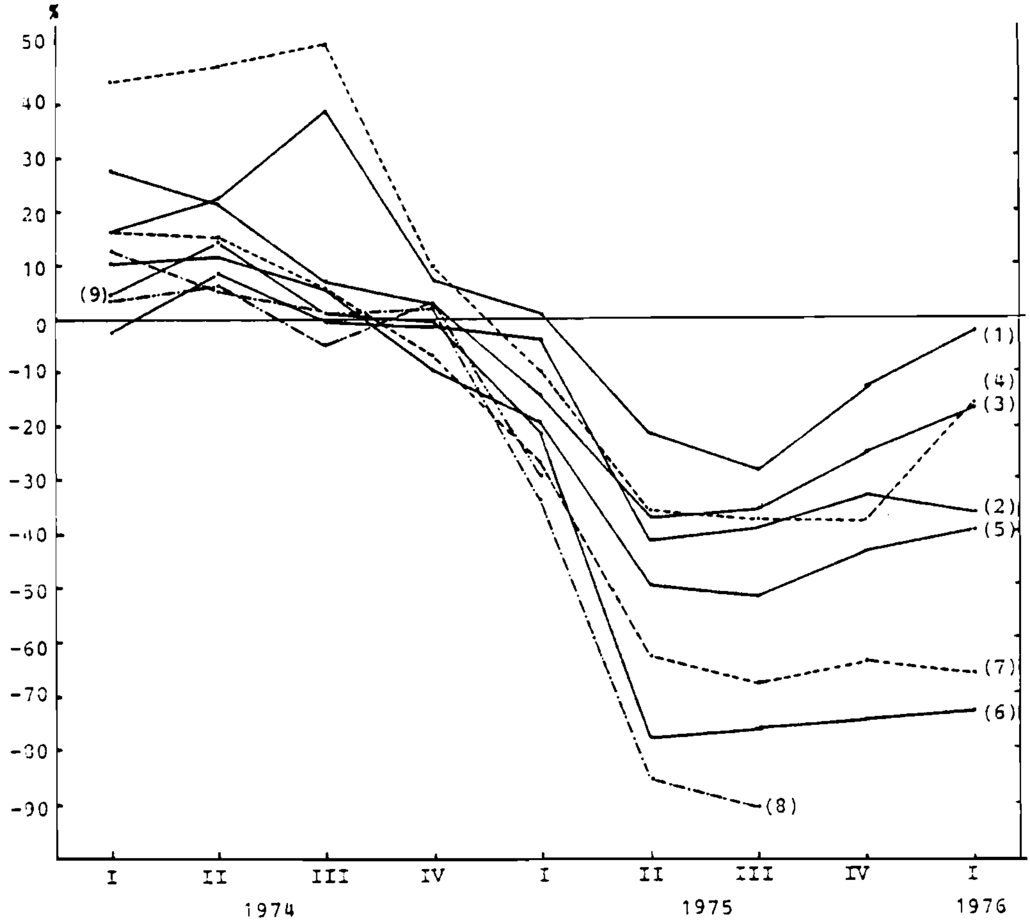
Figure 4.24 illustrates the time-dependent development of infrastructure investments. One observes that on a national scale the investments in road construction and improvement were larger than the corresponding investments for railway, airports, ports and harbors.

As one result, the length of the expressway network could be increased by a factor of 10, i.e., from about 180 km in 1965 (Table 4.6) to 1,891 km in 1976 (Figure 4.25). The quality of the whole road network was improved drastically (Table 4.6, Figure 4.25a).



Source: Japanese National Railways Kokutetsu Sen, September 1975

Figure 4.22 DIVERSION AND INDUCEMENT TO SHINKANSEN
(On-board investigation in April 1975) (Okabe, 1977)



(1) Tokyo - Fukuoka
(2) Tokyo - Hiroshima
(3) Tokyo - Ube
(4) Nagoya - Fukuoka
(5) Osaka - Fukuoka
(6) Osaka - Kita Kyushu
(7) Osaka - Ube
(8) Osaka - Hiroshima
(9) Hiroshima - Fukuoka

Source: (Okabe)

Figure 4.23 <u>THE PER CENT INCREASE OR DECREASE OF AIRLINE PASSENGER TRAFFIC AGAINST THE PRECEDING YEAR</u>

Table 4.8 COMPARISON OF TRANSPORT CONDITIONS BETWEEN THE SHINKANSEN AND AIRLINES

ITEM / SECTION	AIR TRAFFIC				SHINKANSEN			Difference between fares	Time difference	Inc. or dec. of air psgrs
	Operating distance (km) (a)	Fare (yen)	Operating time (mins.)	Traveling time incl. access time (mins.) (b)	Operating distance (km)	Fare incl. Green Car charge (yen) (c)	Traveling time hrs. mins. (d)	(yen) (a)-(c)	(d/b)	'75/'74 (%)
(Cities along the line)										
Tokyo - Fukuoka	1,006	19,500	90	240	1,117	12,710	6.56 416	6,790	1.733	-16.1
Tokyo - Ube	901	17,100	170	320	1,053	12,010	6.30 390	5,090	1.219	-28.5
Tokyo - Hiroshima	835	15,800	150	300	895	10,910	5.08 308	4,890	1.027	-30.3
Nagoya - Fukuoka	661	12,400	75	275	811	10,710	4.53 293	1,690	1.066	-30.9
Osaka - Fukuoka	520	9,700	55	205	621	8,610	3.44 224	1,090	1.090	-40.9
Osaka - Kita Kyushu	463	8,400	90	240	556	7,020	3.10 190	1,380	1.292	-64.9
Osaka - Ube	419	8,300	80	230	497	6,300	3.30 210	2,000	0.913	-55.9
Osaka - Hiroshima	320	7,700	65	215	343	4,890	1.56 116	2,810	0.540	-77.1
Hiroshima - Fukuoka	300	5,800	60	180	282	4,280	1.46 106	1,520	0.589	-83.1
(Cities in Kyushu beyond Fukuoka)										
Tokyo - Nagasaki	1,125	21,900	105	315	1,331	14,310	10.22 622	7,590	1.975	102.6
Tokyo - Kagoshima	1,043	22,100	105	285	1,491	15,510	12.15 735	6,590	2.578	2.5
Tokyo - Kumamoto	993	20,200	95	275	1,295	14,360	8.53 533	5,840	1.938	5.8
Tokyo - Oita	913	18,400	100	310	1,242	14,260	8.39 519	4,140	1.674	-1.4
Nagoya - Kumamoto	668	14,200	65	275	929	12,360	6.50 410	1,840	1.491	-19.5
Osaka - Nagasaki	600	12,600	70	280	778	10,210	7.10 430	2,390	1.536	0.4
Osaka - Kumamoto	600	11,200	60	240	743	10,260	5.41 341	940	1.421	-14.4
Osaka - Oita	453	8,600	55	265	689	8,860	5.27 327	- 260	1.234	-16.9
(Cities in Shikoku)										
Tokyo - Matsuyama	861	15,900	85	235	979	11,430	9.07 547	4,470	2.328	48.8
Tokyo - Kochi	698	15,100	120	270	944	11,330	8.57 537	3,770	1.989	0.4
Osaka - Matsuyama	453	8,600	55	265	426	5,620	5.55 355	1,080	1.340	-0.9

Notes: (1) Access time calculated on the basis of "Koku Ryokaku Dotai Chosa" (Air Passenger Movement Statistics, Nov. 1975), the Ministry of Transport.
(2) Access time required to each airport: (in mins.) Tokyo, Osaka, Kumamoto & Kagoshima: 90; Nagoya, Nagasaki & Oita: 120; Hiroshima, Ube, Kita Kyushu, Fukuoka, Kochi, & Matsuyama: 60

Source: (Okabe, 1977)

Table 4.9 PASSENGER TRAFFIC ON COMPETITIVE AIRLINES

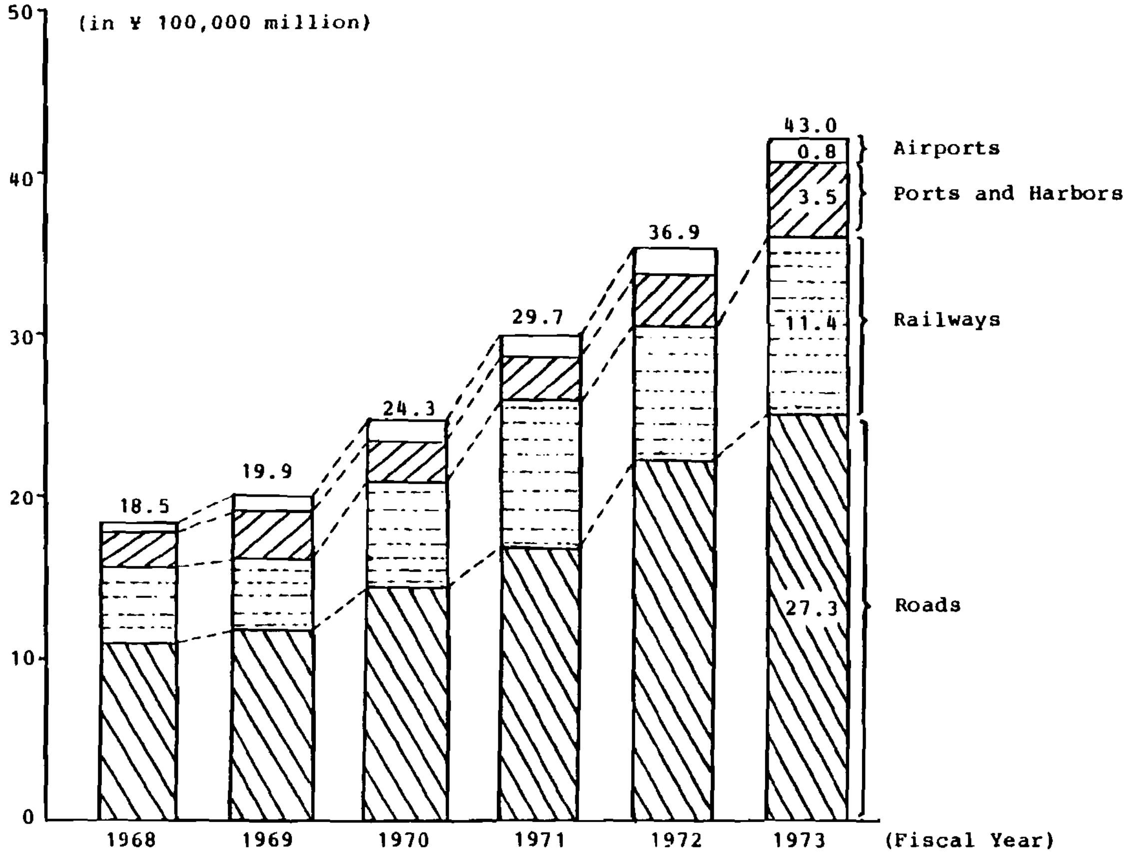
(Unit: persons)

		TOKYO - FUKUOKA	TOKYO - UBE	TOKYO - HIROSHIMA	NAGOYA - FUKUOKA	OSAKA - FUKUOKA	OSAKA - KITA KYUSHU	OSAKA - UBE	OSAKA - HIROSHIMA	HIROSHIMA - FUKUOKA
1974	Jan - Mar	459,514 (3.3)	12,701 (-6.4)	54,361 (-10.6)	68,359 (7.4)	448,073 (2.3)	60,873 (-6.3)	23,805 (-7.8)	73,431 (3.6)	18,285 (1.7)
	Apr - Jun	483,549 (5.2)	13,816 (8.8)	60,488 (11.3)	70,591 (3.3)	445,339 (-0.6)	65,033 (6.8)	25,339 (6.4)	70,902 (-3.4)	17,379 (-4.9)
	Jul - Sep	585,531 (21.1)	15,271 (10.5)	63,720 (5.3)	81,577 (15.6)	455.745 (2.3)	68,273 (5.0)	28,067 (10.7)	71,401 (0.7)	18,198 (4.7)
	Oct - Dec	470,357 (-19.7)	13,938 (-8.7)	59,753 (-6.2)	69,793 (-14.4)	395,410 (-13.2)	64,269 (-5.9)	24,225 (-3.7)	72,184 (1.1)	18,505 (1.7)
1975	Jan - Mar	462,399 (-1.7)	10.869 (-22.0)	52,151 (-12.7)	61,370 (-12.1)	360,916 (-8.7)	47,731 (-25.7)	17,430 (-28.0)	49,188 (-31.9)	12,201 (-34.1)
	Apr - Jun	377,910 (-18.3)	8,710 (-19.9)	35,417 (-32.1)	45,043 (-26.6)	224,070 (-37.9)	14,400 (-69.8)	9,426 (-45.9)	10,121 (-79.4)	-
	Jul - Sep	426,967 (13.0)	9,813 (12.6)	38,804 (9.6)	50,739 (-12.7)	221,080 (-1.3)	16,351 (13.6)	9,081 (-3.7)	6,662 (-34.2)	-
	Oct - Dec	409,040 (-4.2)	10,436 (6.4)	39,842 (2.7)	43,529 (-14.2)	224,319 (1.5)	16,475 (0.8)	8,806 (-3.0)	-	-
1976	Jan - Mar	449,040 (9.8)	9,041 (-13.4)	38,456 (-3.5)	51,471 (18.3)	219,374 (-2.2)	13,001 (-21.1)	5,966 (-32.2)	-	-
TOTAL FOR 1974		1,998,951 (18.3)	55,726 (13.3)	238,322 (0.7)	290,320 (36.3)	1,744,567 (4.0)	268,448 (7.7)	101,436 (6.9)	287,918 (5.2)	72,367 (3.1)
TOTAL FOR 1975		1,676,316 (-16.1)	39,828 (-28.5)	166,214 (-30.3)	200,681 (-30.9)	1,030,385 (-40.9)	94,957 (-64.6)	44,743 (-55.9)	65,971 (-77.1)	12,201 (-83.1)

Notes: (1) The figures in parentheses indicate percentage of increase or decrease against previous year.

(2) Source: Koku Yuso Tokei Nempo (Air Transport Statistic Yearbook) compiled under the supervision of the Ministry of Transport.

Source: (Okabe, 1977)



Source: (MOT, 1975)

Figure 4.24 TRANSITION OF DEVELOPMENT WORK COSTS OF TRANSPORT INFRASTRUCTURES

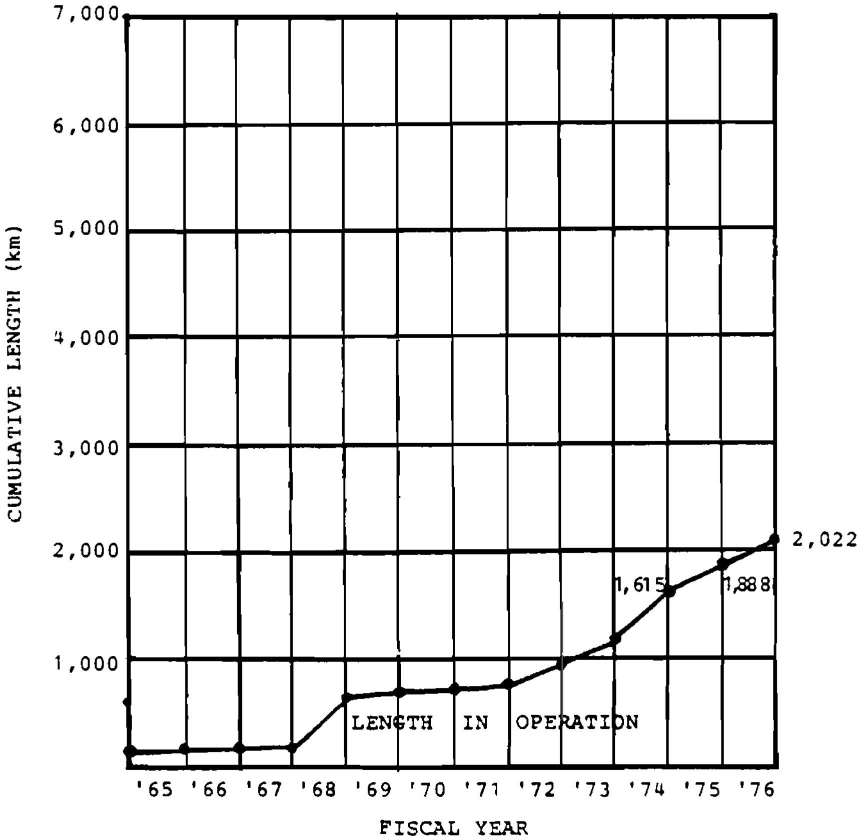
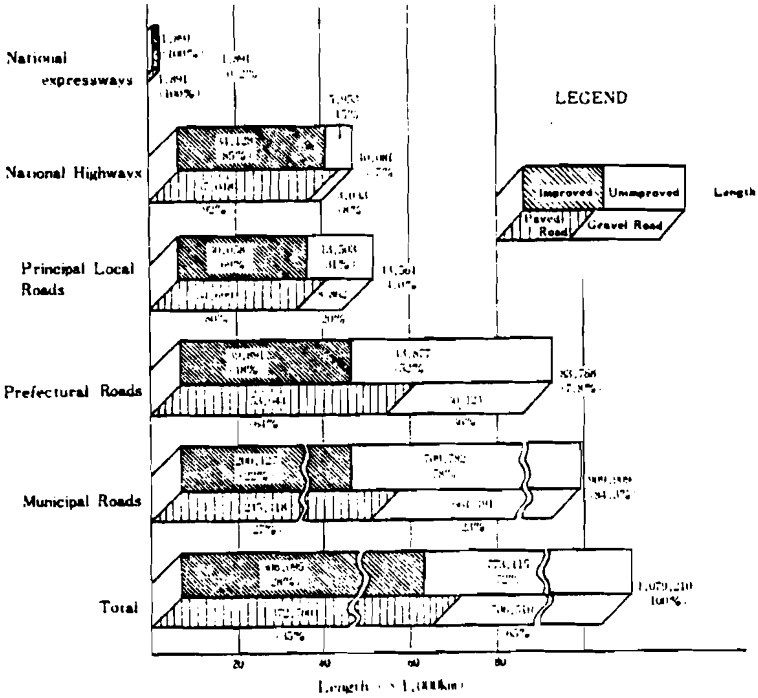


Figure 4.25 HISTORY OF THE NATIONAL EXPRESSWAY DEVELOPMENT

(MOC,1977)



Source: MOC, 1977

Figure 4.25a PRESENT STATUS OF ROADS AS OF APRIL 1, 1976

The progress of the Five Year Road Improvement Programs is illustrated by Table 4.10. Moreover the number of registered motor vehicles increased from about 7 million in 1965 to about 28 million in 1976, i.e., by a factor of four (Table 4.11, Figure 4.7). During the first decade of the Shinkansen, Japan was becoming one of the most heavily motorized countries of the world.

Resulting from this development, the traffic volume on the opened expressways increased by factors in the order of about two to three (Table 4.12).

Air transportation in Japan has been growing steadily since 1965. Under the First and Second Five Year Airport Improvement Programs, old airports were being improved and the construction of new airports was being stepped up energetically. The civil airports which existed as of August 1, 1974, included three Class I Airports (airports necessary for international air routes), 19 Class II Airports (airports necessary for major domestic air routes), 40 Class III Airports (airports necessary for the maintenance of local air transport), and 60 Airports for Common Use (airports established and managed by the Defense Agency but usable by civil aircraft).

Figure 4.26 shows that almost all large cities lying along the Shinkansen do have access to airports. Tokyo, Osaka and Fukuoka are served by all three domestic airlines, i.e., Japan Air Lines (JAL), All Nippon Airway (ANA) and Toa Domestic Airlines (TDA) (Figure 4.26a).

The large road and air system investments that were made during the first decade of the Shinkansen resulted in a further increase of traffic volume, as shown by Figures 4.12 and 4.13.

Now let us turn to the question: What impacts resulted from the increase of rail, road and air transport capacities? This question will be dealt with by focusing on a comparison of Shinkansen impacts with the impacts of air and road traffic systems. Figure 4.27 summarizes the essential results of this comparison.

Table 4.10 PROGRESS OF THE FIVE-YEAR IMPROVEMENT PLAN

(Unit: 100 million yen)

CLASSIFICATION	PLAN				WORK ACCOMPLISHED				FIVE-YEAR RESULTS		DETERMINANTS OF THE INVESTMENT SCALE
	PLAN PERIOD	WORK EXPENDITURES (A)	RATIO	PUBLIC INVESTMENT SHARE	EXECUTION PERIOD	EXPENDITURES	RATIO	GROWTH IN THE FIRST YEAR	WORK EXPENDITURES (B)	(B)/(A)	
				%							
1st Five-Year Program	1954-58	2,600	-	-	1954-57	3,086	1.005	-	4,468	1.718	Funds available
2nd Five-Year Program	1958-62	10,000	1.186	-	1958-60	5,252	1.247	1.247	12,539	1.254	Work required
3rd Five-Year Program	1961-65	21,000	1.143	21.74	1961-63	12,522	1.292	1.496	25,731	1.225	"
4th Five-Year Program	1964-68	41,000	1.139	23.03	1964-66	21,896	1.165	1.188	43,355	1.057	"
5th Five-Year Program	1967-71	(66,000) 64,500	(1.131) 1.119	22.36	1967-69	34,618	1.129	1.171	71,064	(1.077) 1.102	"
6th Five-Year Program	1970-74	(103,500) 102,500	(1.130) 1.125	21.27	1970-72	62,234	1.273	1.214	120,182	(1.161) 1.173	"
7th Five-Year Program	1973-77	(195,000) 190,000	(1.153) 1.139	21.11	1973-77	157,248	1.072	1.116	157,248	(0.806) 0.828	"
Late '70s Plan	1976-80	195,000	1.124	19.50	-	-	-	-	-	-	Funds available and work required

Note: Figures in parentheses includes reserve funds.

Source: (MOC, 1977)

Table 4.11 NUMBER OF REGISTERED MOTOR VEHICLES (AT THE END OF MARCH EVERY YEAR)

Unit: 1,000 vehicles

	1965	1968	1969	1970	1971	1972	1973	1974	1975	1976
Trucks	2,492	4,057	4,671	5,126	5,460	5,792	6,263	6,721	7,058	7,381
Passenger cars	1,462	3,275	4,291	5,512	6,777	8,173	9,965	11,598	13,207	14,822
Buses	95	133	153	176	190	197	206	214	219	220
Special cars	145	224	263	306	352	404	461	515	557	596
TOTAL	4,193	7,688	9,349	11,120	12,779	14,566	16,895	19,048	21,041	23,019
Light vehicles	2,747	3,938	4,567	5,298	5,968	6,436	6,737	6,654	6,553	5,867
Motor cycles	44	64	77	110	172	220	238	262	277	257
TOTAL	6,985	11,691	14,022	16,528	18,919	21,222	23,870	25,964	27,871	29,143
Vehicles with not less than three wheels	5,990	10,953	13,320	15,816	18,165	20,435	23,088	25,166	27,062	28,366
Increase rate of the vehicles with not less than three wheels (against the previous year)	1.22	1.24	1.22	1.19	1.15	1.12	1.13	1.09	1.08	1.05

Note: (1) Refers to the Brief of Statistics for Land Transportation, Ministry of Transportation.

(2) Excludes bicycles with engine and small special vehicles (mainly for agricultural use).

Source: (MOC, 1977)

Table 4.12 CHANGES IN TRAFFIC VOLUMES ON THREE MAIN EXPRESSWAYS

(Vehicles/day)

Expressway \ Fiscal Year	1968	1969	1970	1971	1972	1973	1974	1975
Nagoya-Kobe Expressway	17,622	24,598	31,757	32,135	36,966	41,179	41,505	37,700
Tokyo-Fujiyoshida Expressway	9,347	10,205	11,331	12,833	14,051	16,295	17,194	16,618
Tokyo-Nagoya Expressway	13,985	21,300	28,053	32,282	39,516	44,840	44,858	41,636

Note: Each figure means the annual average of daily traffic weighted by the sectional lengths on the expressway. The low growth rate in 1974 is due to the Oil Crisis in 1973 and the slight decrease in 1975 is mainly due to the 67 percent rise in toll fares in April.

Source: (MOC, 1977)

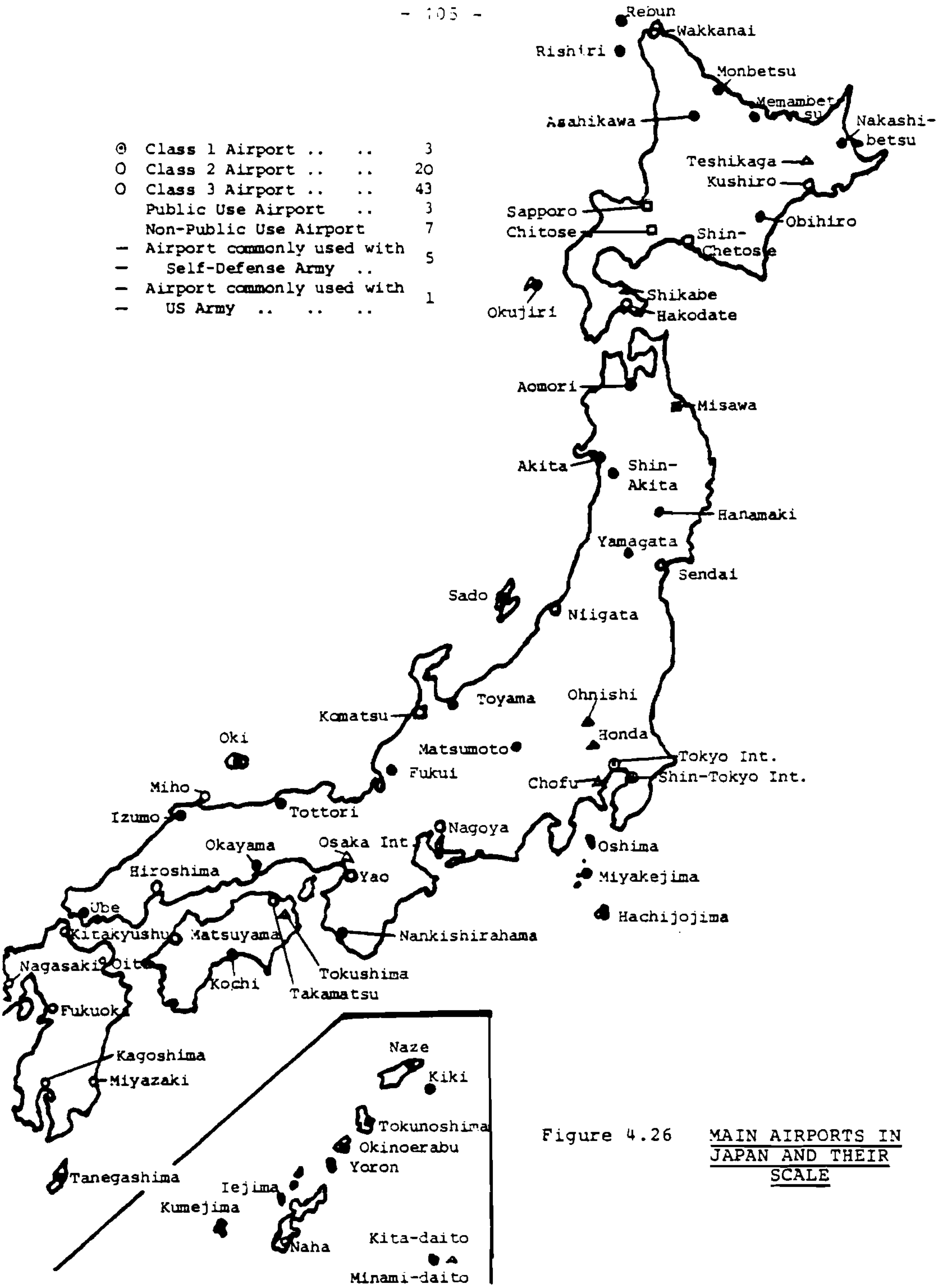


Figure 4.26 MAIN AIRPORTS IN JAPAN AND THEIR SCALE

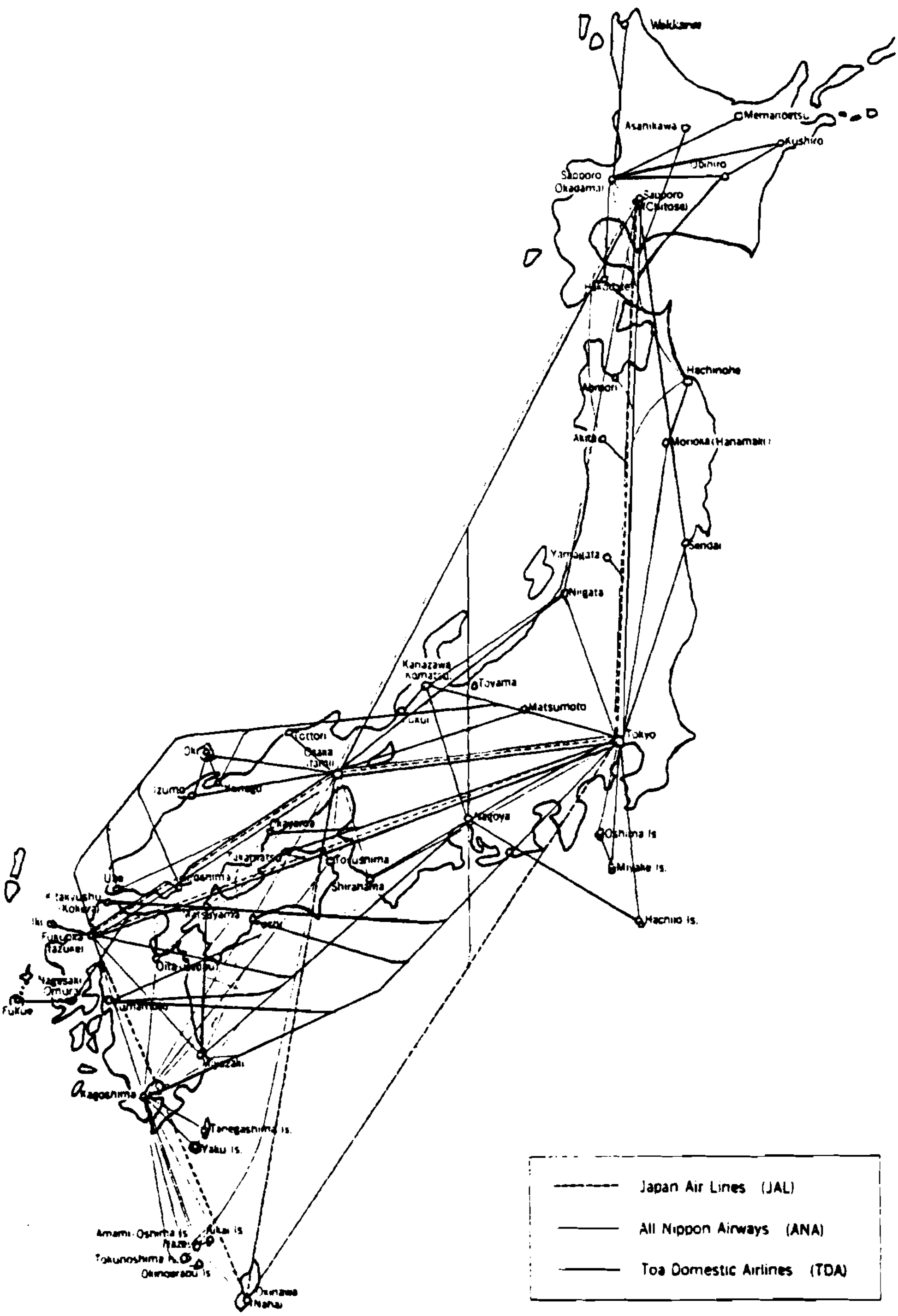


Figure 4.26a DOMESTIC AIRLINE ROUTES (AS OF OCTOBER 1973)

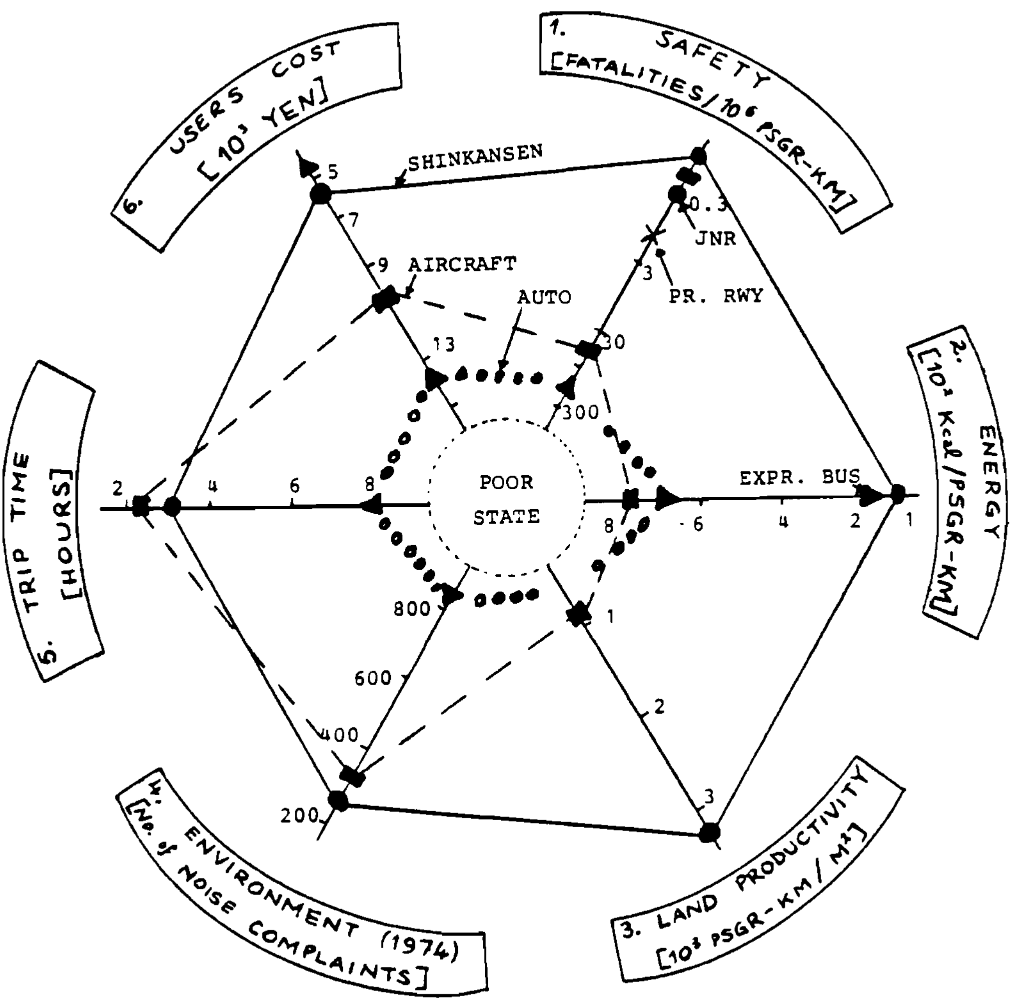


Figure 4.27

COMPARISON OF VARIOUS IMPACTS CAUSED BY SHINKANSEN (—●—), AIRCRAFT (-■-), AND AUTO (∘∘▶∘∘) traffic parameters [1,2,5,6 are taken from Kamada (1977); 3: according to Sanuki (1977), 4: according to Yorino (1977).]

4.3.2.2 Trip-Time Impacts

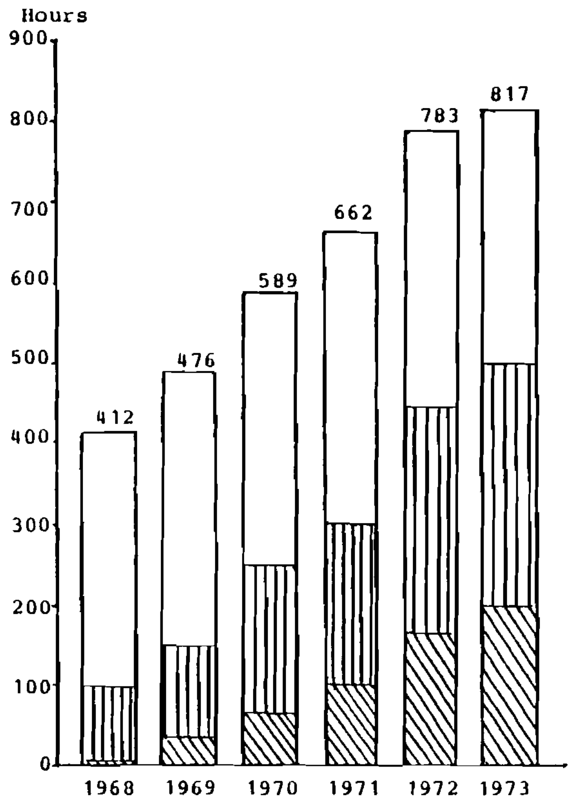
It is seen from Table 4.13 and Figure 4.27, valid for the Tokyo-Osaka relation, that from a trip-time viewpoint a railway system of the Shinkansen type will be highly competitive with the air connection and much more attractive than the auto if the travel distance lies in a range of about 500 km. As far as private car travel is concerned, drastic negative impacts occurred during the first Shinkansen decade with respect to congestion near and within the agglomeration centers. Between 1969 and 1970 the Tokyo Metropolitan expressway experienced up to six complete traffic breakdowns a day. Figure 4.28 shows the occurrence conditions of traffic congestion in Tokyo and Figure 4.29 illustrates the impact of traffic congestion on travel speed, environmental parameters, safety and energy consumption. For this purpose the following three states of freeway traffic were analyzed:

- Free traffic flow at low densities (≈7 cars/km/lane)
- Heavy but smooth-flowing traffic at a density of about 20 cars/km/lane
- Congestion caused by a high traffic density of about 55 cars/km/lane.

One observes that congestion can double or triple the travel times.

Table 4.13 TRIP-TIME BETWEEN TOKYO AND OSAKA (Kamada, 1977)

CARRIER	TIME	TIME TO AND FROM AND AT AIRPORT	TOTAL TIME
Shinkansen (Hikari)	3 hrs. 10 min.	-	3 hrs. 10 min.
Express bus	8 hrs.	-	8 hrs.
Aircraft	50 min.	Tokyo 60 min. Osaka 25 min. At airport 60 min.	2 hrs. 35 min.



KIND / DEGREE OF CONGESTION	DISTANCE OF CONGESTION (per lane)	NUMBER OF VEHICLES ON TRAFFIC CONGESTION (per lane)
3	181m ~ 360m	30 ~ 60 vehicles
4	361m ~ 900m	61 ~ 150 vehicles
5	901m or above	151 vehicles or more

Figure 4.28 OCCURRENCE CONDITION OF TRAFFIC CONGESTION (DAILY AVERAGE IN TOKYO)

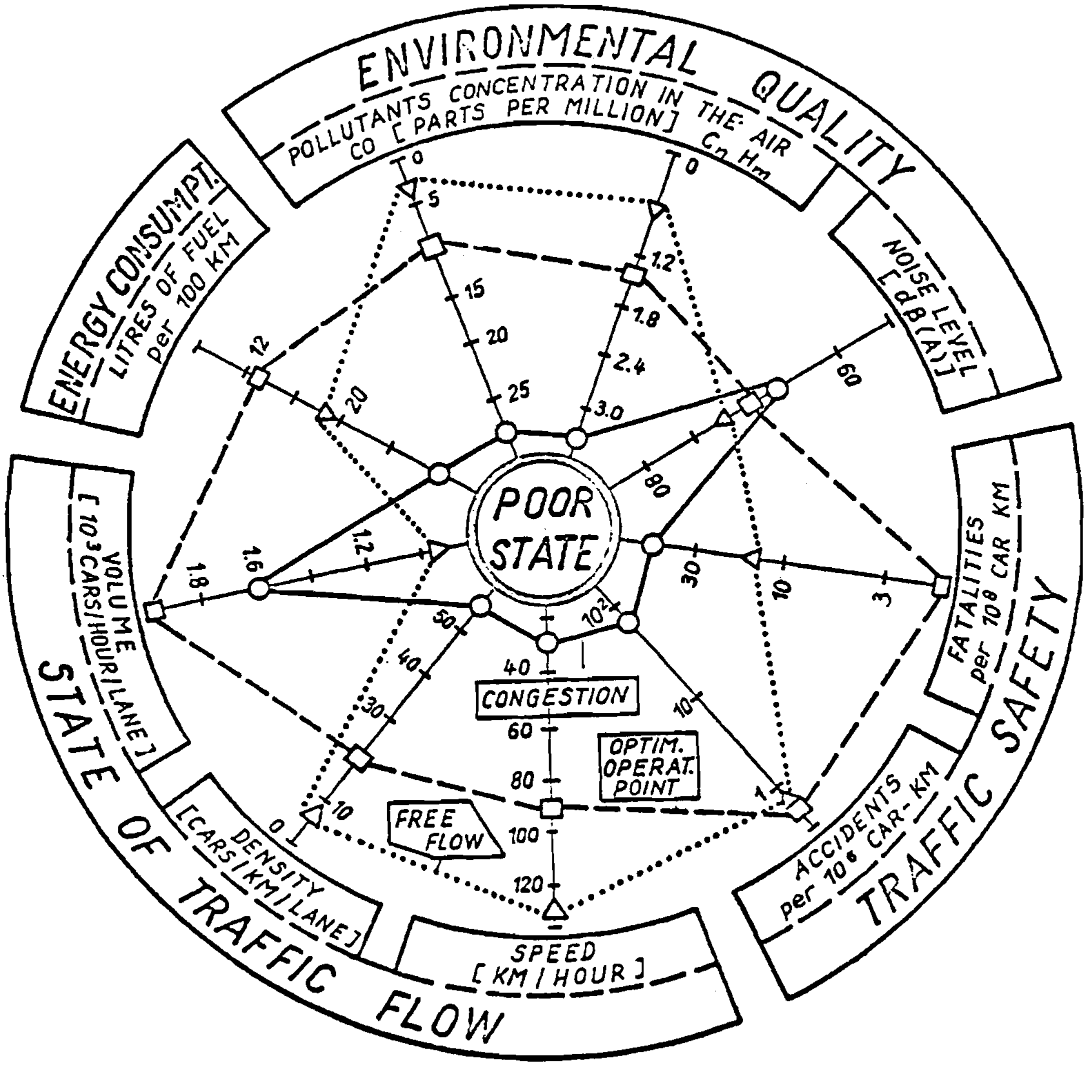


Figure 4.29

<u>RELATION BETWEEN TRAFFIC FLOW CONDITIONS AND TRAFFIC SAFETY</u> (cf. Beatty, 1972), <u>ENVIRONMENTAL QUALITY</u> (cf. Marcus, 1973; Ullrich, 1973,74; Baerwald, 1976; Dare 1976), <u>AN ENERGY CONSUMPTION</u> (cf. Baerwald, 1976).

4.3.2.3 Safety Impacts

Table 4.14 and Figure 4.27 indicate that the Shinkansen showed outstanding features with respect to traffic safety: Not a single fatal accident occurred during the first Shinkansen decade. Thus, Shinkansen delivered the practical proof that it is feasible to operate such a high-speed rail system with high safety. It should be mentioned that there existed certain skepticism with regard to this question among Japanese and international railway experts. During the first Shinkansen decade 54 fatalities occurred on other JNR lines, 146 at private railway lines, 437 in air traffic and 45,338 in road traffic (Table 4.14). If one relates these figures to the corresponding traffic volumes it appears that auto and aircraft accidents resulted in 183.4 and 49.8 fatalities per 10^8 psgr-km, respectively. Here one has to consider that the safety of the road traffic system is highly dependent on the state of traffic flow. Figure 4.29 shows that the accident rate in number of accidents per 10^6 car-km can rise by a factor of about 100 and the fatality rate by factors in a range of 3 to 20 under congested conditions. The time dependent development of road traffic accidents is shown in Table 4.15 and Figure 4.30.

Table 4.14 Safety of Different Carriers (Kodoma, 1977)

		TRAFFIC VOLUME (A) (100 mil. psgr-km)	DEATHS (B) (persons)	INCIDENCE OF DEATHS	
				(B/A)	INDEX
Railway	JNR	19,019	54	0.003	1
	(Shinkansen)	(2,551)	(0)	(0.000)	(0)
	(Other lines)	(16,468)	(54)	(0.003)	(1)
	Private railways	9,478	146	0.015	5
Automobile		24,715	45,338	1.834	611
Aircraft		878	437	0.498	166

Notes:
1. Figures are for 10 year period from 1965 to 1974.
2. Traffic volume source: Rikuun Tokei Yoran (Land Transport Statistics Handbook)
3. Death source: JNR Unten Jiko Tokei (Operational Accident Statistics; Private Railways Shitetsu Tokei Yoran (Private Railways Statistics Handbook); Automobile and Aircraft Kotsu Anzen Hakusho (Transport Safety White Paper).

Table 4.15 THE TENDENCY FOR TRAFFIC ACCIDENTS

	1965	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Number of Accidents (1,000)	567	521	635	721	718	700	659	587	490	473	471
Deaths (1,000)	12.4	13.6	14.3	16.3	16.8	16.3	15.9	14.6	11.4	10.8	9.7
Injuries (1,000)	426	655	828	967	981	950	889	790	651	622	614
Deaths & Injuries (1,000)	438.4	669.6	842.3	983.3	997.8	966.3	904.9	804.6	662.4	632.8	623.7
Deaths per 100,000 population	12.7	13.6	14.1	15.8	16.2	15.5	14.8	13.4	10.4	9.6	8.7
Injuries per 100,000 population	433	654	817	972	946	904	829	727	592	556	548
Deaths per 10,000 registered motor vehicles	15.8	12.1	10.5	10.1	9.0	7.8	6.8	5.6	4.1	3.7	3.2
Injuries per 10,000 registered motor vehicles	539	581	609	598	528	455	378	302	235	215	202

Source: (MOC, 1977)

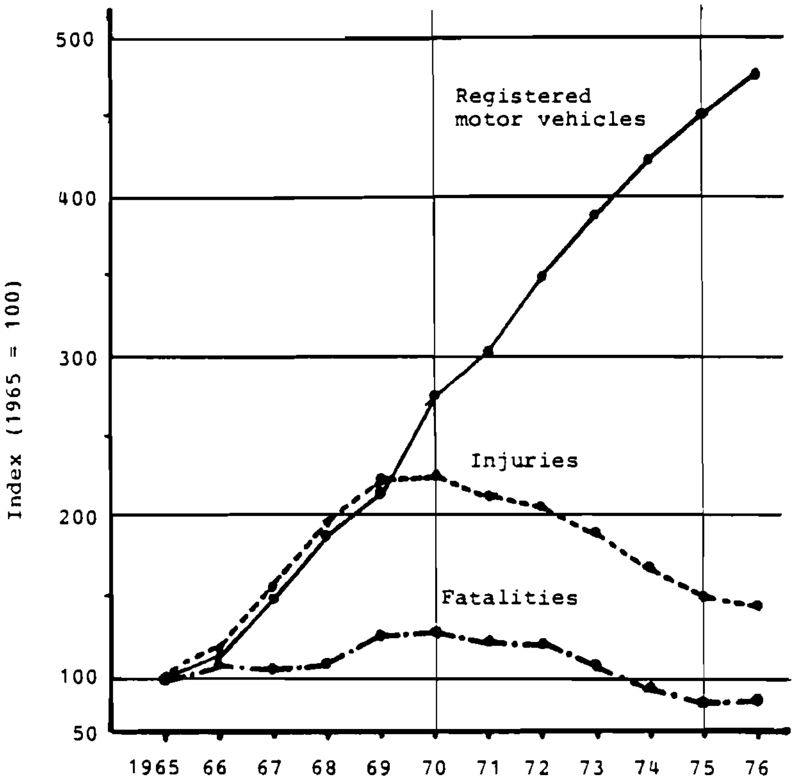


Figure 4.30 TRENDS OF THE NUMBER OF REGISTERED MOTOR VEHICLES WITH NOT LESS THAN THREE WHEELS, FATALITIES AND INJURIES CAUSED BY TRAFFIC ACCIDENTS

(MOC, 1977)

4.3.2.4 Cost Aspects

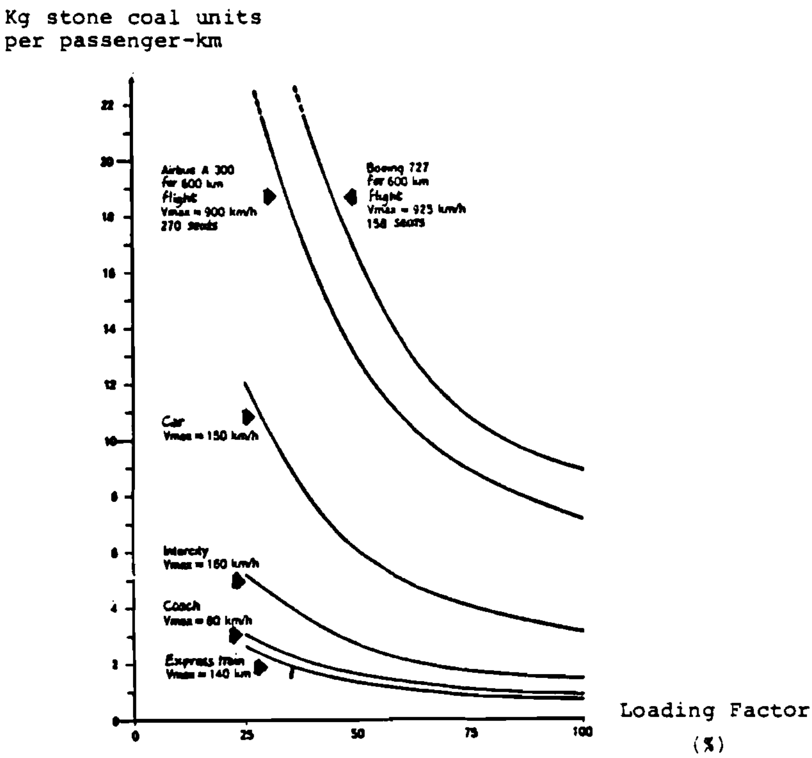
The user's costs for a trip from Tokyo to Osaka are compared for different transport modes in Table 4.16 and Figure 4.27. It can be seen that the automobile is the most expensive mode of inter-city transport.

Table 4.16 USER'S COSTS FOR A TRIP BETWEEN TOKYO AND OSAKA (Kadama, 1977)

	COST (YEN)		REMARKS
	OCTOBER 1964	APRIL 1976	
Shinkansen (Ordinary car)	2,480	5,510	
Aircraft	7,000	10,400	
Express bus	-	4,200	
Automobile (per car)	-	13,400	Cost of gasoline plus toll

4.3.2.5 Energy Consumption

The energy impacts of the Shinkansen and other transport modes are shown in Figure 4.27 and Table 4.17 in terms of kcal per passenger-km. Though the schedule speed of Shinkansen is twice as high as that of the other railway lines, the energy consumption rate of Shinkansen is only 30% higher. Autos and aircraft consume seven to eight times more energy per passenger-km than the Shinkansen. This figure obviously depends on the loading factors of the individual transport modes. This is indicated by Figure 4.31, showing the relations between energy consumption expressed in "kg stone coal units per passenger-km" and the loading factor for the airplanes Boeing 727 and Airbus A300, middle size car, inter-city train with maximum speeds of 160 km/h and 140 km/h and an express bus, considering conditions as they were valid in the FRG (Bauermeister, 1977).



Source: Bauermeister, 1977

Figure 4.31 <u>RELATION BETWEEN ENERGY CONSUMPTION PER PASSENGER-KILOMETER AND LOADING FACTOR</u>

Table 4.17 ENERGY CONSUMPTION OF DIFFERENT CARRIERS (Kamada, 1977)

PASSENGER	Kcal/psgr-km	FREIGHT	Kcal/ton-km
Railway (Incl. Private Railways)	80 (1)	Railway (Incl. Private Railways)	190 (1)
Shinkansen	100 (1.3)	Truck	1,210 (6.4)
Bus	120 (1.5)	Coastal Ship	350 (1.8)
Automobile	700 (8.8)		
Aircraft	780 (9.8)		

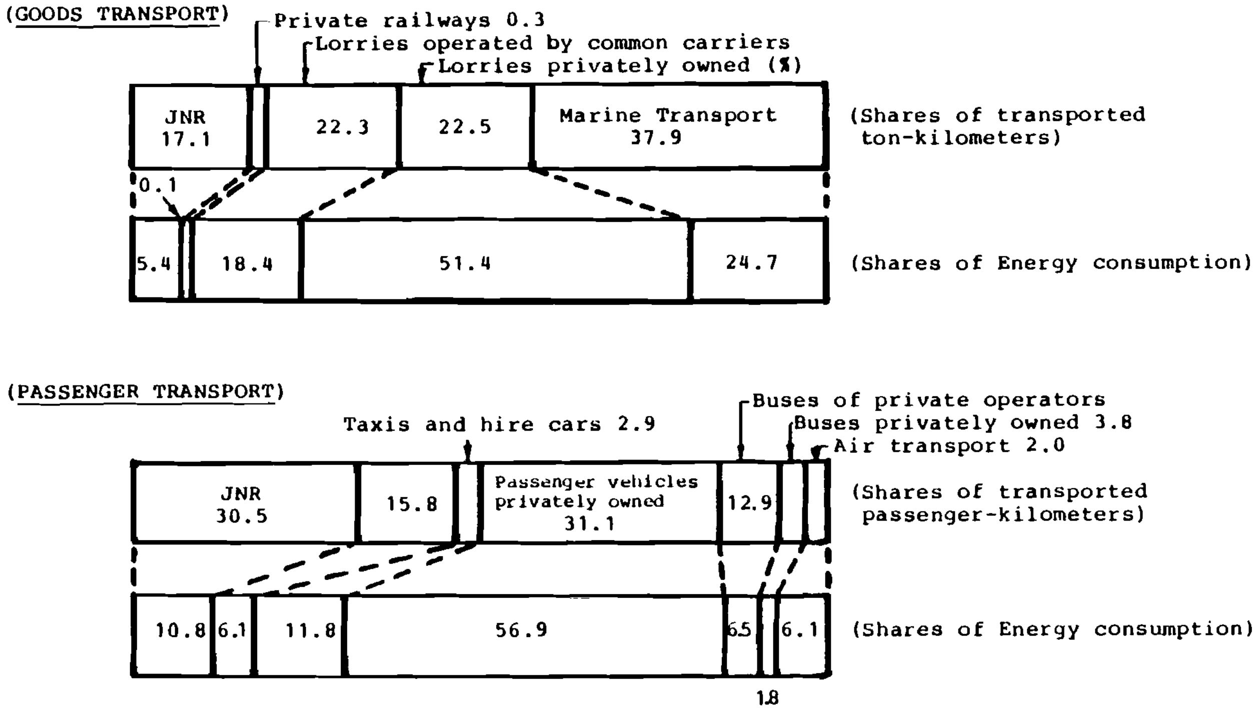
Notes: (1) Figures in parentheses are indices with railway as 1.

(2) Computed by JNR from: Ministry of Industry and Trade, (Energy Statistics); Ministry of Transport, Rikuun Tokei Yoran (Land Transport Statistics Handbook); JNR, Information Systems Department Data.

The low energy efficiency of the motor vehicles and the airplanes is furthermore characterized by Figure 4.32 showing the volume of transport classified by transport sector and the corresponding energy consumption for the whole of Japan; railways accounted in 1972 for 35.3% of passenger traffic but only consumed 16.9% of passenger transport energy. Taxis and privately owned passenger cars accumulated 34% of passenger traffic but used 68.7% of passenger transport energy. The influence of traffic congestion is shown in Figure 4.29; one observes that the fuel consumption rates can double or triple under congested conditions.

4.3.2.6 Environmental Impacts

All three modes of inter-city passenger transport showed remarkable environmental impacts with respect to noise pollution (Table 4.18 and Figure 4.27). The number of complaints increased over time. Complaints regarding road traffic noise occurred two to four times more often. It is reported that the Shinkansen noise problem became more serious than originally expected (Yorimo, 1977). On the other hand, railways including Shinkansen experienced a smaller number of complaints than the air traffic and the road



Note: Fiscal 1972

Source: MOT, 1975

Figure 4.32 VOLUME OF TRANSPORT CLASSIFIED BY TRANSPORT SECTOR AND ENERGY CONSUMPTION

Table 4.18 BREAKDOWN OF COMPLAINTS ON NOISE

YEAR	KIND OF NOISE	WORKSHOP NOISE	CONSTRUCTION NOISE	ROAD TRAFFIC NOISE	MIDNIGHT NOISE	AIRPLANE NOISE	RAILWAY NOISE	OTHERS	TOTAL
1971	No. of cases	11,506	1,983	479	720	341	63	3,643	18,735
	%	61	11	2	4	2	1	19	100
1972	No. of cases	14,828	3,619	527	1,026	166	162	3,653	23,981
	%	62	15	2	4	1	1	15	100
1973	No. of cases	14,908	3,424	691	1,205	249	144	3,524	24,146
	%	62	14	3	5	1	1	14	100
1974	No. of cases	12,567	2,647	891	1,179	265	244	3,251	20,972
	%	60	13	4	6	1	1	15	100

Note: Investigated by the Environment Agency.

Source: (Yorino, 1977)

traffic systems (Figure 4.27 and Table 4.18). Moreover, the road traffic system causes serious air pollution problems near and within large cities.

igure 4.29 indicates that the pollutant concentration levels increase under congested conditions by factors in a range from four to seven.

4.3.2.7 Land Productivity and Further Impacts

Effective usage of the resource "land" is especially important for Japan. Figure 4.17 and Table 4.19 make clear that the land productivity of the Tokaido Shinkansen, measured in passenger-kilometers per m^2 of space, is 3.3 times larger than that of the air traffic system. Table 4.19 shows furthermore that the Shinkansen is also much more effective compared with the aircraft from the viewpoint of capital and labor productivity. As a matter of fact, the high efficiency of Tokaido Shinkansen has been proved, not only by physical indices, but also by financial and safety indices.

4.3.3 Impacts on Actors

The first decade of the Shinkansen showed various impacts on the actors summarized in Figure 4.1:

(1) Travellers: The impact on travellers is reflected by their decision to use more and more Shinkansen, i.e., their reaction is definitely positive.

(2) Residents: The environmental problems, especially the noise problems discussed above, became the subject of serious public opposition of certain groups of residents. This is reflected among others by the newspaper headlines collected in Figure 4.33. These public movements against Sinkansen noise are becoming a serious factor with respect to the further extension of the Shinkansen.

(3) JNR and the Government: The rapid economic growth from the latter half of the 1950's was accompanied by excessive concentration of population and industries in the major cities, and sparsity of population and lowering

Table 4.19 EFFICIENCY OF TOKAIDO SHINKANSEN AND AIRCRAFT

		UNIT	TOKAIDO SHINKANSEN	AIRCRAFT
CAPITAL PRODUCTIVITY	(A) Annual capital charges on ground installations	Psgr-km/yen	0.62 (1.82)	0.34 (1.00)
	(B) Annual capital charges on vehicle and plane	Psgr-km/yen	1.41 (5.64)	0.25 (1.00)
LAND PRODUCTIVITY (Transport efficiency per unit of Tokyo - Nagoya - Osaka right-of-way land area)		(A) Psgr-km/m^2	3,261 (3.34)	976 (1.00)
		(B) Passengers/m^2	11.11 (3.97)	2.80 (1.00)
LABOR PRODUCTIVITY (No. of passengers per employee)		Million psgr-km/Employee	2.9 (2.64)	1.1 (1.00)
ENERGY PRODUCTIVITY		Psgr-km/kcal	0.96 (8.81)	0.11 (1.00)

Source: (Sanuki, 1977)

4 The Japan Times Thursday, December 9, 1976

Shinkansen Station Site Scene of Public Protest

ASAHI EVENING NEWS, SATURDAY, DECEMBER 17, 1977

Air pollution found worsening in cities

ASAHI EVENING NEWS, SATURDAY, DECEMBER 24, 1977

Car noise worsening along trunk highways

Railway Gazette International April 1978

news

Narita's future uncertain as airport link opens

Figure 4.33 NEWSPAPER HEADLINES REFLECTING PUBLIC OPPOSITION TO ENVIRONMENTAL IMPACTS OF TRANSPORTATION SYSTEMS of economic activity in the rural and outlying areas.

The success of the Tokaido Shinkansen encouraged JNR and the corresponding local and national governmental offices to set up plans for a nationwide Shinkansen network. This network is expected to correct these social strains and regional imbalances. Moreover of the Diet initiated a law for "construction of nationwide Shinkansen network" which was enacted in May 1970.

According to this law, the Minister of Transport determines the basic plan of the lines to be constructed after consulting the Railway Construction Council being an advisory body to the Ministers. This council is composed of Diet members, vice-ministers of ministries concerned, experts, the President of JNR and the President of the Japan Railway Construction Public Corporation.

A 7,000 km network as shown in Figure 4.34 was conceived in the basic plan.

The Shinkansen Program was started prescribing that the following lines be constructed in the first stage:

- Tohoku Shinkansen (Tokyo-Morioka, about 500 km)
- Joetsu Shinkansen (Tokyo-Niigata, ≈ 300 km)
- Narita Shinkansen (Tokyo-Narita, ≈ 65 km)

Subsequently, decision was made to construct the following lines and they are undergoing investigations and surveys for preparation of detailed construction plans:

2nd State of Tohoku Shinkansen	Morioka-Aomori approx. 170 km
Hokkaido Shinkansen	Aomori-Sapporo approx. 370 km
Hokuriku Shinkansen	Tokyo-Osaka (via Toyama) approx. 590 km)
Kyushu Shinkansen	Fukuoka-Kagoshima approx. 270 km
Kyushu Shinkansen	Fukuoka-Nagasaki approx. 120 km

In addition to the lines mentioned here, there are twelve others, totalling 3.500 km, proposed in the basic plan (Figure 4.34).

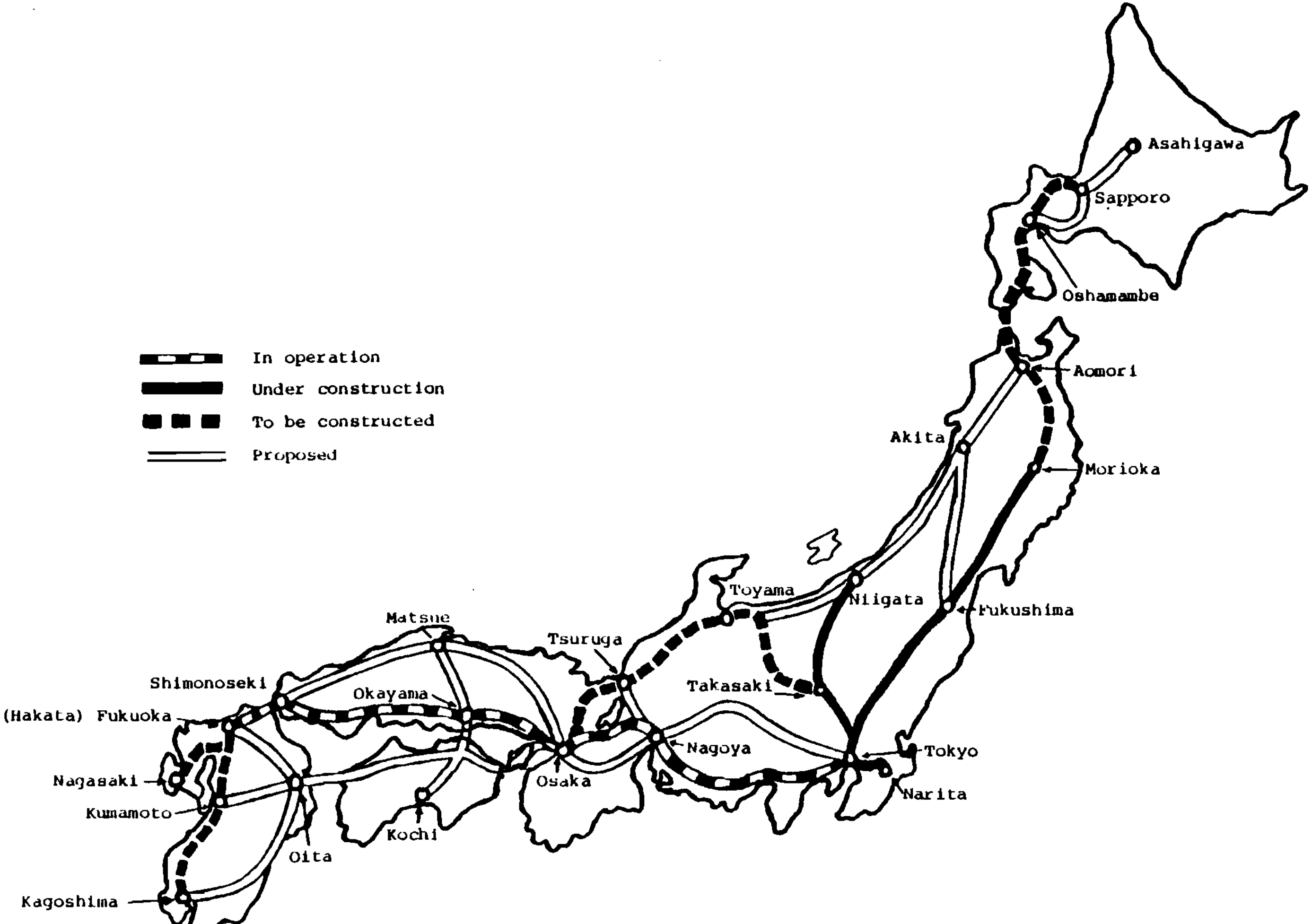


Figure 4.34 NATIONWIDE SHINKANSEN NETWORK (Kamada, 1977)

(4) Impacts on International Actors: The Japanese Shinkansen experience delivered the proof that the "railway downfall theory" mentioned in the introduction is wrong. Indeed, during the first Shinkansen decade considerable efforts were made in various countries--even in the auto-oriented USA--to rehabilitate inter-city rail passenger service. As a visible result one could consider the significantly increased schedule speeds for several lines, as for example:

- Paris - Lyon (France) at 137 km/h
- Hannover - Dortmund (FRG) at 136.9 km/h
- London - Cardiff (UK) at 133.6 km/h
- Moscow - Leningrad (USSR) at 130.4 km/h
- New York - Washington (USA) at 121.2 km/h.

Tables 4.20a and 4.20b illustrate this development.

But it is important to mention that up until now no country has directly followed the Shinkansen example by constructing completely new high-speed trunk lines; the above mentioned speed increases are the result of an improvement of existing rail systems. Construction work for completely new lines was started recently in France, Italy and the FRG. One can state that those lines will probably reach or exceed the Shinkansen speed as one of its outstanding features. But train frequency as the second characteristic will very likely remain maximal for Shinkansen.

4.3.4 Findings

The results of the analysis presented above may be summarized as follows:

- The Tokaido and Sanyo Shinkansen did exceed the expectations of its developers with regard to travel demand. These two lines provided the needed transport capacity and supported the economic development in the corresponding regions.
- The Shinkansen, during the first decade of its existence, delivered the practical proof that high-speed railway systems are capable of competing successfully with the

Table 4.20a Notable Inter-City Runs timed at over 120 km/h inclusive of intermediate Stops

COUNTRY	TRAIN	FROM	TO	STOPS	DISTANCE km	TIME h.min.	SPEED km/h
JAPAN	107 Hikari	Tokyo*	Osaka	2	515.4	3 10	162.8
	24 Hikari	Tokyo*	Hiroshima	4	821.3	5 08	160.0
	13 Hikari	Tokyo*	Hakata	6	1,069.1	6 56	154.2
FRANCE	Rhodanien	Paris	Lyon	0	510.9	3 43	137.5
	Rhodanien	Marseille	Paris	3	861.6	6 34	131.2
	Mistral	Nice	Paris	9	1,085.7	9 01	120.4
WEST GERMANY	Münchner Kindl	Hannover	Dortmund	1	207.7	1 31	136.9
	Mercator	Basle	Mannheim	3	256.0	2 03	124.9
	Patrizier	Bremen	Dortmund	1	228.2	1 52	122.2
GREAT BRITAIN	8 trains	London*	Cardiff	1	233.8	1 45	133.6
	Royal Scot	London*	Glasgow	1	646.2	5 00	129.2
	Manchester Pullman	Manchester	London	3	304.2	2 27	124.2
SOVIET UNION	Aurora**	Moscow	Leningrad	1	649.9	4 59	130.4
UNITED STATES	5 Metroliners	New York	Washington	4	361.7	2 59	121.2

* Runs in both directions.

** Summer season only.

Source: Steffee, 1977)

Table 4.20b <u>Comparison of fastest point-to-point Timings of 1977 with 1970 for each Country</u>

COUNTRY	YEAR	FROM	TO	DISTANCE km	TIME min.	SPEED km/h	CHANGE km/h
GREAT BRITAIN	1977	Swindon	Reading	66.5	24	166.2	+32.4
	1970	Crewe	Watford	226.4	101½	133.8	
FRANCE	1977	St. Pierre des C	Poitiers	101.0	37	163.7	+19.4
	1970	St. Pierre des C	Poitiers	101.0	42	144.3	
JAPAN	1977	Nagoya	Shizouka	174.6	59	177.5	+ 5.9
	1970	Kyoto	Nagoya	134.3	47	171.6	
SWEDEN	1977	Halisburg*	Skovde	114.0	56	122.1	+ 2.5
	1970	Sodortalje	Skovde	277.0	139	119.6	
WEST GERMANY	1977	Dortmund	Bielefeld	98.2	41	143.7	+ 0.1
	1970	Hamm	Bielefeld	67.0	28	143.6	
SOVIET UNION	1977	Moscow**	Bologoe	331.0	147	135.1	- 0.6
	1970	Leningrad**	Bologoe	319.0	141	135.7	
CANADA	1977	Kingston	Guildwood	233.6	102	137.4	- 1.5
	1970	Toronto	Dorval	520.9	225	138.9	
UNITED STATES	1977	Baltimore*	Wilmington	110.1	44	150.1	- 3.5
	1970	Baltimore*	Wilmington	110.1	43	153.6	
ITALY	1977	Rome*	Naples Merg	210.0	95	132.6	- 7.4
	1970	Rome*	Naples Merg	210.0	90	153.6	
BELGIUM	1977	Ghent	Brussels	52.3	28	112.1	- 8.6
	1977	Brussels	Ghent	52.3	26	120.7	

* Runs in both directions. ** Summer season only.

Source: (Steffee, 1977)

aircraft and the private car in inter-city travel, especially with regard to travel distances lying somewhere in the range between 100 and 700 km. This is illustrated by significant modal-split impacts.

- The Shinkansen has delivered the proof that rail-transport systems of that type are superior to the other transport modes regarding:

  - safety
  - energy consumption
  - land productivity
  - labor productivity
  - and other factors.

- The first Shinkansen decade was, at its end, characterized by an increased sensibility of people against environmental impacts of air, road, and rail traffic systems. Though the number of complaints against Shinkansen noise is smaller than the number of corresponding complaints against aircraft and motor vehicle noise, the issue of public opposition against an extension of the Shinkansen arose. Residents along planned and existing lines that will, or are, affected by Shinkansen noise became an important factor in the future process of planning and constructing new Shinkansen lines.

- The establishment of a nationwide Shinkansen network was enacted in a special law in 1970 after several years of positive experience with the Tokaido Shinkansen. The main actors in the Shinkansen planning process, i.e., the Diet, MOT and JNR do consider this Shinkansen network as a means for controlling and balancing the development of the different regions of Japan. This corresponds to a change of the basic development targets which was followed in the construction of the Tokaido Shinkansen: The Tokaido Shinkansen was constructed to avoid a deadlock of the old Tokaido Main Line. The new high-speed line fulfilled this mission but it showed moreover its capabilities to influence regional development.

- The success of the Shinkansen changed the world opinion on the future of railways in inter-city rail transportation.

4.4 The Future of the Shinkansen Program

It cannot be the aim of a retrospective study to investigate in detail the future of such a huge program as the nationwide Shinkansen network development project. Therefore the discussion will be restricted to important issues.

4.4.1 Demand Issues

4.4.1.1 Ecomomic Factors

The oil crisis has slowed down the economic growth of the Japanese economy. This could result in a reduced increase of travel demand on a national level (Table 4.21).

4.4.1.2 Population Factors

The process of concentration of population in the large agglomeration centers will continue (Tables 4.22a and 4.22b, Figure 4.35).

This can have the following consequences with respect to travel demand and the future of the Shinkansen program:

- Travel demand in the Tokaido Megalopolis will grow faster than in the other region. The capacity limit of the existing Tokaido Shinkansen will be reached during the next ten years. Therefore, there may occur a new "deadlock problem" leading to the need to construct a second Tokaido Shinkansen (Figure 4.36).
- More than 80% of the population will live in regions which are already served by the Shinkansen in operation or by those lines which are presently under construction. This will doubtless result in the fact that a very large part of the planned 7,000 km network will not find the sufficiently large traffic volumes that are needed for profitable operation of Shinkansen lines.

Table 4.21 Transportation Volumes

Index (1975 = 100)

			1965	%	1975	%	1985	%	1990	%	Index 1965	Index 1975	Index 1985	Index 1990
PASSENGERS	NUMBER OF PASSENGERS (10^6 people)	TOTAL	30,792	100.0	46,176	100.0	60,200	100	67,500	100	67	100	130	146
		Car	14,863	48.3	28,412	61.5	41,000	68	45,000	67	52	100	144	159
		Train	15,798	51.3	17,588	38.1	19,000	32	22,000	33	90	100	108	126
		Ship	126	0.4	151	0.3	200	0.3	220	0.3	79	100	132	148
		Air	5.2	0.0	25	0.1	60	0.1	110	0.2	21	100	228	445
	GROSS VOLUME (10^8 people·km)	TOTAL	3,821	100.0	7,104	100.0	10,100	100	11,700	100	54	100	141	164
		Car	1,207	31.6	3,609	50.8	5,800	57	6,400	55	33	100	160	177
		Train	2,554	66.8	3,238	45.6	3,800	38	4,400	38	79	100	117	137
		Ship	31	0.8	66	0.9	100	1	120	1	47	100	158	182
		Air	29	0.8	191	2.7	390	4	740	6	15	100	204	385
MERCHANDISE	VOLUME (10^6 t)	TOTAL	2,625	100.0	5,030	100.0	8,600	100	10,000	100	52	100	171	199
		Car	2,193	83.5	4,393	87.3	7,500	87	8,600	86	50	100	170	196
		Train	252	9.6	185	3.7	170	2	190	2	136	100	94	103
		Ship	180	6.8	452	9.0	960	11	1,200	12	40	100	212	269
	GROSS VOLUME (10^8 t·km)	TOTAL	1,864	100.0	3,609	100.0	6,300	100	7,600	100	52	100	176	210
		Car	484	26.0	1,297	35.9	2,400	39	2,900	38	37	100	189	224
		Train	573	30.7	474	13.1	460	7	500	7	121	100	96	107
		Ship	806	43.3	1,836	50.9	3,400	54	4,100	55	44	100	187	226

Note: Total volume of transportation of merchandise includes shipping by air.

Source: Third Comprehensive National Development Plan

Table 4.22a Population

	1975 (1,000)	ESTIMATED POPULATION (1,000)			BLOCKED POPULATION (1,000)			DEVIATION (%)		
		1985	1990	2000	1985	1990	2000	1985	1990	2000
Hokkaido	5,338	6,040	6,430	7,540	6,089	6,393	6,923	-0.80	0.58	8.91
Tohoku	11,625	12,808	13,562	15,063	12,891	13,506	14,515	-0.64	0.41	3.56
Kanto	33,622	39,074	41,034	44,503	38,421	40,164	43,413	1.70	2.17	2.51
Tokyo Area	27,042	31,240	32,559	34,912	31,067	32,473	35,111	0.56	0.26	-0.57
Chubu	18,644	21,195	22,031	23,485	20,948	21,910	23,674	1.18	0.55	-0.80
Hokuriku	2,914	3,274	3,421	3,662	3,235	3,368	3,608	1.21	1.57	1.50
Kinki	21,231	23,790	24,756	26,542	24,050	25,120	27,131	-1.08	-1.45	-2.17
Osaka Area	15,696	17,232	17,805	18,913	17,896	18,701	20,233	-3.71	-4.79	-6.52
Chugoku	7,366	8,133	8,443	8,941	8,150	8,473	9,056	-0.21	-0.35	-1.27
Shikoku	4,040	4,298	4,395	4,514	4,455	4,634	4,934	-3.52	-5.16	-8.51
Kyushu	12,417	13,708	14,244	15,074	13,824	14,487	15,616	-0.84	-1.68	-3.47
Okinawa	1,043	1,125	1,158	1,180	1,176	1,259	1,424	-4.34	-8.02	-17.13
Accumulated Total	-	126,292	131,978	142,441						
Estimated Total Population	111,940	123,749	128,272	136,899						
Deviation (%)	-	2.1	2.9	4.0						

Source: Third Comprehensive National Development Plan.

Table 4.22b <u>Increase of Urban Population</u>

	1960	1965	1970	1975	1985	1990	2000
Number of Permanent Residents (1,000 people)	93,419	98,275	104,665	111,940	123,749	128,272	136,899
Urban Population (1,000 people)	40,830	47,261	55,997	63,823	79,942	86,327	97,883
Percentage of Urban Population (%)	43.7	48.1	53.5	57.0	64.6	67.3	71.5

	1960-65	1965-70	1970-75	1975-85	1985-90	1990-2000
Growth Rate of Permanent Resident per annum (%)	1.02	1.27	1.35	1.01	0.72	0.65
Growth Rate of Urban Population per annum (%)	2.97	3.45	2.65	2.28	1.55	1.26

Notes: 1. 1960, 1965, 1970 and 1975 are based on national census.
2. 1985, 1990 and 2000 are estimated by National Land Agency.
3. Figures after 1970 includes population of Okinawa.

Source: Third Comprehensive National Development Plan.

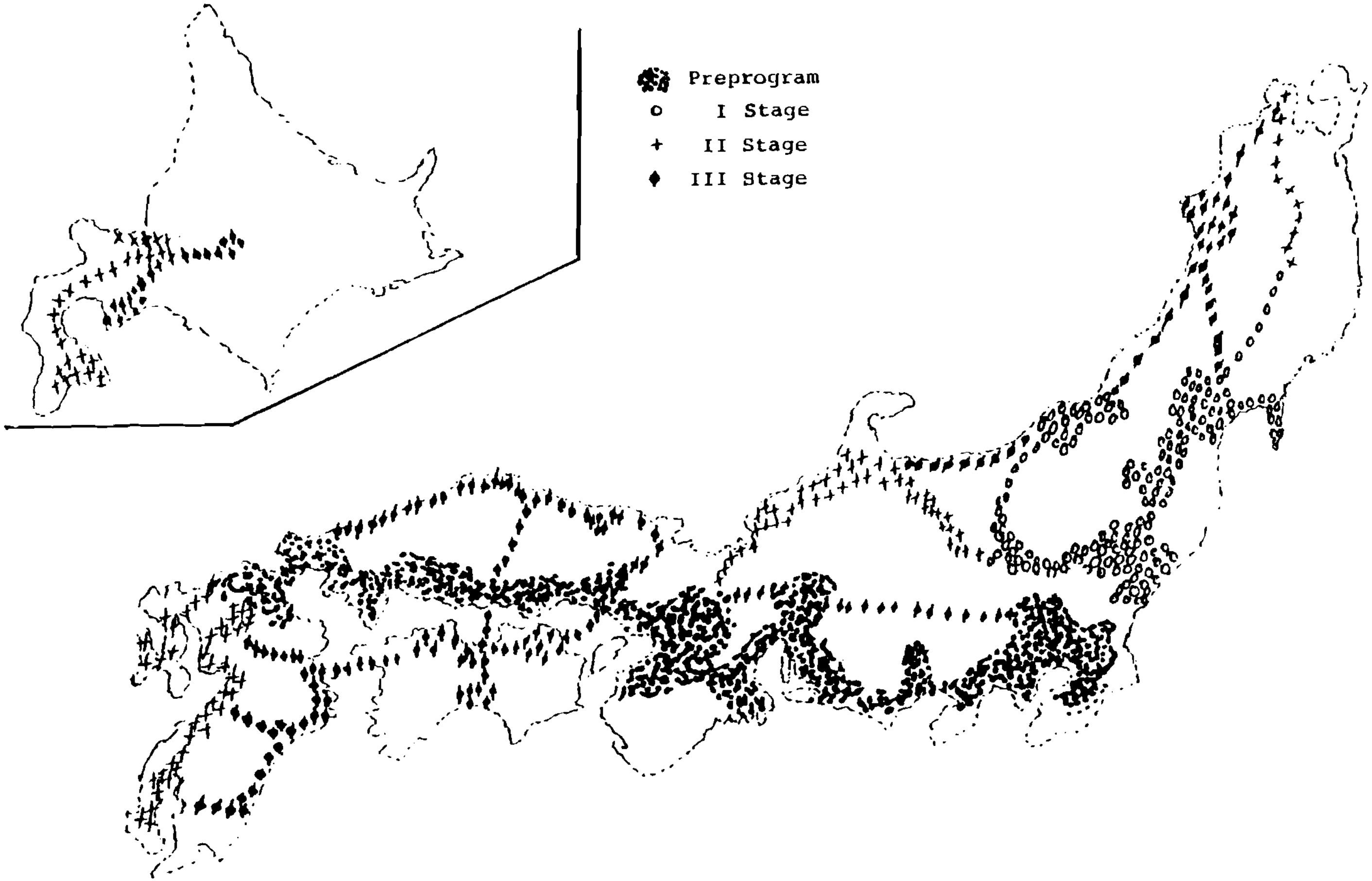
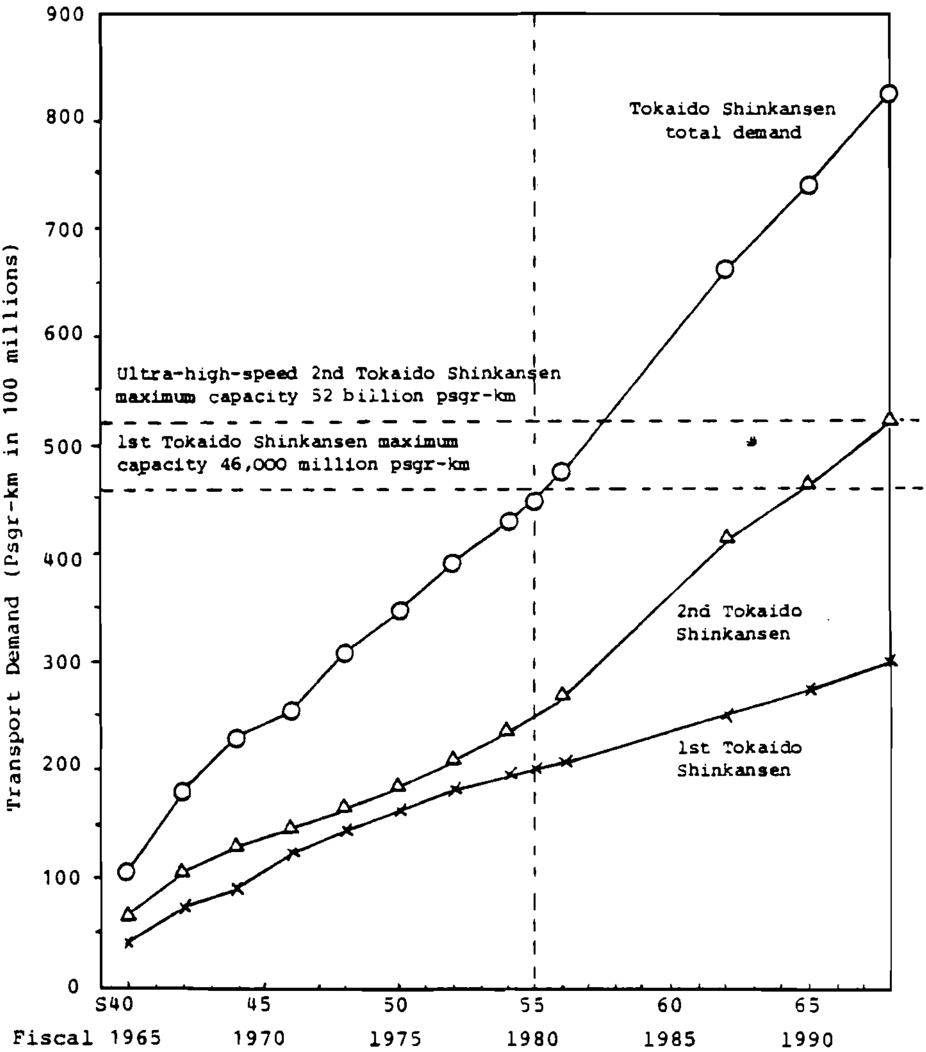


Figure 4.35 SHINKANSEN PROGRAM BY STAGES AND POPULATION DISTRIBUTION



Note: Up till 1980 bottom line represents capacity by Kodama and middle line by Hikari.

Source: (Sanuki, 1977)

Figure 4.36 TOKAIDO SHINKANSEN FIRST AND SECOND DEMAND PROJECTIONS AND MAXIMUM CAPACITY

- This situation resulted in some skepticism about the future of a 7,000 km Shinkansen network.

4.4.2 Supply Issues

Under all possible scenarios it is considered as very likely that the road and the air traffic systems will continue to grow. But energy shortage may change, i.e., reduce, the growth rates.

4.4.2.1 Energy Factors

Table 4.23a shows that Japan used about 13% of its energy in the transportation sector. The road and the air transportation systems consumes most of this. The influence that an auto and aircraft-oriented traffic system can have on the energy consumption structure is illustrated by the USA example (cf. Table 4.23a). The USA assigns 23% of its energy to transportation systems, where 50% of its petroleum is consumed by motor vehicles. Therefore, the issue of energy-conserving transportation systems development policies arose in North America (Lukasiewicz, 1976/77; Ward, 1977). For Japan this issue can become a dominating one, since Japan depends heavily on imported oil (cf. Table 4.23b). Table 4.24 and Figure 4.37 summarize results of studies published in JETRO (1974) on alternative transport development strategies aiming to reduce energy consumption.

Such alternatives have to reduce auto and air traffic volumes and to increase railway traffic demand. Thus, the energy situation could become a new driving force to extend the Shinkansen system to a nationwide network.

4.4.2.2 New Technology Options

Japan is investing a large amount of research funds in the development of a new Shinkansen generation which will be characterized by a maximum speed of about 500 km/h and a magnetic levitated suspension system (Usami, 1974).

Though there is a lot of controversial discussion on the possible future of this new super high-speed ground transportation system the following advantages are forecast from R&D work carried out especially in Japan and the FRG:

Table 4.23a Energy Consumption by Sector in Major Nations

(in million kiloliters of oil equivalent)

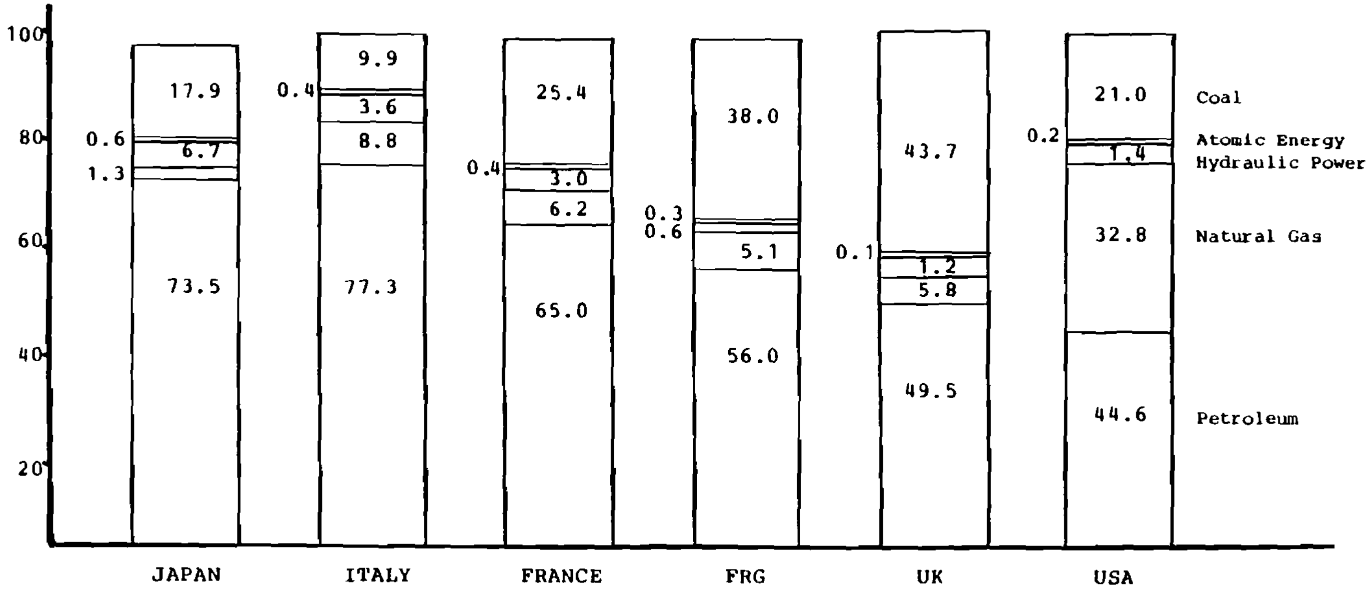
	MANUFACTURING INDUSTRIES	ENERGY	TRANSPORTATION	CONSUMER AND MISCELLANEOUS PURPOSES	TOTAL ENERGY CONSUMPTION
JAPAN	176.0 (59.2)	20.2 (6.8)	38.3 (12.9)	62.8 (21.1)	297.3 (100)
UNITED STATES	458.4 (31.6)	146.3 (10.1)	344.4 (23.0)	513.2 (35.3)	1,452.3 (100)
GREAT BRITAIN	71.4 (37.7)	19.3 (10.2)	25.8 (13.7)	72.5 (38.4)	189.0 (100)
FRANCE	59.6 (45.8)	8.9 (6.8)	20.5 (15.8)	41.0 (31.6)	130.0 (100)
WEST GERMANY	89.4 (42.0)	20.1 (9.4)	26.6 (12.5)	76.8 (36.1)	212.9 (100)

Note: Japan - Surveyed in Fiscal 1971; Other Nations - Surveyed in 1969.
Source: Overall Energy Statistics (Japan); OECD Statistics (Other Nations).

Source: (JETRO, 1974)

Table 4.23b Composition of Primary Energy in Major Nations

(Source: JETRO, 1974)



Notes: (1) Japan; Fiscal 1971 figures, Other nations; 1970 figures.

(2) Japan: On a supply basis.
Other nations: On a consumption basis.

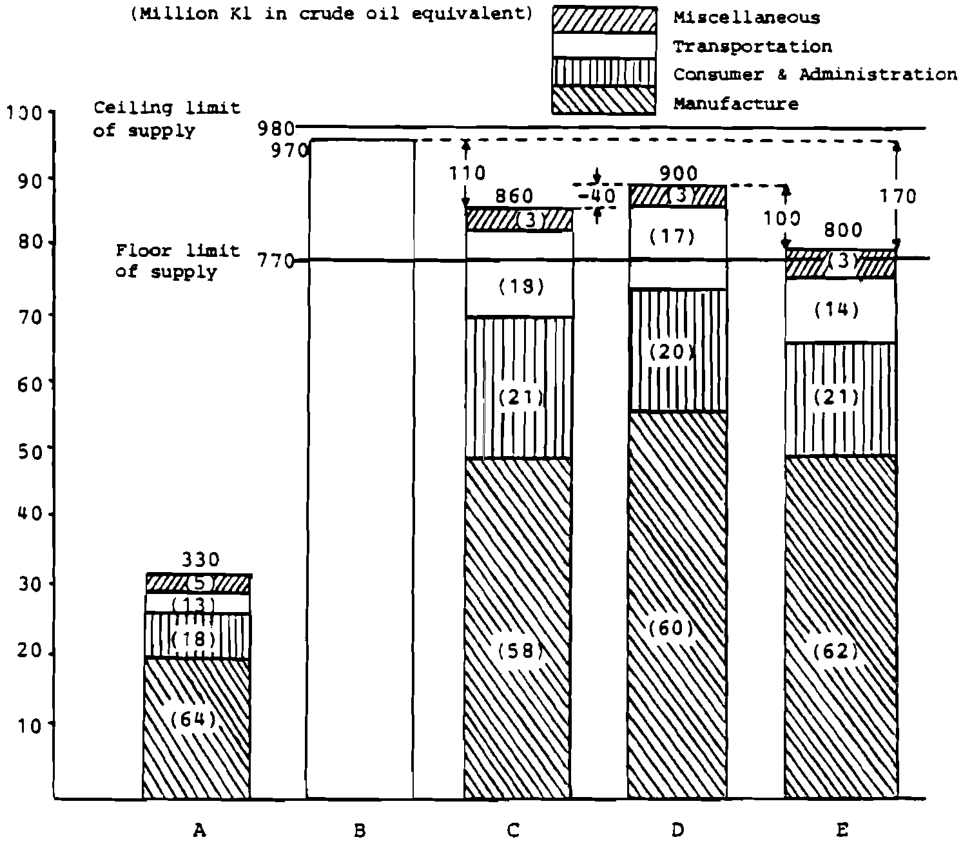
Sources: MITI Survey; British Petroleum Statistics.

Table 4.24 A Tentative Calculation of Energy Conservation due to Improvement of the Transportation System

	A TRANSPORTATION DEMAND 1985	B TRANSPORTATION DEMAND 1971	C 1971 ENERGY CONSUMPTION (In 1,000 Kl.crude oil equivalent)	D 1985 ENERGY CONSUMPTION: $\frac{A}{B}$ x C
TRANSPORTATION SYSTEM OF THE PROJECTION MODEL (1985)				
FREIGHT TRANSPORT	Billion ton-kilometers			
Rail transport	74.5	62.2	1,700	2,040
Truck transport	583.6	142.7	16,700	68,300
Coastal marine transport	340.9	127.7	5,600	14,950
Sub-total			24,000	85,290
PASSENGER TRANSPORT	Billion passenger-kilometers			
Rail transport	423.1	290.0	2,700	3,940
Bus transport	206.0	100.8	1,500	3,066
Passenger-car transport	563.8	211.6	14,800	39,427
Air transport	97.8	10.3	2,200	20,900
Sub-total			21,200	67,333
GRAND TOTAL			45,200	152,623
TRANSPORTATION SYSTEM OF THE IMPROVEMENT MODEL (1985)				
FREIGHT TRANSPORT				
Rail transport	165.0	62.2	1,700	4,510
Truck transport	369.0	142.7	16,700	43,186
Coastal marine transport	465.0	127.7	5,600	20,392
Sub-total			24,000	68,088
PASSENGER TRANSPORT				
Rail transport	623.0	290.0	2,700	5,800
Bus transport	227.0	200.8	1,500	3,378
Passenger-car transport	376.0	211.6	14,800	26,300
Air transport	55.0	10.3	2,200	11,748
Sub-total			21,200	47,226
GRAND TOTAL			45,200	115,314

Note: The transportation system of the improvement model saves 152,623 - 115,314 = 37,000 thousand kiloliters of crude oil equivalent.

Source: (JETRO, 1974)



Notes: (1) A: Energy consumption structure in 1970
B: Energy consumption structure in 1958 (with elasticity coefficient of 1.15)
C: After changing the industrial structure
D: Considering the increasing trend of energy base unit
E: After "Energy-saving policy" employed

Energy saved by industrial structure change	110
Increment of energy base unit	-40
Saving by "Energy-saving policy"	100
Total Energy-Saving	170
	(million Kl)

(2) The chart is a tentative projection, which is currently under scrutiny by the Advisory Committee for Energy

(3) The figures in parentheses indicate percentage distributions.

Figure 4.37 A TENTATIVE PROJECTION OF ENERGY-CONSERVATION IN JAPAN IN 1985

(JETRO, 1974)

- lower infrastructure costs compared with Shinkansen type railways (cf. Figure 4.38a);
- energy effectiveness (cf. Figure 4.38b);
- less noise impacts (Figure 4.38c);
- excellent competition capabilities in relation to the air system (cf. Figure 4.38d);
- mass transport performance.

Figures 4.38a to 4.38d were taken from a comprehensive study on a West European super high-speed MAGLEV system for which a network, according to Figure 4.38e was assumed.

It is considered as possible that a part of the 7,000 km network planned in the Shinkansen program will be implemented by this new generation of Shinkansen (Figure 4.36). The Tokaido corridor will very likely be the first candidate again, for the new MAGLEV system.

4.4.3 Actors Issues

Any future activity in transportation planning should more directly involve the public. Public opposition against Shinkansen noise could slow down expansion of the Shinkansen network and so support the development of the new MAGLEV system.

The governmental actors and JNR will probably be more and more forced to change from the existing supply strategy to an integrated approach to transport system planning which has to give more emphasis on the following two development policies:

- control, i.e., reducing and restructuring traffic demand concerning its spatial distribution, its volume, and its time distribution;
- control, i.e., changing modal split by supporting energy efficient transport modes.

(cf. Figure 4.1).

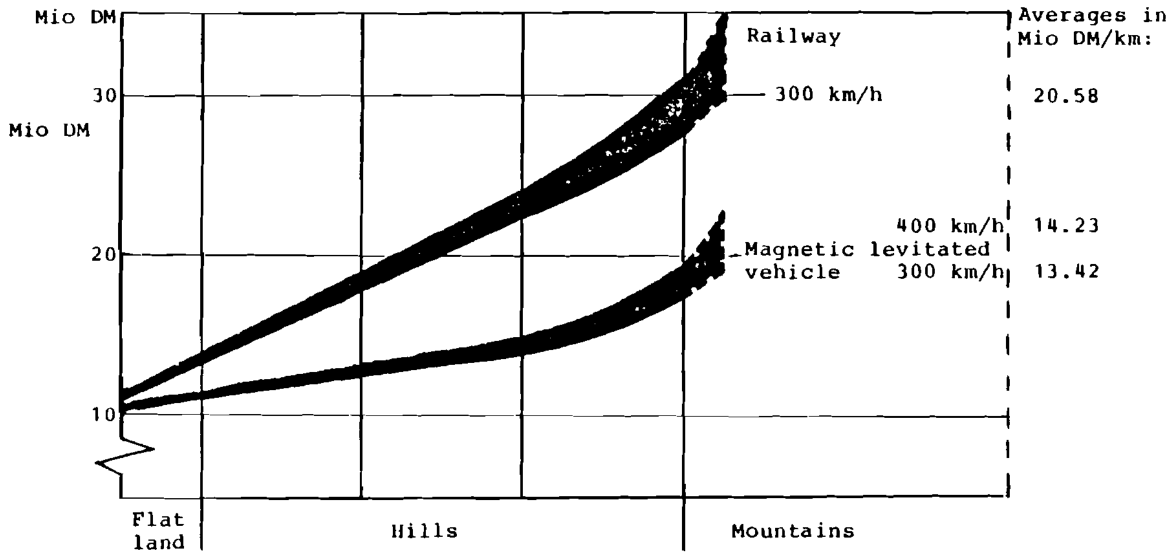


Figure 4.38a NEEDED INVESTMENT COSTS IN 10^6 DM HIGH-SPEED RAILWAY SYSTEM WITH A MAXIMUM SPEED OF 300 KM/H AND A MAGNETIC LEVITATED SYSTEM FOR 300 KM/H AND 400 KM/H DERIVED FOR A ROUTING STUDY BETWEEN HANNOVER AND KASSEL, FRG

Source: Matthöfer, 1977

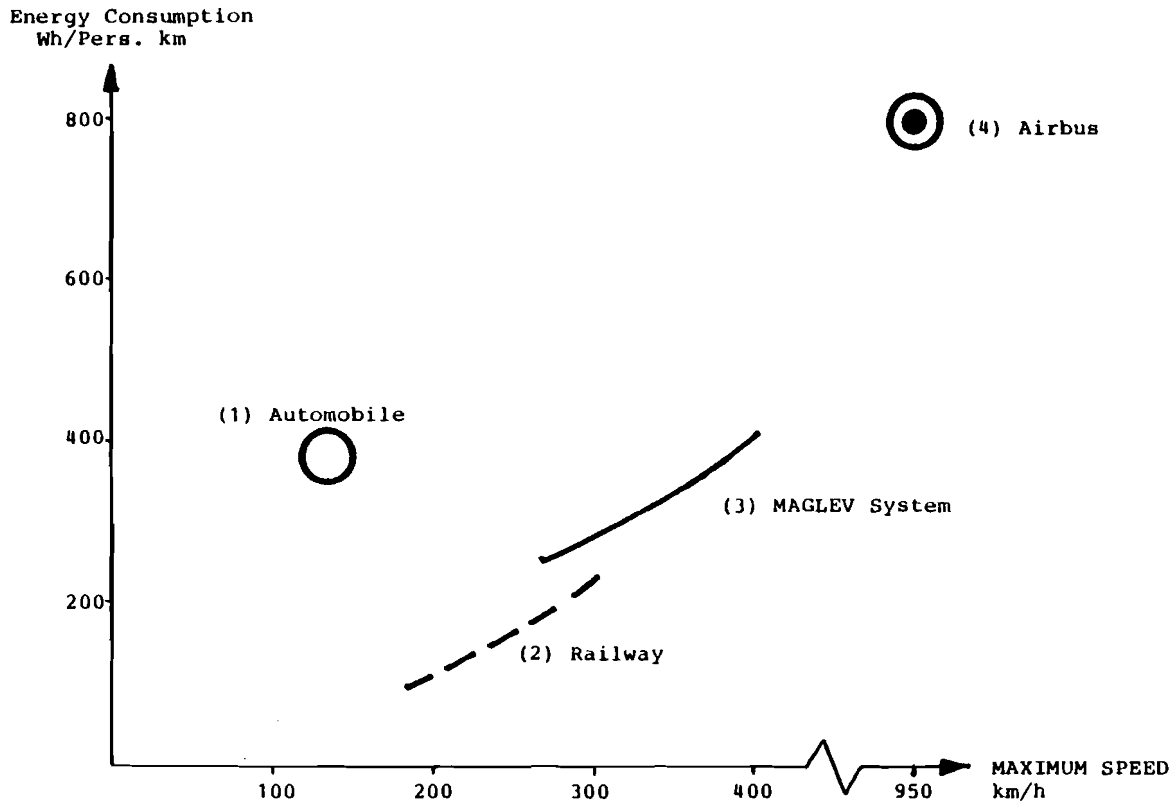


Figure 4.38b <u>ENERGY CONSUMPTION OF THE AUTOMOBILE (1), A CONVENTIONAL RAILWAY (2), A MAGLEV-SYSTEM (3), AND THE AIRCRAFT 'AIRBUS' (4), FOR AN OPERATION AT MAXIMUM SPEED AND LOADING FACTORS OF 0.64</u>

Source: Matthöfer, 1977

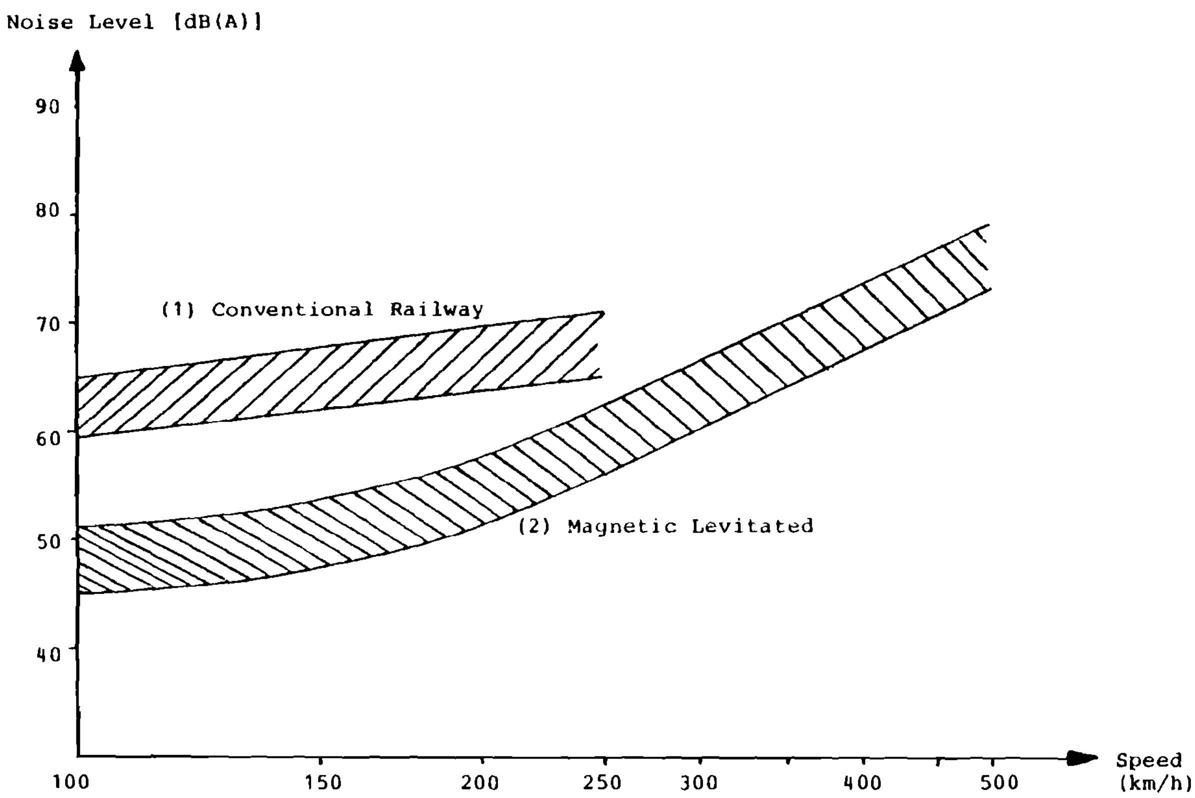
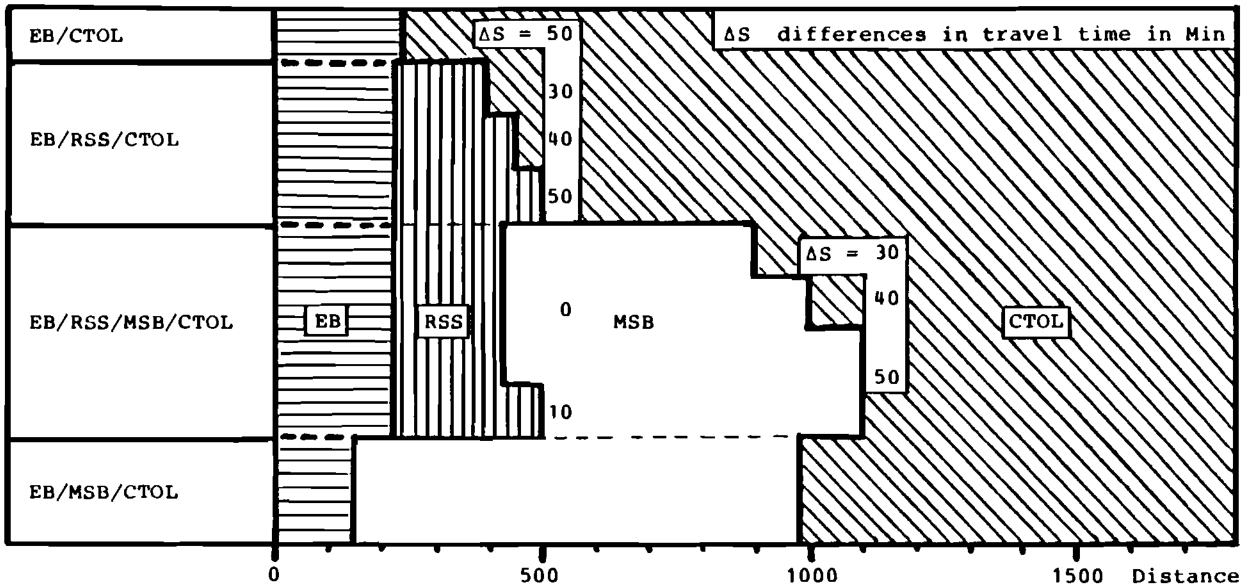


Figure 4.38c NOISE LEVELS AT A DISTANCE OF 25M FROM THE GUIDEWAY AT TEN VEHICLES PER HOUR FOR CONVENTIONAL RAILWAY VEHICLES (1) AND MAGNETIC LEVITATED VEHICLES (2)

Source: Matthöfer, 1977



EB : Conventional Railway
RSS : High-Speed Railway System (Vmax ≈300 km/h)
MSB : Magnetic Levitated Systems (Vmax ≈400 km/h)
CTOL: Conventional Air Transport System

Figure 4.38d RANGES OF PASSENGER SERVICE FOR DIFFERENT PASSENGER TRANSPORTATION SYSTEMS RESULTING FROM A MODAL-SPLIT ANALYSIS BASED ON AN EVALUATION OF SIGNIFICANT TRAVEL TIME DIFFERENCES ΔS (IN MIN.)

Source: Matthöfer, 1977

1 London
2 Lille
3 Paris
4 Brüssel
5 Randstad

6 Rhein-Ruhr
7 Rhein-Main
8 Rhein-Neckar
9 Stuttgart
10 München

11 Zurich/Basel
12 Milano
13 Torino
14 Lyon
15 Hannover

16 Hamburg
17 Birmingham
18 Manchester/Liverpool
19 Newcastle
20 Glasgow/Edinburgh

21 Luxemburg/Saar
22 Genf
23 Marseille
24 Bologna
25 Firenze

26 Roma

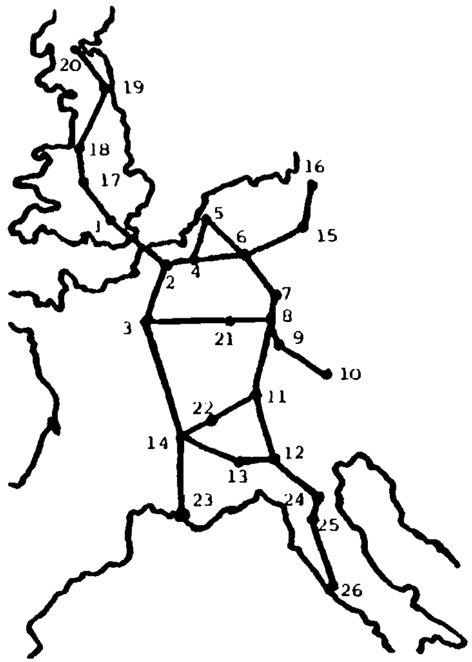


Figure 4.38e <u>SUPER-HIGH-SPEED INTERNATIONAL INTER-CITY PASSENGER TRANSPORT NETWORK BASED ON THE MAGLEV SYSTEM AS HAS BEEN STUDIED BY OECD FOR WEST EUROPE</u>

(cf. Matthöfer, 1977)

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5. THE SHINKANSEN AND RAILWAY ISSUES

5.1 Main Features of Railway Development in Japan

5.1.1 Situation Prior to the Construction of the Tokaido Shinkansen

The first railway in Japan was opened between Shimbasi (Tokyo) and Yokohama in 1872. This railway was only 22 km long and was built 43 years after the first railway system was built in Europe and when USA and transcontinential trains had already been in operation connecting the Atlantic and Pacific coasts. The first Tokaido line was completed in 1889 linking the six major cities of Tokyo, Yokohama, Nagoya, Kyoto, Osaka and Kobe. This line was, and still is, the most important one in Japan. The overall length of the line is no more than 590 km and is only about 3% of the total JNR system. However, at that time the annual transportation volume on this particular line accounted for about 24% of total passengers and about 23% of the total freight tonnage carried on the JNR. This was due to the fact that about 40% of the total population, more than 36 million people, were living along the line. The traffic on the Tokaido line was growing faster than on the entire JNR system, which was also growing quite fast. In 1950 the total JNR passenger traffic was equal to 69.1 billion passenger/km, while the Tokaido line alone was 15.3 billion passenger/km. Until 1957 the JNR passenger traffic had increased by 46% and the Tokaido line by 58%. However, if we exclude inter-urban (in and around Tokyo and Osaka cities) and commuter traffic, then the Tokaido line traffic increased by 71% between 1950 and 1957.

Electrification of the Tokaido line was completed in 1956. This line, as well as the entire Japanese railway system, was of the narrow-gauge type (1067 mm) at this time. The narrow-gauge type railway system was introduced into Japan on the advice of British consultants at the beginning of the railway construction period as a more economic solution. However, in the mid-thirties a group of Japanese railway engineers proposed and prepared blueprints for a normal gauge (1435 mm) railway line between Tokyo and Kyushu and the so-called normal-gauge lobby was established.

The transfer of Japanese research and technology development from a military oriented basis in the 30's and early 40's to a more civil oriented basis in the late 40's and 50's heavily influenced railway development. Many military engineers and experts were transferred into the railway network. An important role was played by the Railway Technical Research Institute in railway technical development. It was established in 1907 as the "Railway Investigation Laboratory" of the Imperial Railway Agency. Since its establishment, it has undergone changes in name and organization a number of times, expanding its activities each time. After World War II it took on many aviation engineers and experts from the defunct Japanese Army and Navy in order to make use of their technical knowledge and experience, especially that of the aeroplane engineers for railway development. Thus it was no accident that in 1957, when this Institute was celebrating its 50th anniversary, that a public statement pointed out the possibility of "Tokyo-Osaka in three hours".

Research interests of the Institute for high-speed railways has a long record and a high-speed steam locomotive project was considered by the Institute long before the Shinkansen concept was thought about. This Institute is the only all-round research organization on railways in Japan and is the center for technical development of the JNR.

From the beginning of Japanese railway planning, research and design were carried out by railway centers where the contract system of work--construction, as well as building industries--was adopted for the purpose of increasing efficiency. At present, the contract system of track construction is used in North America and many European countries. Japanese railway development had three major periods of fast growth. The first was the first ten years of this century, when in 1907 the state railways achieved the 7,000 km mark; the second was between 1935 and 1945, when passenger and traffic volume almost trebled and route length almost reached 20,000 km; the third was in 1950-57 just before the Shinkansen concept was proposed. The first two periods were directly connected with wars, the third one partly so (as an indirect consequence of the contracts concluded by Japan's war industry and related business in the first part of this period during the Korean War).

Japanese railways offered the opportunity of responding quickly to national needs and new demands with very high local efficiency. The Tokaido line, before the Shinkansen was developed, was considered to have the highest efficiency in the world, handling, as it does, the maximum volume of transport within the limits of its capacity.

5.1.2 The Situation After the Tokaido Shinkansen was Built

Since the opening of the first Shinkansen Tokaido railway line in October 1964, Japanese railways have become the leading passenger railway system in the world and will remain in this position for many years. The preliminary objective of building a Shinkansen freight railway has not materialized but in actual fact it was only considered in the very early stages. Shinkansen should be considered more as a first generation of high-speed mass passenger, inter-city, ground transport system. Nevertheless, it was proposed, designed, constructed, and now is in operation by railway managers and engineers. In 1975 Shinkansen carried 1,032,136 passengers in a single day, and 157.2 million passengers in one year. Passengers/kilometers reached 53,318 million and the length of the route reach 1,070 km. In 1958, the proposed estimate for passenger traffic in the Shinkansen Project was 19.90 million and the length of the route 590 km. The number of trains operated per day in 1975 averaged 275.

Shinkansen passenger traffic in 1975 was almost 25% of total JNR passenger traffic, counted in passengers per km. It is necessary to add that in 1975 passenger traffic was less than in the previous years for the first time sine 1950. However, Shinkansen passenger traffic enjoyed an increase of 31%, mainly due to the extension of the Shinkansen from Okayama to Hakata.

Full safety precautions were reached on the Shinkansen line and so far no fatal accident has been recorded. Introduction of Shinkansen technology into the JNR has increased the overall technical level of the entire system. For example, contralized traffic control (CTS) equipment was applied in 1966 to the total tunnelling and bridge construction technology and is now being expanded to conventional lines.

5.1.3 The Present Situation

Twenty years after the Shinkansen concept was proposed and almost 14 years after the first Shinkansen operational run, the JNR faces more difficult problems than it did in the late 50's. The unquestionable technical and economic success of the Tokaido Shinkansen line has generated several societal problems.

The concept of the Shinkansen is again under investigation by the Japan Cabinet and Shinkansen at the moment has nation-wide opponenets and supporters. Shinkansen, viewed still as a new railway technology and candidate for further extensions, is the subject of technology assessment in Japan. The technology assessment movement began in Japan in 1971, when people began to be seriously concerned with environmental and housing problems in the urban areas. Japanese technology experienced a drastic conversion from military-oriented to industry-oriented after 1945. Today in the 70's, it faces another need for drastic conversion from industry-oriented to society-oriented.

Another serious JNR problem is connected with chronic financial difficulties; JNR has been suffering financial losses for more than 10 years. The financial situation of the JNR is shown in Tables 5.1 and 5.2. A deficit. which has been accumulating since 1964, has now grown to an enormous total of 3,161,000 million yen (~ 12.5 billion US $). The Long-Term Improvement Plan of the JNR (April 1977) stated:

> The finances of JNR are in a critical situation. This is mainly attributable to the loss of JNR's dominant position in the domestic transportation system. The unprofitability has become more pronounced in the sectors of freight and light traffic. In the field of freight service, due to the lag in adaptation to the changing market conditions, enormous deficits are incurred every year.

Table 5.1 REVENUES AND EXPENSES

(thousand millions of yen)

CLASSIFICATION \ YEAR	1971	1972	1973	1974*	1975*
Operating revenues	1,178.2	1,244.3	1,379.1	1,571.4	1,820.9
Passenger	859.6	921.6	992.2	1,125.2	1,315.1
Freight	250.1	239.5	238.1	240.5	241.6
Miscellaneous	68.5	83.1	148.7	205.7	264.2
Financial rehabilitation subsidies	29.2	39.9	93.8	147.9	197.8
Special grant to promote rationalization	1.0	0.5	0.3	0.2	0.1
Others	38.3	42.7	54.6	57.6	66.3
Operating expenses	1,420.7	1,594.4	1,840.7	2,232.9	2,744.4
Personnel	784.9	873.4	1,040.2	1,244.0	1,522.6
Material	258.4	288.4	327.9	461.7	517.5
Taxes and public dues	13.2	13.9	15.7	16.9	18.8
Interest and bond handling expenses	163.2	198.3	227.8	269.8	405.5
Depreciation	201.0	220.4	229.1	240.5	280.0
Non-operating revenues	11.9	13.6	14.2	15.7	12.3
Non-operating expenses	3.6	5.0	6.9	5.0	3.5
Net profit or loss	-234.2	-341.5	-454.4	-650.8	-914.7
Profit or deficit carried over	-799.6	-1,141.1	-1,595.5	-2,246.3	-3,161.0

Notes: (1) Asterisk indicates the year the tariff was revised.
(2) The personnel expenses are those chargeable to the Profit and Loss Account.

Source: JNR Facts and Figures 1976.

Table 5.2 BALANCE SHEET

(thousand millions of yen)

CLASSIFICATION / YEAR	1971	1972	1973	1974	1975
Total Assets	3,912.2	4,356.9	4,886.2	5,424.2	5,937.8
Fixed assets (net)	3,366.4	3,707.9	4,284.3	4,778.8	5,271.5
Investments	91.1	92.8	94.7	97.2	99.2
Working assets	34.8	39.4	49.3	54.0	51.9
Current assets	299.9	399.8	351.2	328.8	330.1
Deferred assets and others	120.0	117.0	106.5	165.4	185.1
Total Capital and Liabilities	3,912.2	4,356.9	4,886.2	5.424.2	5,937.8
Long-term liabilities	3,087.1	3,719.1	4,367.9	5,538.1	6,779.3
Short-term liabilities	322.7	386.7	448.3	316.3	383.5
Other liabilities	22.2	26.5	75.9	82.4	96.3
Capital	12.4	78.0	273.0	386.0	456.0
Capital reserves	1,267.4	1,287.7	1,316.6	1,347.7	1,383.7
Deficit carried over	-796.6	-1,141.1	-1,595.5	-2,246.3	-3,161.0
Net deficit for the year	(-234.2)	(-341.5)	(-454.4)	(-650.8)	(-914.7)

Source: JNR Facts and Figures 1976

Light traffic lines are those where the strong points of the railway cannot be brought into full play, making them a burden on management. Greater efforts should be made to promote the efficiency of the operation of these lines, or a basic solution, however it is hoped that drastic measurements, including the discontinuation of construction of light traffic lines, should be taken by the Government, with the opinions of regional residents and users taken into account.

The huge personnel expense and capital cost are big problems when JNR's cost structure is examined. As personnel expense accounts for a very high percentage of the operating expenses, JNR finance is extremely affected by the rise in general wage rates. Therefore, the improvement in labor productivity by conversion of the railway into a labor-saving plant industry is urgent.

Railway investments require enormous amounts of funds involving a long period of gestation. For this reason the capital cost incurred from the capital investments tends to become a financial burden. Thus, for capital investments, a thorough measure will be taken to make the investments on a priority basis and promote their effectiveness, taking into consideration the aid therefore from the Government as well as ascertaining carefully the effect of each investment.

Due to the leading world position of JNR, it is obliged to make the necessary research effort which should lead to the construction of a new generation of high-speed mass passenger, intercity, ground transportation systems. In JNR, the Technical Research Institute has been playing the leading role in the basic studies of the levitation type "railway" for more than 10 years and it has come up with several technical successes: superconducting magnet and linear motor designs can be considered as examples of such developments.

In July 1972, JNR ran a prototype called ML-100, using a superconducting magnet to propel the linear synchronomous motor, levitated at 60 km/hour, for the first time in the world. In April 1977, JNR set up a Miyazaki Levitation Type Railway Testing Center, construction of a test track of 7.1 km between Hyuga city and Tsuno-cho, was decided in June 1973 and is already underway with 1.3 km of it recently completed for use in order to test the new prototype in August 1977. The test track in Miyazaki is constructed for a speed of up to 500 km/hour maximum. Current Japanese railway development problems can be seen from the JNR research map (Table 5.3).

5.2 Main Actors Involved in Railway Development and Railway Policy in Japan

5.2.1 National Government

The State has played a very important role in the development of railways in Japan. The railroad made its debut in Japan in October 1872 when Emperor Meiji rode in the inaugural train between Tokyo and Yokohama. In 1906 the government purchased the leading private railways and came to administer approximately 7,000 km of railway lines. In 1920 the Ministry of Railways was established and was then absorbed in 1943 when the Ministry of Transport and Telecommunication was established, in 1945 this ministry was reorganized and the Ministry of Transport was established. Up until June 1949 the state railway was operated directly by the railway department of the Ministry of Transport. Since then, due to Japanese National Railways Law, State railways are operated by a public corporation of the highest status (kosha) under the name of "Japanese National Railways". In Japan there are three public corporations with this status: JNR, The Japan Tobacco and Salt Public Corporation, and the Nippon Telegraph and Telephone Public Corporation. JNR is operated under the supervision of the Ministry of Transport.

Table 5.3 Research Map Classifying the Items to be Developed

Purpose	Description of items
1. Development of levitated railway	1.1 Guideway
	1.2 Support, guide
	1.3 Drive, brake
	1.4 Vehicle structure
	1.5 Vehicle Dynamics
	1.6 Aerodynamics
	1.7 Power supply
	1.8 Current collection
	1.9 Train control
	1.10 Others
2. Technical development of nationwide SHINKANSEN	2.1 Investigation of new technology
	2.2 Running speed-up
	2.3 Efficient tunnel excavation
	2.4 Anti-snow measures
	2.5 Automation of train control
	2.6 Others
3. Modernization of narrow-gauge lines	3.1 Development of high-speed vehicles
	3.2 Ground facilities for speed up
	3.3 High-speed, high-density operation
	3.4 New transport system
	3.5 Others
4. Modernization of freight transport	4.1 Freight transport system
	4.2 New freight transport
	4.3 Yard modernization
	4.4 Pipelines
	4.5 Others
5. Modernization of managing system	5.1 Modernization of train operation information processing
	5.2 Modernization of passenger information processing
	5.3 Modernization of freight information processing
	5.4 Others
6. Saving of manpower and expense	6.1 Modernization of passenger and freight station facilities
	6.2 Manpower saving in track maintenance
	6.3 Modernization of structure design, construction and maintenance
	6.4 Modernization of vehicle design and maintenance
	6.5 Modernization of electrical equipment design and maintenance
	6.6 Modernization of ships and automobiles
	6.7 Others
7. Securing of safety	7.1 Improvement of running safety
	7.2 Improvement of train operation safety
	7.3 Improvement of reliability in equipment and vehicle
	7.4 Anti-disaster measures
	7.5 Others
8. Conservation of environment	8.1 Noise, vibration mitigation measures
	8.2 Preventive measures for radio-wave interference
	8.3 Anti-pollution measures
	8.4 Others
9. Development of universal research technique	9.1 Modernization of instrumentation and data processing
	9.2 Others

SOURCE: J N R

The following are subject to the permission or authorization of the Ministry of Transport:

(1) the construction of new railway lines and the acquisition of the ownership or private railways of other modes of transport;

(2) Suspension of service on a line or closure of a line;

(3) Electrification of railway lines and other major projects stipulated under the Ministry of Transport Ordinances.

Revision of the basic passenger and car-load freight rates is subject to the approval of the National Diet, that of passenger and freight charges is subject to the authorization of the Ministry of Transport. JNR capital is wholly invested by the State and the JNR budget is an item in the Ministry of Transport's budget; therefore it must be approved by the Ministry of Finance, the Cabinet and the National Diet.

The National Diet, as the highest organization of state power and the sole law-making organization of the State, can enact a law which would effect the Ministry of Transport as well as the JNR.

The Cabinet, the Prime Minister's Office and its Agencies (Economic Planning, National Land and Environmental Agencies) can formulate, or participate in the formulation of, railway development policy through the Development Plan. In Japan there is a consensus style of governmental policy that allows the participation of other ministries and agencies. Advisory Councils play an important role in policy formation, in national government and ministries, these councils having been established as a device to get information from specialists in various fields, to secure fairness of administration, to adjust conflicting interests, and to coordinate various fields of administration. It is considered useful for the government and ministries to keep up with social, economic, and technological development.

The Transportation and Railway Construction Councils, established within the Ministry of Transport, are directly connected with railway development policy.

5.2.2 Japanese National Railways (JNR)

Japanese National Railways is a large organization with 430,051 employees as of March 1976. The JNR President has full decision-making powers on some matters in operating the JNR while for others the permission or authorization of the Minister of Transport is required. On minor JNR operational matters the top decision is given by the President, but for more important matters the Board's permission is required--the President serves as Chairman. The Board consists of the following members: The Vice-Chairman, this position is taken by the Executive Vice President; the Vice President of Engineering and advisory directors to the President (those serving in the head office and those dispatched to Sendai, Tokyo, Nagoya and Osaka); Shinkansen general manager of administration; two regional managers (Hokkaido, and Kyushu) and others from external organizations. The organizations which have been involved in railway development and railway policy are the head office and its attached organizations with 3,673 employees. The administration of Shinkansen, engaged solely with the operation of existing Shinkansen lines, employs 12,369 people. Until recently the two departments in the head office were engaged entirely with Shinkansen development, these two departments were the Shinkansen Network Planning Department and the Shinkansen Construction Department.

5.2.3 Japan Railway Construction Corporation (JRCC)

The JRCC was established in March 1964 as a public corporation of the Kodan type (second in the hierarchy of public corporations) it was set up in order to construct new railway lines with financial aid from the government in accordance with its policy of reinforcing the JNR network and metropolitan area transport and transferring or leasing such newly constructed lines to the

A Simplified Organization Chart for the Japanese National Railways

As of April 1977

Board, President, Executive Vice-President, Vice-President - Engineering, Advisory Directors to the President

- Personnel Committee
- President's Secretariat
- Public Relations Dept.
- International Dept.
- Inspection & Audit Dept. - Investigation Division
- Corporate Planning Dept.
- Local Line Countermeasure Dept.
- Technical Development Dept.
- Staff Relations Dept.
- Finance & Accounting Dept.
- Purchasing & Stores Dept.
- Information Systems Dept.
- Environmental Preservation Dept.
- Passenger Dept.
- Freight Dept.
- Train Operation Dept.
- Construction Dept.
- Shinkansen Construction Dept.
- Track & Structure Dept.
- Electrical Engineering Dept.
- Rolling Stock & Mechanical Engineering Dept.
- Motor Transportation Dept.
- Ferry Service Dept.
- Diversification Dept.
- Development Dept.
- Railway Police Dept.
- Mutual Aid Association Secretariat

- Regional Office (Hokkaido, Shikoku, Kyushu)
- Shinkansen Administration
  - Operating Div. (2)
    - Car maintenance Center
  - Workshop
- Tokyo Metropolitan Sphere Headquarters
- Office of Resident Board Members (Sendai, Nagoya, Osaka)
- Traffic and Operation Office (Tohoku, Chubu, Kansei)

- Railway Operating Div. (20)
  - Workshop (12)
- District Motor Transportation Div. (4)
- District Motor Transportation Office (2)
- District Purchasing & Stores Office (6)
- Workshop (3)
- Construction Div. (10)
- Building Construction Div.
- Power Supply Control Div.
- Electric Construction Div. (4)
- Systems Development & Construction Div.

Chart 5.1

JNR and other railway enterprises. The capital of this corporation in 1977 was 403,800 million yen, with 331,100 million of this provided by the government and 72,000 from the JNR budget (nearly 50% in government guaranteed bonds).

The Corporation partly took over the work on the construction of new lines from the JNR; this included work on local lines, metropolitan area lines, trunk lines and the Seikan Undersea Tunnel. The Seikan Undersea Tunnel is a huge construction project to build the largest undersea tunnel in the world (53.9 km) which will join the main and largest island of Japan, Honshu, with Hokkaido, which is the second largest island but is, as yet, undeveloped. This undersea tunnel is 2.1 km longer than the proposed undersea tunnel between France and the UK. A careful geological survey for this tunnel was started as early as 1946. In 1964 excavation of the exploratory tunnels was started in order to observe the characteristics of faults and rock formations and to study the construction methods of excavation and sealing water inflow. In March 1971, the investigation stages were over and in April 1971 the construction project was authorized by the Government. Construction cost was estimated at 2,000 hundred million yen and the proposed accomplishment date was March 1979. The pilot tunnel being constructed at the sea bottom is under direct control of the JRCC; the service tunnels and the main tunnel are being excavated by construction companies.

The JRCC was put in charge of the construction of Joetsu (Tokyo - Niigata) and the Narita lines.

The construction of the Joetsu Shinkansen has been under way between Omiya (near Tokyo) and Niigata since November 1971. On account of the mountainous topography, the line passes through many long tunnels, among which are the world's longest tunnels, the Daishimizu (22.2 km), the Nakayama and the Haruna. Upon completion of the Joetsu Shinkansen line, trains will be able to reach Niigata in an hour and a half from Tokyo.

The JRCC has also been assigned to undertake the construction of two additiona projected lines, the Hokuriki Shinkansen (Tokyo-Osaka) and the Hokkaido Shinkansen (Aomori-Sapporo). Apart from these, the JRCC commenced preliminary investigations in July 1974 on an undersea tunnel between the islands of Shikoku and Kyushu for another Shinkansen line which is envisaged in the 7,000 km Shinkansen network plan. In 1977 the JRCC employed 3,365 regular staff members, 11 officers, a president, a vice-president and seven directors. Most officers as well as engineers were previously employed by the JNR. Personnel also pass from the JRCC to the JNR. The annual budget of the JRCC is supervised by the Ministry of Transport; however, unlike the JNR, this corporation does not suffer a financial deficit.

5.2.4 Industries Working for Railways

It is a long-standing Japanese railways tradition that research, design and planning are made by the state railway and that private industry (construction, machine-building, electric and electronic industries) are contracted for the execution of work. This appears to be a very suitable arrangement for Japanese industry.

5.2.5 Regional and Local Authorities

Regional representatives of central government, prefectures and city governments should also be considered as important actors in railway development and railway policies. National Development Plans which also include railway development are taken into consideration and regional authorities and local governments are consulted. The JNR and the JRCC consult prefectures and city governments about the plans of new railways. The location of the Tokaido Shinkansen intermediate stations can be considered as an illustration. The route between Nagoya and Maibara (transfer station from and to Hokuriku trunk line) had to be decided. There were three routes proposed: A, B, C, whose main features were those shown in Table 5.4.

Table 5.4 MAIN FEATURES OF THREE NAGOYA-MAIBARA ROUTES

ROUTE	A	B	C
Length	15 km longer than B-route		22 km shorter than B-route
Soil Condition	Not so bad	Bad	Very bad
Tunnel Length	1 km	1 km	15 km

Source: JNR

Proposal C was rejected for the following reasons:

(1) Soil conditions were bad.

(2) A 15 km long tunnel had to be built and construction costs would have been very high, furthermore, the period of construction would have been nine to ten years.

The Gifu Prefecture and city authorities and citizens group, with the support of all the Diet members except Mr. Ohno, strongly recommended that the JNR adopt route A. The JNR decided, however, to select the B route for these reasons: The Shinkansen Project is not planned for the convenience of Gifu City, but for the convenience of all users, users from the Gifu City being assumed to be less than 3% of the total passengers. The running time of the A route takes five minutes more than that of the B route. The total time loss for users was estimated by the JNR as 9,600 man-hours per day. Route B has been adopted and Hajima City was selected as the intermediate station instead of Gifu City. In the case of the Kyoto Shinkansen station, negotiations with city authorities made things difficult. Nagoya City was the most co-operative in its response to the JNR proposal; the city drew up its own planning to remove the black market, which was just behind the Nagoya station.

5.2.6 Citizen Groups

The influence of citizen groups in railway development in Japan has increased rapidly in the past ten years. Citizen groups also played a role at the time when Tokaido Shinkansen was built; an example of this was the case of Gifu City which was described in the previous paragraph, although this case only illustrates the citizen group's reaction to Shinkansen. In Japan now there are citizen groups both for and against Shinkansen. Nagoya City could not be considered by the JNR as the most cooperative community, since the first court suit was issued against the JNR in 1974 in this city.

Environmentalists are the most active and sound citizen group in Japan, however some regional and city-development oriented citizen groups also belong to the anti-Shinkansen group. Shinkansen changes not only environmental conditions but economic and social ones as well. This problem will be discussed in detail in the chapter on the regional aspects of the Shinkansen Project.

The success of Shinkansen plus the heralding of very ambitious and optimistic plans to link all Japanese islands by a Shinkansen network have stimulated the ideas of many regional and city developers and politicians. This success has also stimulated the formation of citizen groups advocating the construction of Shinkansen, some of these groups are located in very remote areas and in areas of low population in Japan.

5.3 Main Issues

In the case of the New Tokaido Line, a pure passenger transportation system is considered. Passenger transportation is only a need for organizational, sociological or political objectives. Freight transportation is a fundamental need for living: to provide resources or food suitable for a comfortable standard of living, or for exchange of resources. Transport started with salt roads, iron roads, tea roads, etc., and even transport routes at present are following these patterns to some extent.

In Japan, the political situation, especially during the Shogunate, had fostered passenger transport. At this time the Tokaido Line had already been founded. In Figure 5.1 Japanese railways are compared with other railways. The difference in situation can also be found concerning freight transport. JNR gains 84% of its income from passenger transport.

Its situation as an island allows JNR to follow advanced technologies without the problems of negotiating with neighboring railway authorities. For example, JNR is promoting extremely motive cars or multiple unit trains, instead of locomotive-hauled trains which have many disadvantages concerning reliability, modern maintenance methods, etc.

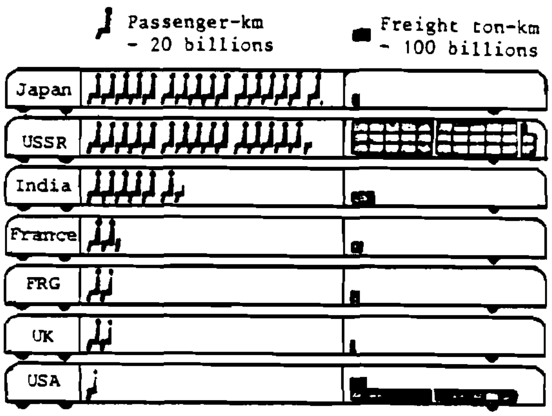


Figure 5.1 RAILWAYS BY COUNTRY (1975)

Source: Statistical Handbook of Japan, 1977.

5.3.1 Speed

It is recognized that speed is one of the most important factors for users as well as transport suppliers. Speed has influence in a psychological sense and short travelling time in a rational sense for the selection of transportation means. In transportation systems, one always tries to improve the maximum speed of vehicles, the cruising speed, and the operating speed limits, and depends on them to some extent to get shorter travelling times. It is widely acknowledged that an increase of speed and shortening of travelling time results in an increase of demand (see references 10,19,35,39,71,80,86,88,89,101 and Figures 5.2 to 5.6). In addition, the productivity of rolling stock will be increased [11,35]. More effort for maintenance, especially for tracks, is needed and the optimal speed depends on the distance of the stations and on the price for energy and the costs for construction with installations for environmental protection.

JNR did not hold any world speed record at the time of designing the New Tokaido Line. The New Tokaido Line itself has had only the record for shortest travelling time for such distance and travelling speed, but this is very remarkable (Figure 5.7).

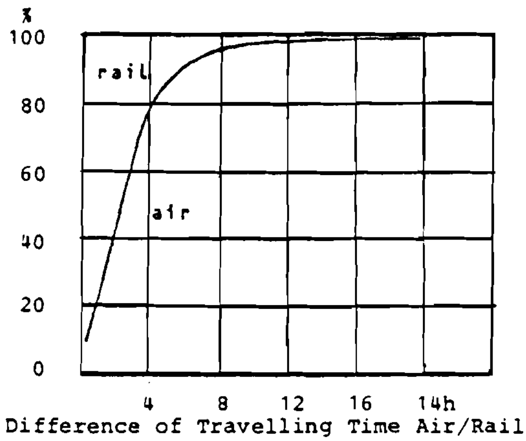
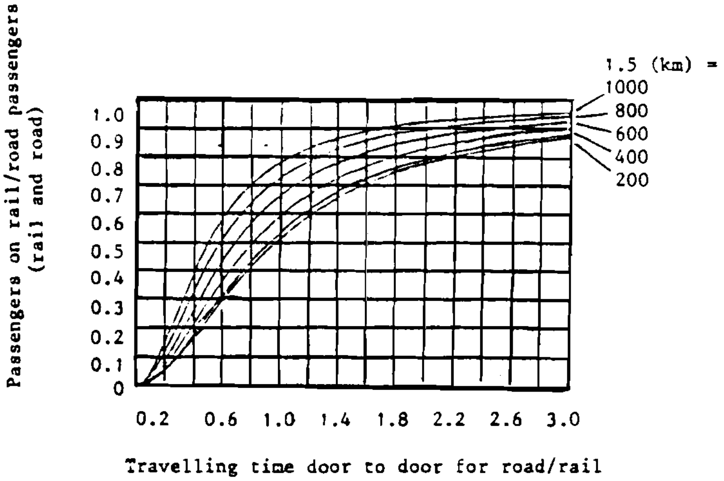


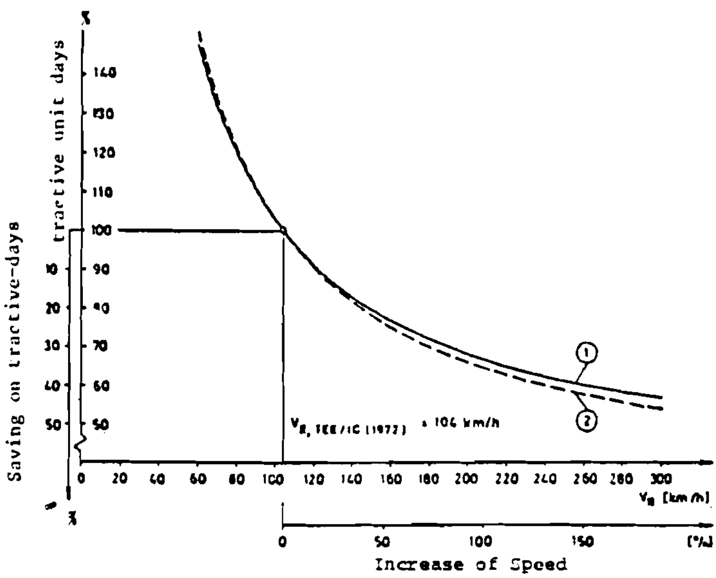
Figure 5.2 SELECTION OF TRANSPORTATION MEANS DEPENDING ON TRAVELLING TIME

Source: [38]



Source: [19]

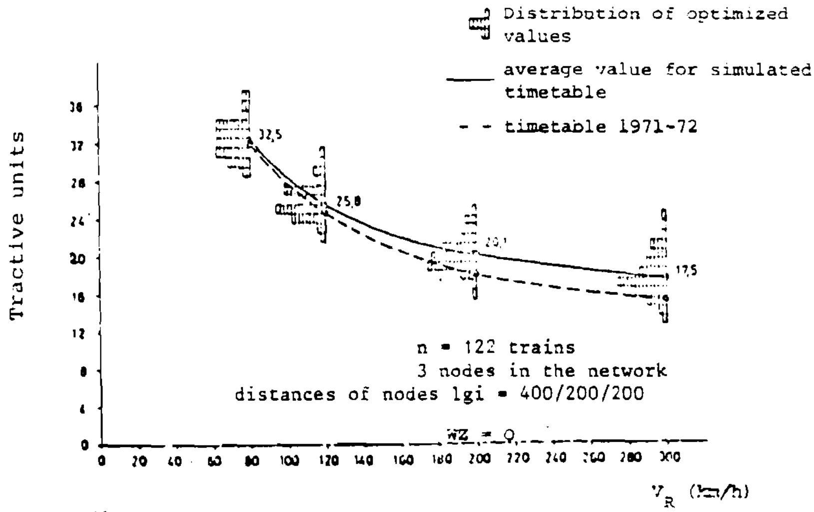
Figure 5.3 MODAL SPLIT RAIL/ROAD WITHOUT AIR TRANSPORTATION



Notes: (1) Since 1972 unchanged, average distance (302 km) of turn around.
(2) If 375 km average distance of turn around is predicted.

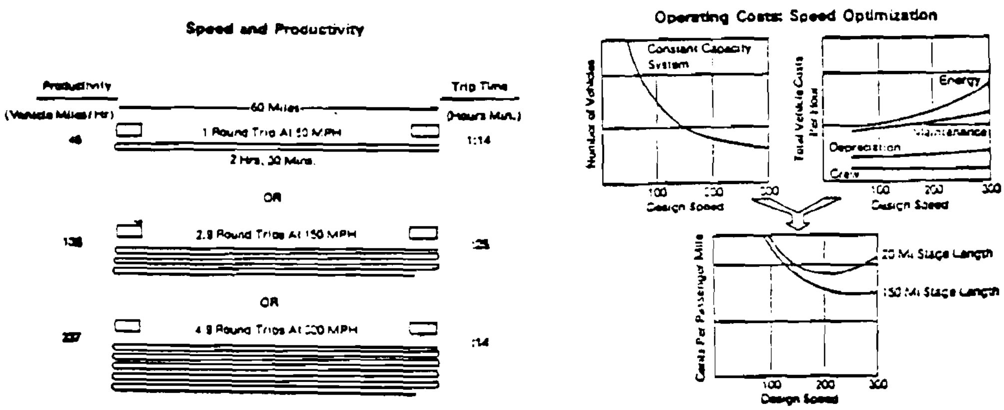
Source: [35]

Figure 5.4 SAVING ON TRACTIVE UNIT-DAYS DEPENDING ON TRAVELLING SPEED



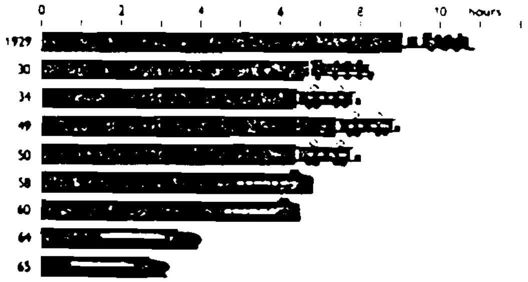
Source: [35]

Figure 5.5 NUMBER OF TRACTIVE UNITS DEPENDING ON TRAVELLING SPEED



Source: [11]

Figure 5.6 SPEED OPTIMIZATION



Source: Statistical Handbook of Japan, 1977

Figure 5.7 GROWTH OF TRAIN SPEED
(between Tokyo and Osaka, 515 km)

5.3.2 Safety

In general, safety standards for railways are very severe [23,52] but, even today, man-made regulations are relied upon and safety measures are not considered in an overall systems approach. The New Tokaido Line shows that best results in safety can be achieved only by well designed systems, and that man is, at the present level of technology, the weak point. The success of the reliability approach in safety-related systems is made evident. Not only has new technology like electronics been used well, considering the long lifetime experience of railways, but, rather extensive research has been done on human factors and control of human behavior. The possibilities of hazards to the system have been considered as far as possible, for example, earthquake and typhoon warning systems, countermeasures against intruders, and obstacle warning devices etc. The New Tokaido Line is a fail-soft system which, in case of failures, progressively deteriorates in performance rather then collapsing completely or becoming dangerous.

As shown in statistics, the JNR is one of the railways ranked highest concerning safety [7,6]. This is also true for the conventional lines of JNR; the exception being crossings with road traffic. The much used system of the New Tokaido Line shows that, not only can the highest safety standards be achieved economically, but also safety in the long run is more economical. Research towards further improvement of safety and reliability is continuing [56,92]. In [22] the correlation between investment and safety is pointed out.

Even today an idealistic viewpoint concerning safety is evident not only with the public and courts, but among engineers.

The Technical Committee on Reliability, Safety, and Security of the European Purdue workshop has decided to use the definition [28]: a system is "safe" if dangerous effects are considered negligible in the application. In the above sense, fail-safe means safe in the presence of failures.

It should be recognized that man, because of his limitations, cannot create an absolutely safe system. These limitations are caused by economical, technical, and psychological reasons, as well as by man's inability to conquer his environment. But too often, as stressed in [26], people (especially governing or regulatory bodies) incorrectly imagine that they can virtually avoid risks instead of trading them off.

In railways it was (and is in many countries) common to apply a deterministic approach to safety-related systems. Of course, this only means a very high probability for the occurence of assumptions. Even in case of a simple fail-safe relay, the quality expected is not deterministic, even though it works with high probability, because it is assumed that gravity will work any time and a sticking contact is impossible. Deterministic behavior would imply an absolutely controllable system and environment, a very short time span in relation to the response time of all dynamic processes of the environment, or systems embedding and simplicity so that man can know and recognize all influences and behaviors.

Even if denied by lawyers, all regulations and laws concerning acceptance of a system's safety rely on probabilistic assumptions. It is a knowledge acquired by experience and by comparison or analytical deduction, not by access to all required information. This is also true for the well designed system of the New Tokaido Line [103]. Recently, the BART project in San Francisco [37] showed how things can go wrong if this recurring process of step-by-step trial, learning, and information feedback is neglected by a short-cut design and by not involving railway engineers. The New Tokaido Line project exemplifies the successful implementation of this process.

The New Tokaido Line has shown that, in safety-related systems, not only hardware and software have to be considered, but also the orgware. The organization of continuous improvement in safety and reliability has great impact on results. Safety problems in other fields have a strong impact upon new safety approaches in railways [31,30,29]. Figure 5.8 shows such a structure as an example [70].

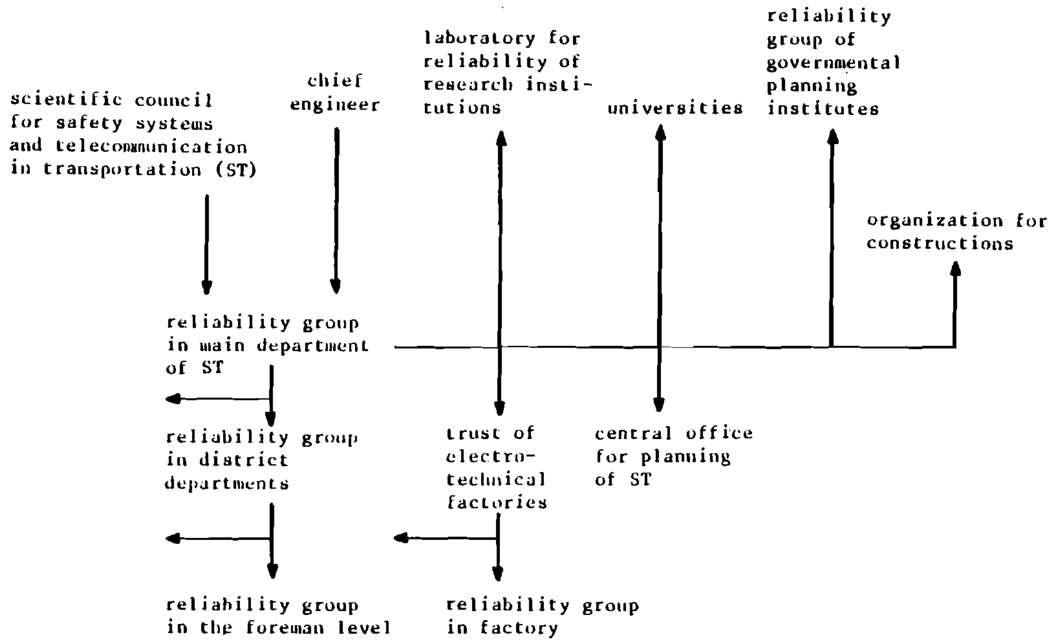
In some countries a trend can be noticed in the courts to switch concentrating their investigation of accidents from weak points at the operational level to investigating weak points at the planning level, in long-term management, and stressing the state-of-the-art technology for man. Their intention is not to neglect man-related problems in their concern over machine regulations [60].

5.3.3 Reliability

The JNR was the first railway in the world which transferred, to a great extent, the results gained in the realibility approach of space systems or military systems to railway [40,54].

The roots of success have been:

- to have made an over all system design
- to have recognized that a well designed system in the planning stage gives best results in reliable performance during operation
- to have recognized the advantages of using automation in railways, and that man is, at the present state of technology, already the weak point
- to have utilized the advantages of modern electronics and communications systems [3,90]
- to have chosen dedicated systems for reducing complexity
- to have used modern algorithms and computers as a help and completion for man and not vice versa; the real



Note: Formalized information collection; among other things, age and qualifications of foremen are recorded.

Source: [70]

Figure 5.8 RELIABILITY SYSTEM AT SZD

optimum in practice has to be learned during a system's life time: for such purposes flexible, robust, and easily understood algorithms, whose results are perhaps only near to a theoretical optimum are helpful.

- to have had the opinion that a reliability approach is also suitable for railways

The effects can be noticed not only in the railway system itself but also in related systems as the seat reservation systems etc.

Recently there was some deterioration of the reliability of operation; passengers were dissatisfied with the increasing time delay and lack of dependability of trains. It should be mentioned that JNR pays back a percentage of the fare if the delay of a train has reached a fixed threshold. This problem arose at the end of the predicted systems life time and, as far as it can be discerned, it was not an engineering, but rather a management or social problem, which seems to have been settled. JNR showed that reliability is closely connected to safety and profitability [69].

5.3.4 Ergonomics, Education and Training

In 1963 the Railway Labor Science Research Institute was established with laboratories for:

- Labor Physiological Research
- Labor Health Research
- Labor Pathological Research
- Labor Psychological Research
- Social Psychological Research
- Human Engineering Research
- Psychology Aptitude Research [5].

Much effort has been concerned with ergonomics applied to finding well designed cabs and signalling systems. Of course, because of the broad use of computers (about fifty computers had been installed at JNR by 1965) the problem of the man-machine interface has been investigated intensively.

The design of the passenger cars is concerned with handicapped passengers. The cars are very similar to an airplane in design. They cause an uncomfortable change in pressure when the train enters a tunnel due to their soft bodies. Therefore, the car body is tightly closed and climatized.

As stated in [34]: "the most comprehensive series of studies available to vehicle designers is that concluded in the 1960's under the auspicies of the JNR."

Figure 5.9 shows the educational level of the labor population at JNR as being quite better then at many other railways. Not only in railways, but also in other transportation systems, education is recognized as a vital aspect for further advance.

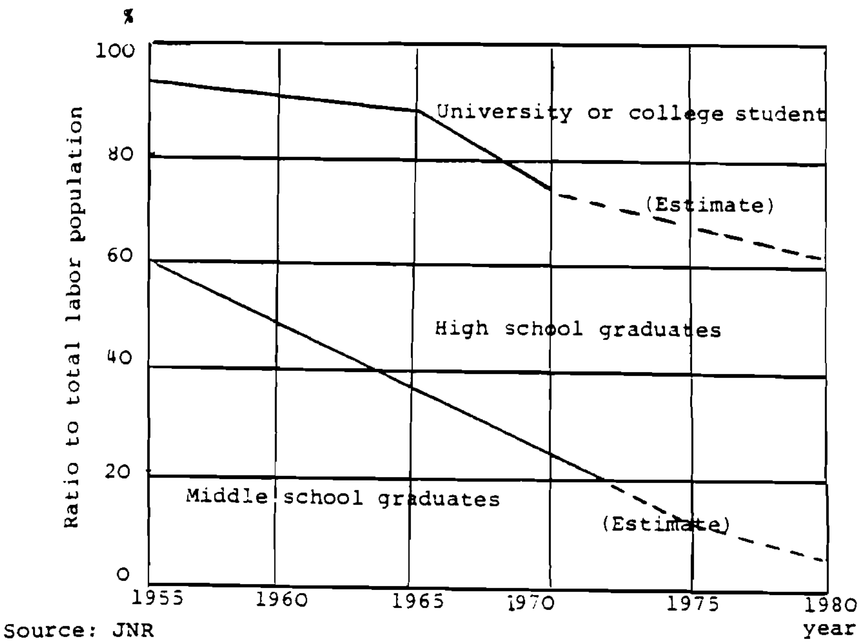


Figure 5.9 LABOR POPULATION BY SCHOOL LEVELS AT JNR

Education at JNR Institutions*

Employees are removed from their jobs temporarily to be educated and trained at JNR's own schools set up for the purpose.

Education at JNR's institutions is further divided as follows:

Regular training: New recruits and candidated for promotion are given needed education and training under this program.

Reassignment training: Employees are given this training when newly developed equipment and installations are introduced for modernization and rationalization or when they are to be reassigned to different kinds of jobs.

Refresher courses: As technical innovations call for higher-level and diversified knowledge and skills, the employees concerned are made to attend these courses to up-level their knowledge and skills for adequate job performance.

The above listed training is conducted at the Central Railway Training School attached to the Head Office and at local railway training schools attached to Railway operating divisions. JNR's training institutions are outlined in Table 5.5.

On-the-job training

Employees are trained at the places of work by their supervisors in the knowledge and skills required in performing their daily jobs.

Table 5.5: Outline of JNR'S Training Institutions*

	Central railway training school	Local railway training schools	Nurse-training schools	To
Number of schools	1	30	5	
Classroom accommodations (students)	2 765	12 672	433	15
Dormitory accommodations (students)	2 146	8 872	463	11
No. of instructors	171	1 033	34	1

*Source: JNR, Rail International, Monthly Review, April 1979, Vol. 4., pp. 366/12.

Education at External Institutions

Some employees are sent to external educational institutions such as universities and research institutes to study specific subjects.

5.3.5 Comfort

The comfort of cars was influenced by the standards of airway service. It may be described as an economical comfort with optimized effectiveness. As mentioned already, handicapped passengers are considered. A new standard was set for the railways by the possibility of telephone calls from passengers on the train to the public telephone network and vice versa.

Different from many other reailways, JNR had, from the very beginning, an on-board loudspeaker information system, one of the high standards to which passengers travelling by air have become accustomed. The next stops are not only announced in reasonable advance, but the name of the next station can be read on board with the station name on the platform just passing.

At the start of the New Tokaido Line, the seat reservation system was the most advanced for railways. But this is still true at present because it is now operated by the telephone reservation system MARS 150 with audio response from the computer.

The passenger information organization at the platform is famous. The automatic stop control for trains allows passengers to wait just in front of the right door of the right car with the seat reserved [15].

In general it may be said that travellers from other countries are impressed by the comfort of the New Tokaido Line, which is no luxury!

5.3.6 Accessibility

The first category, accessibility, means designing a route which would provide the greatest number of people the possibility of usage. It becomes obvious, purely on economic means, that high speed service can not be offered to every city in a country, or to every city along a specified route. A trade-off has to be made which takes into account not only the economic costs of such a system, but also the social costs and benefits.

The Shinkansen experience has shown the importance of route design to ensure maximum usage of its vehicles. The Tokaido corridor is ideally suited for a high speed route--it contains the major population centers of Japan, these centers are far enough apart to allow maximum certified speeds of relatively long duration, and urban center to urban center service can be offered. Indeed, the Tokaido Shinkansen can be looked at as one of the most economically profitable lines in existence in the world today, with over 1 billion passengers carried since ints introduction. Serious consideration is being given to the construction of yet another Tokaido Shinkansen system to complement the one currently in existence, the demand being so great.

Even though the existing Shinkansen lines allow a large amount of accessibility for residents in the major urban centers of Japan, people in other areas of Japan would also like to have the possibility of using this service. Accessibility to existing Shinkansen lines is increased by coordinating connections between normal narrow-gauge lines and Shinkansen lines, although narrow-gauge service is more time consuming for the passengers. There is also increased pressure in Japan to have a nation-wide Shinkansen network, allowing people in the outermost regions of Japan access to Shinkansen service. JNR appears to be opposed to a wide extension of the Shinkansen network on economic grounds. Passenger demand appears to be too small, even with future projections, to warrant the economic investment required for construction and operation of a nation-wide system. The proposed expansion is being argued, not strictly on economic terms, but on the broader social advantages such a system would bring to the residents of Japan. A nation-wide Shinkansen network is seen as contributing to the economic development of all regions of Japan, and would also serve as a uniting factor for residents in the outlying regions. Even though a nation-wide network would not be operationally profitable, it may well be socially profitable for Japan in the long run--certaintly a consideration that warrants further investigation.

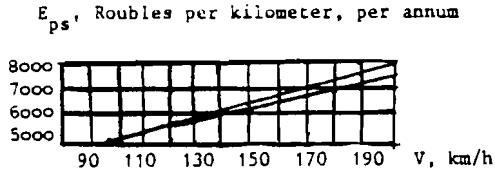
5.3.7 Frequency of Service

Together with accessibility, frequency of service is a major factor in assuring economic and social success of a high speed system. Indeed, the frequency of service on the Japanese Shinkansen lines can be said to be the major difference between the Shinkansen systems of Japan and the other high-speed lines of the world. With a frequency of only six minutes on Hikari and Kodama Shinkansens (a total of nearly 200 trains in 18 hours with a total distance of over 1000 km) and a fixed-pattern time table, the Shinkansens have shown the way to a new dimension of inter-city transport. Such a frequency would not be required for many routes, calculations would have to be based on the passenger demand of certain routes, the carrying capacity of the train cars, whether or not the lines could also be used for freight, etc. But at least the fixed pattern time table is now considered at many railways as a mean for increasing the popularity of train travel.

5.3.8 Profitability

Profitability in relation to high-speed lines has to be discussed in two categories--the pure economic determination of the operating agent, and the social (or socio-economic) benefits of the country in general. Profitability of railroads is an extremely difficult question to answer. It appears today that no railroad system can be operated profitably. Individual lines may indeed show quite large profits, as in the case of the Tokaido Shinkansen, but it is rapidly becoming apparent that railroads serve a purpose far in excess of the passengers or freight carried by them. If decisions for new rail lines or upgrading of existing lines were based purely on economic terms, passenger service would not be increasing, but would be declining (as in the case of the US passenger service since the late 1940's) in major countries of the world.

Economic calculations have to be made (Figure 5.10), but social benefit calculations have to be included in the decision making process also. The Proceedings of the Shinkansen Conference devote an entire section to discussion of the socio-economic



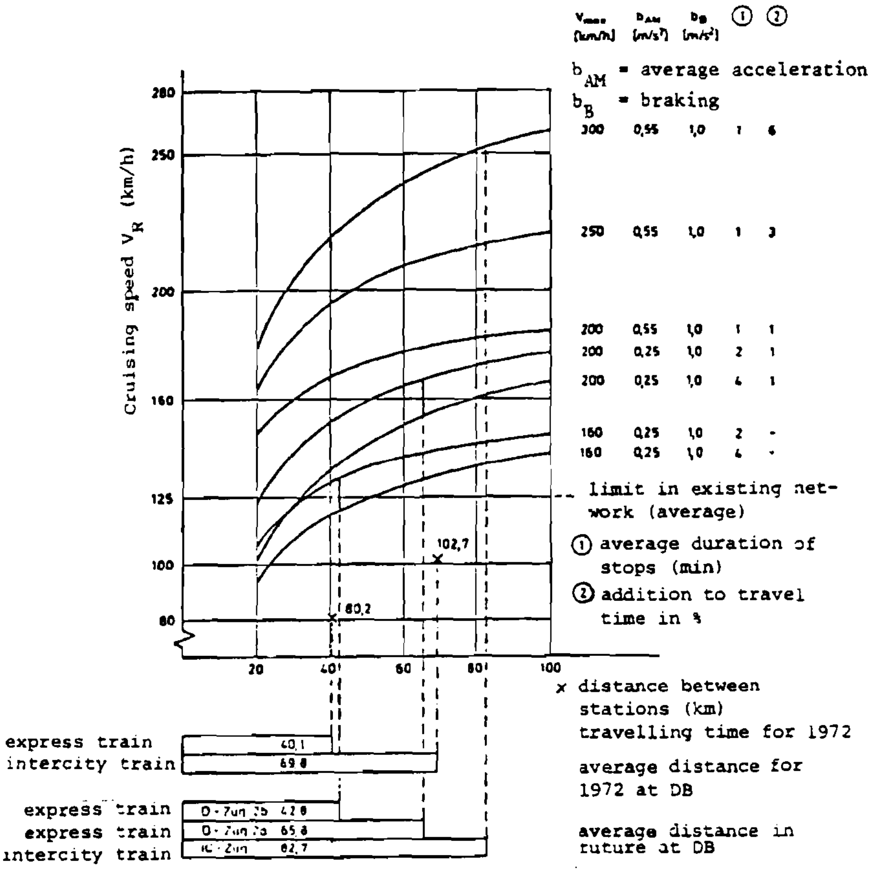
Source: [57]

Figure 5.10 EXPENSES FOR FIXED INSTALLATIONS DEPENDING ON OPTIMAL SPEED

benefits which can arise from a high-speed transportation system: its influence on industrial development, new urban growth centers, opening up new market areas, easier access to the centers of government, a viable alternative to travel with private automobiles (savings of energy and lives).

Even the question of unprofitable lines may be resolved by changes in settlement and industrial patterns spurred by the presence of a high-speed system. Unprofitability may have only a relatively short time span compared to the life of the system.

Business journeys are characterized by a 3 to 10 hour interval from arrival to return. This demand results in rush hours. Railways are not economical for short distances. In this case, because the investment needed to satisfy the rush hours, which is attributed directly to the railway enterprise, consists, not only of the expenses for the rolling stock, but also for line, signalling, and operation, which are high because of strict safety and rail conditions. However, because of the short distance, operational costs are low. Therefore, the fares had to exceed some thresholds or, frequently, some limits of social considerations if the railways tried to have cost-covering fares and earn the expenses for the rush hours predicted in the short interval of operation. If all costs were counted, as is done in the case of railways, and if the safety conditions and other obligations remain consistent, every transportation means would be a loss for the company or the individual at the present fare structure, as

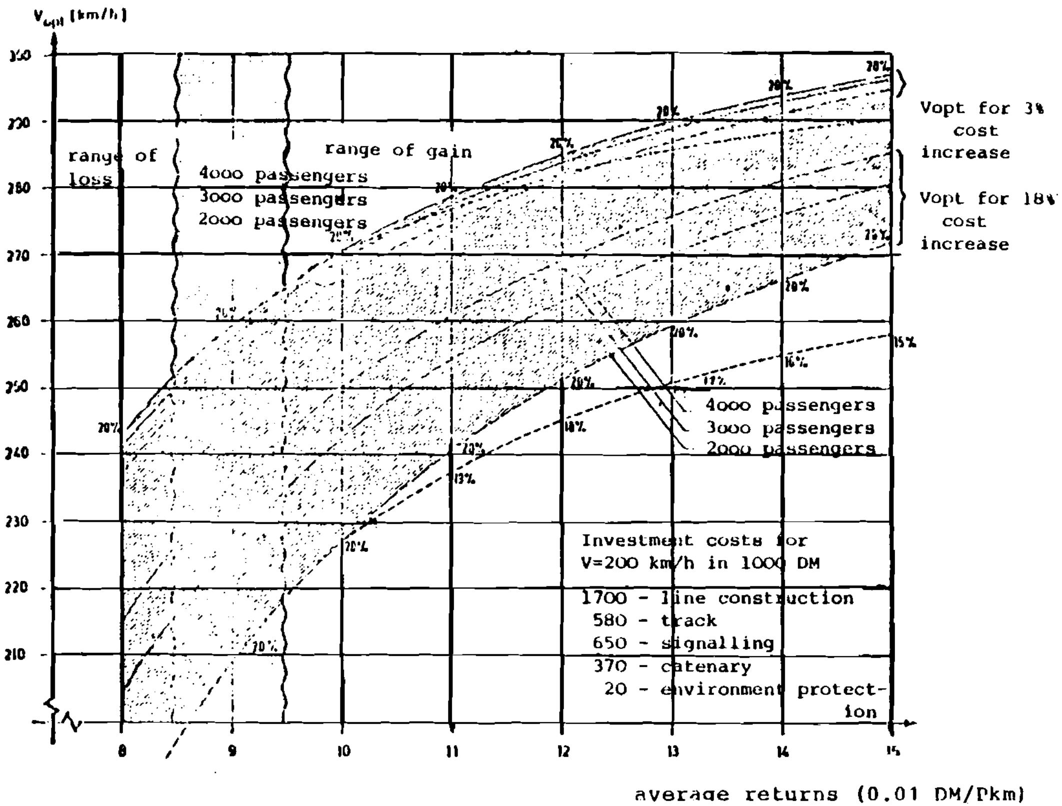


Source: [35]

Figure 5.11 LIMITS OF TRAVELLING SPEED DEPENDING ON AVERAGE DISTANCE OF STATIONS AND DURATION OF STOPS in the case of pure commuter transport. The only exceptions involve the use of animals, which can also be used for meat or milk products, or going on foot. The ratio of operational costs to expenses for the predicted peak hours becomes better with long distances. Besides, this causes a longer capacity use of railway equipment by the passengers. Such distances and lines are optimal (Figure 5.11 and 5.12), allowing the required use of trains as much as possible--with maintenance work coinciding with intervals of reduced traffic demand. Distances are optimal, allowing speeds and travelling time of remarkable advantage in comparison to other transportation means--and this from the viewpoint of economical energy consumption (Figures 5.13, 5.14, 5.15, 4.31).

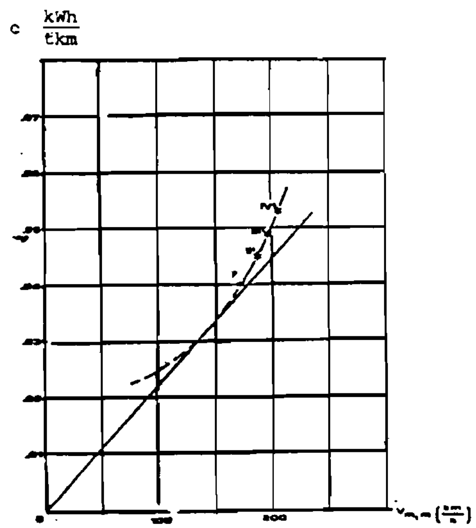
In the case of the New Tokaido Line, there is not only the structure of settlements, the sources and sinks of demand, and the amount of prospective passenger fitting to be considered. The distances involved remove other transportation methods from competition, considering costs for high safety standards, reliability, dependability, comfort, and reduction of travel time, not to mention for energy and operation. The reasons for the New Tokaido Line success are:

- recognizing the mission for contemporary railways and not relying upon subcriteria for optimal solutions or, at worst, only to administer an existing railway;
- recognizing more than short range success;
- the ability to share risks, as in former days when railways were being established;
- putting great effort into learning and information collection;
- not only seeing the state of the art of railways, but also investigating the development of science and technology in other fields;
- spending enough time before deciding upon a plan, but afterwards realizing it as quickly as possible;
- realizing the quick change of technology and the short lifetime of modern equipment, especially considering the economic aspect.



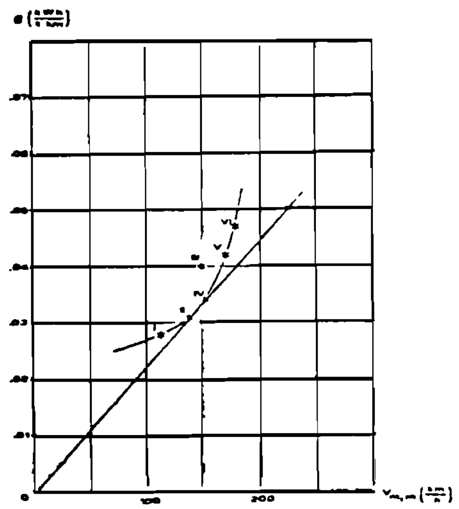
Source: [27]

Figure 5.12 OPTIMAL RANGE OF SPEED DEPENDING ON RETURNS/PASSENGER-KM AND PASSENGERS



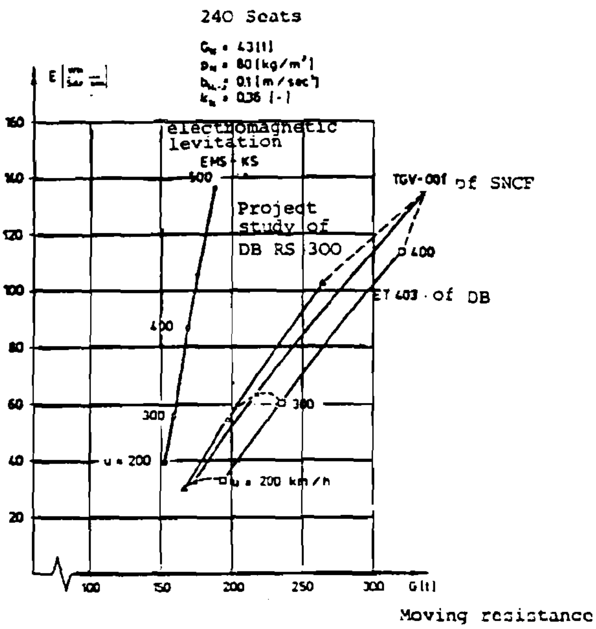
Source: 71

Figure 5.13 EXPENSES FOR ENERGY FOR AN ELECTRIC MULTIPLE-UNIT TRAIN



Source: 71

Figure 5.14 EXPENSES FOR ENERGY FOR A LOCOMOTIVE-HAULED ELECTRIC TRAIN



Source: [27]

Figure 5.15 COMPARISON OF DIFFERENT RAIL-GUIDED VEHICLES

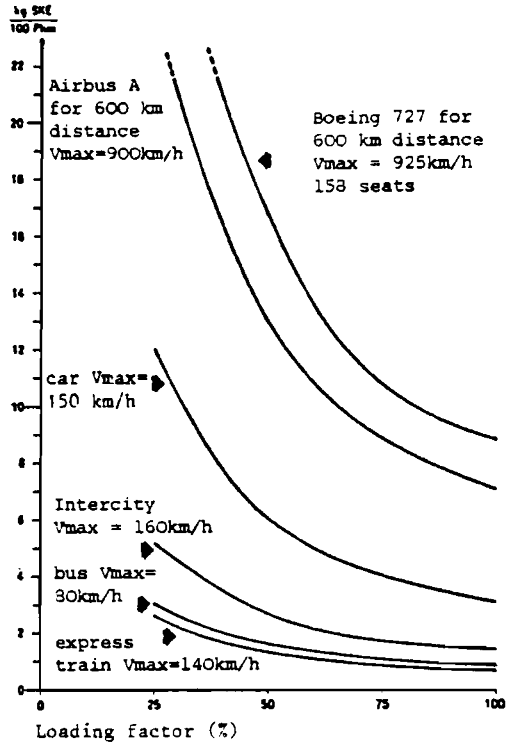


Figure 5.16 <u>SPECIFIC ENERGY CONSUMPTION OF DIFFERENT TRANSPORTATION MEANS DEPENDING ON LOAD FACTOR</u>

Of course, due to the uncertainty of demand predictions beyond 10 years, cost-effectiveness analysis is problematical for long-range planning.

Closely connected with profit is the suitable selection of life-time devices. Long life time reduces maintenance costs and renewal. The return of cash can be longer. But long life time causes higher costs for investment and reduces flexibility to changes of demand or specifications, which can result in loss (Figure 5.17).

Profitability was considered in the overall systems approach and therefore has led to the proper use of computers. The results are, for example, that the running time can be calculated for a 3,500 km distance in one hour instead of 100 km in 8 hours and the time table can be prepared in about one-third of the time required by the former method [44].

At present JNR recognizes that, not only productivity, but also reliability and effectiveness are important factors in the economical operation of railways in an open market.

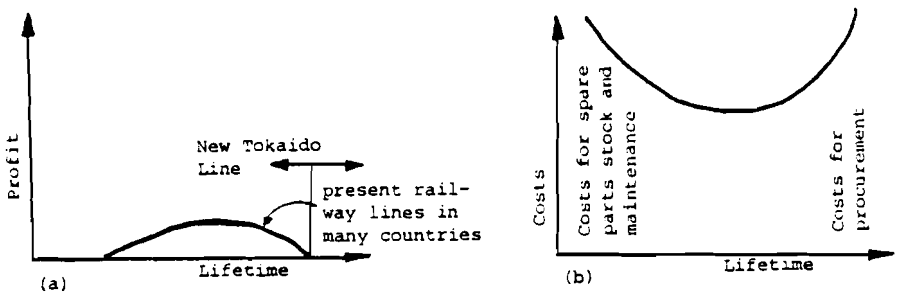


Figure 5.17 LIFETIME, PROFIT AND COST RELATIONS

5.3.9 Computerization and Automation

As early as 1965 about 50 computers were in use at JNR including, for example, IBM 360/40, UNIVAC 490, etc. [83].

Advanced methods optimization in railways were used very early, including dynamic programming [49], and the maximum principle of Pontryagin [42]. A great importance was given to the practicability of algorithms. In time-table calculation, the computer is used for logical decisions and control, the human makes the heuristic decisions and can use his experience, which is important in such complex systems with long system life time as railways. From the very beginning, man-machine interface was considered (e.g., COMTRAC [39,44,74,84,91,99]).

From calculation of train operation [43,48,46,57,79,96,100] to train table preparation [25,44,45,91,93,98], etc., in all possible fields of application, computers have been utilized. Although railways are complex, large systems, an attempt to transfer the pattern of computerizing relatively simple systems such as factories to railways has not been made. As the information system at JNR was designed, it was decided to use functionally dedicated systems [44] (see Figure 5.18). From the seat reservation systems MARS, COMTRAC, KICS, to SMIS (see Table 5.6, which shows the costs and some results gained by these systems) all systems are designed according to this philosophy.

Automation is used for positioning the stop of cars [15,53], for train control (ACT) in some speed ranges [61,58,59,81,87,102], which is now extended by using on board mini-computers [42,60,65], to central traffic control (CTC) [3,40,39,47,74,76,82,84,99,102, 103]. Of course this has caused a change of technology for signalling and data transmission in railways [3,66,83,104].

5.3.10 Maintenance

The main characteristics of the progress at JNR are the extensive use of new methods and technologies in the field of maintenance. For example:

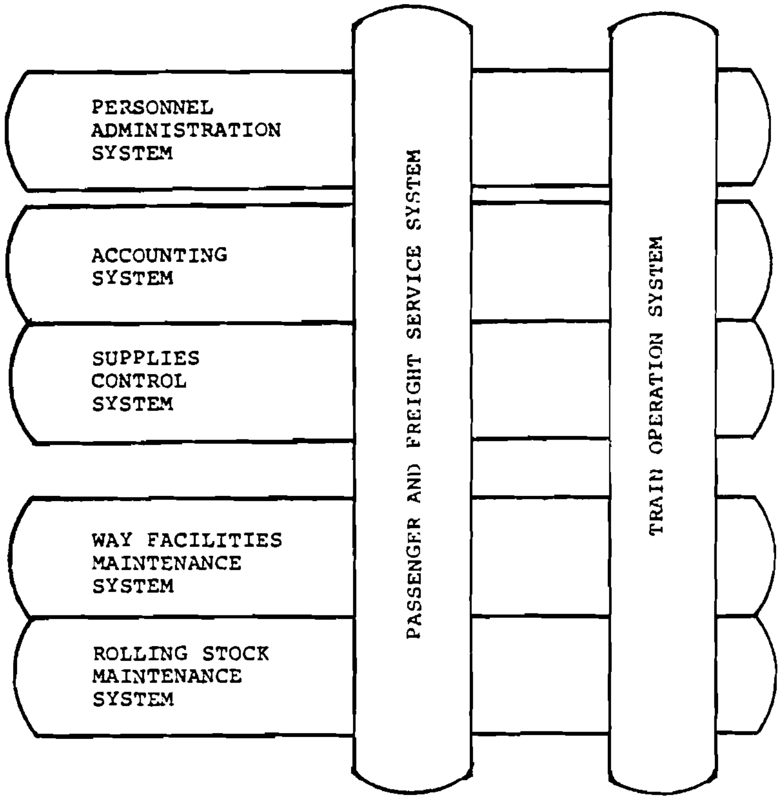


Figure 5.18 RAILWAY INFORMATION SYSTEM OF JNR [44]

Table 5.6 Outline of JNR Computer Applications

(Figures as of 1976)

Computers applied to: (See notes on systems.)	PRODUCTION (1) COMTRAC	(2) SMIS	(3) YACS	(4) KICS	SALES (5) MARS	(6) FOCS-EPOCS	ADMINISTRAT'N (7) RES/STAT	(8) DACS	Five minor systems	TOTAL JNR
* Sum total invested (¥ billions):	2.0	1.0	7.0	1.8	25.0	4.4	4.2	0.4	0.6	44.4
** Man-power saved (persons):	30	150	120	980	-	270	2,800	300	540	5,190
*** Computer personnel (persons):	30	50	50	270	130	80	1,050	200	80	1,940
Hard ware CPUs installed at:	Shinkansen General Control Center	Shinkansen General Control Center	4 marshalling yards	9 workshops	Kunitachi Computer Center (KCC)	Kunitachi Computer Center (KCC)	27 local divisions (ROD)	KCC & 6 local divisions	-	-
CPUs 500KB or more (Number of sets):	2	-	-	-	7	2	-	-	1	12
65-500KB (Number of sets):	3	1	2	9	2	2	23	8	2	52
Less than 65KB (Number of sets):	-	-	10	-	-	-	13	-	9	32
Terminals (Number of sets):	80	47	11	18	1,950	361	-	900	-	-
Soft ware Program steps (thousands): ([illegible])	650	315	950	300	1,300	590	8,360	1,864	1,100	15,429
Number of trains a day (Covered by the systems):	1,300	-	400	-	1,700	278	-	-	-	-
Number of railway vehicles a day (Covered by the systems):	-	2,320EC	4,400PC	**** All railway vehicles	-	4,300FC	-	-	-	-
Other features (Covered by the systems):	35 stations	1,100km of tracks	-	-	900,000 seats	700 containers	430,000 employees' payment and other statistical processing for 6000 organs.			-
In-put, in terms of calls per month (millions, unless otherwise shown):		30,000 OMR sheets		1.1	21.0	0.5	10.9	1.3	-	-
Rush-hour traffic, calls per hour (thousands):		0.4			370.0	4.4		4.7	-	-

* Leased assets capitalised by aggregate rental. (44 months)
** Actual decrease as well as prevented increase by computerization in the manpower of the application jobs.
*** Excluding terminal operators.

****
EL, DL 4,214
EC, DC, PC 28,609
FC 144,537

E for electric
D for diesel
L for locomotive
C for car
P for passenger
F for freight
OMR Optional Mark Reader

1977 about 100 computers, 42 operated on-line

Table 5.6 (continued)

Notes:

(1) COMTRAC

An on-line system applied to Shinkansen only, for:

a) route-control throughout Shinkansen according to the given train diagrams.

b) proposal by machine, of the optimum modification of the train diagrams in case of disturbance.

(2) SMIS

An on-line system, applied to Shinkansen only, for making up daily maintenance programs of tracks and of rolling stock, and for cost analysis of the jobs.

(3) YACS

An on-line systems applied to major marshalling yards, for automatic classification of arrived freight-cars and for formation of trains new destinations, by way of a computerised control of car-retarders, switching-points, etc.

(4) KICS

Batch systems applied to car-repairing workshops, for their resource control and for checking the maintenance record of individual cars and parts.

(5) MARS

An on-line system applied to entire sales network, for the reservation of seats and berths.

(6) FOCS-EPOCS

An on-line system applied to freight service, for

a) reservation of freight-cars to be coupled to the inter-block freight express trains, or of containers to be loaded on the freightliner express trains.

b) furnishing the consignees in advance with the arrival information on the cargo.

(7) RESOURCE CONTROL/STATISTIC

Batch systems covering whole JNR, applied to local operating divisions, for personnel, accounting, stock control and for statistical review of the operations.

(8) DACS

An on-line system covering whole JNR, used (not for the particular application jobs but) for message switching and computer-combination, by way of the JNR owned tele-communication network.

/HARDA,H.: Seat reservation system and computer application in JNR. Shinkansen Conference, IIASA, June 1977./

- extensive use of automation in checking of tracks [41] and cars [72,75]
- application of simulation methods [97]
- improved information processing and information systems [1,54,85]
- new maintenance strategies [54], i.e., corrective maintenance
- new philosophy exemplified by installing a scrapping facility for a new line which has an outline for reducing environmental pollution [55].

The railway does not repair the vehicles again until after twelve year's use [55].

Strict review of inspector's data and the analysis of important equipment functions allow for the maintenance of some components after breakdown. Maintenance-free components are increasingly used. With the facilities for complex data processing, steps are being taken to introduce corrective maintenance [54].

Even if the breakdown of a car could be predicted, private repair shops would not know when a customer might arrive with his car. The arrival of cars for repair can only be forecast by analyzing past events. Railways can use information on the behavior of equipment to formulate suitable control of maintenance plans throughout the railway workshops. The goal of optimal workshop control at railways must be the smallest investment for workshop <u>and</u> rolling stock. The optimal strategy is:

- to have an information system with highly efficient data processing for the most reliable railway system
- to use a suitable maintenance plan
- to analyze deviations from the plan with the purpose of improving the system.

But automated on-line control is not done in workshops, with the exception of numerical controlled machines, because on-line control merely smooths over rough spots. The real trouble spots, for example an unsuitable organization, will not be investigated. Man only produces data and connot recognize the effects. He feels he is being controlled by a machine: this is not at all stimulating. But for subsystems or track construction etc., common software packages for network planning [50] are used at railways.

5.3.11 Impact on other railways

High speed surface transportation has fascinated the mind of man since the early days of the industrial revolution. Indeed, part of this revolution can be attributed to the advancement made by engineers in railroad technology, and the use of this technology to improve the communication and movement possibilities among individuals and nations.

The introduction of air transportation in the 20th century placed the railroads in the background as far as speed of movement was concerned, but still significant progress was made in high-speed rail technology on both the European and American continents. In 1935 Germany had two scheduled runs in excess of 120 km/hr: Berlin-Hamburg at 124.7 km/hr, and Hamm-Hanover at 134.0 km/hr. The USA had scheduled runs of 134.9 km/hr for La Junta-Dodge City in 1936, and a 1940 run from East Dubuque to Prairie du Chien at 135.3 km/hr, later increased to 138.9 km/hr by 1947. The Second World War placed a halt on rail speed advancement until the French demonstrated in the early 1950's that speeds in excess of 200 km/hr were possible.

The Japan National Railways (JNR) profited from the French demonstration and post WWII technology by persuading the Japananese National Government to approve construction of a new high-speed rail line in the Tokaido corridor between Tokyo and Osaka. In October, 1964, the Tokaido Shinkansen was opened for service. A new age in rail transportation was started which served to rekindle interest among the developed nations of the world to offer intensive, high-speed inter-city service for its citizens. At the present time no less than 9 nations other than Japan are able to offer a regularly scheduled run in excess of 120 km/hr: France, the United States, Canada, Great Britain, the Federal Republic of Germany, the Soviet Union, Italy, Sweden, and Belgium (Table 5.7).

Even though the Shinkansen was introduced in 1964, no country in the world today is able to match the Shinkansen lines for speed, volume and service. It is apparent that the Japanese engineers did their homework especially well.

Table 5.7 HIGH-SPEED TRAINS OF THE WORLD

Country *Maximum and 'floor' speeds*	Train	from	to	Distance (*km*)	Time (*min*)	Speed (*km/h*)
Japan	104 *Hikari*	Tokyo[1]	Nagoya	342·0	121	169·6
	100 *Hikari*	Nagoya[1]	Kyoto	134·3	48	167·9
Limit: 210 km/h	17 *Hikari*	Osaka	Okayama	160·9	58	166·4
Floor: 160 km/h	63 *Kodama*	Shizuoka[1]	Hamamatsu	71·5	26	165·0
	17 *Hikari*	Okayama	Osaka	160·9	59	163·6
	3 *Hikari*	Maibara	Kyoto	68·1	25	163·5
	61 *Kodama*	Maibara[1]	Kyoto	68·1	25	163·5
	2 *Kodama*	Nagoya[1]	Toyohashi	67·8	25	162·7
	7 *Hikari*	Okayama	Himeji	75·0	28	160·7
France	*Etendard*	St Pierre des C	Poitiers	101·0	37	163·7
	Etendard	Paris	St Pierre des C	230·8	90	153·9
Limit: 200 km/h	*Etendard*	Poitiers	Paris	331·7	135	147·4
Floor: 140 km/h	2 trains	Angoulême	Poitiers	112·7	46	147·0
	Aquitaine	Paris	Bordeaux	579·1	240	144·8
	Capitole	Paris	Limoges	400·5	170	141·3
	2 trains	Angoulême[1]	Poitiers	112·7	48	140·9
United States	25 *Metroliners*	Baltimore[1]	Wilmington	110·1	44	150·1
	3 *Metroliners*	Wilmington	Baltimore	110·1	45	146·8
Limit: 169 km/h	*Metroliner*	Newark	Philadelphia	129·6	56	138·9
Floor: 135 km/h	*Metroliner*	Newark	N Philadelphia	122·4	53	138·6
	Metroliner	Newark	Trenton	77·5	34	136·8
	Metroliner	Metro Park	Trenton	54·6	24	136·5
	Metroliner	Baltimore	Philadelphia	151·4	67	135·6
Canada	2 *Turbotrains*	Dorval	Guildwood	500·6	207	145·1
	2 *Turbotrains*	Guildwood	Dorval	500·6	210	143·0
Limit: 153 km/h	*Rapido*	Guildwood	Belleville	161·8	72	134·8
Floor: 120 km/h	*Rapido*	Dorval	Brockville	185·7	86	129·6
	Ontarian	Kingston	Napanee	41·7	20	125·1
Great Britain	1 train	Rugby	Watford	104·8	43½	144·6
	5 trains	Rugby	Watford	104·8	44	142·9
Limit: 161 km/h	5 trains	Watford	Coventry	123·3	52½	140·9
Floor: 140 km/h	9 trains	London	Coventry	151·4	64½	140·8
	2 trains	Crewe	Watford	226·4	96½	140·7
	2 trains	Carstairs	Lockerbie	77·1	33	140·2
West Germany	*Adler*	Hannover	Bielefeld	109·5	47	139·8
	3 trains	Offenburg	Freiburg	62·8	27	139·6
Limit: 160 km/h	3 trains	Offenburg[3]	Karlsruhe	71·0	31	137·4
Floor: 135 km/h	8 trains	Baden-Oos[3]	Freiburg	102·9	45	137·2
	5 trains	Dortmund	Bielefeld	98·2	43	137·1
	5 trains	Hannover	Bielefeld	109·5	48	136·9
Soviet Union						
Limit: 160 km/h	*Aurora*[2]	Moscow	Bologoe	331·0	148	134·2
Floor: 120 km/h	*Aurora*[2]	Bologoe	Leningrad	319·0	143	133·8
Italy	4 trains	Rome[1]	Naples Merg	210·0	95	132·6
	1 train	Villa Laterno	Rome	181·0	82	132·4
Limit: 200 km/h	*Settebello*	Milan	Bologna	219·0	100	131·4
Floor: 130 km/h	3 trains	Rome[3]	Naples C Fleg	208·0	95	131·4
Sweden	1 train[2]	Skovde	Sodertalje	277·0	136	122·2
Limit: 160 km/h	2 trains	Skovde[1]	Hallsberg	114·0	56	122·1
Floor: 120 km/h	3 trains	Hallsberg	Toreboda	75·0	37	121·6
Belgium/ France	5 trains	Paris[1]	Brussels	309·5	140	132·6

Notes: [1] Runs in both directions
[2] Summer season only
[3] Sunday service

Source: Railway Gazette International July, 1975

While the rest of the world is attempting to approach the level of service offered by the Shinkansen lines, efforts are being made on all sides for the next generation of "super high speed trains", mostly comprising a system of magnetic levitation and electrical propulsion. Germany has plans for such a system operating at a speed of 400-500 km/hr, likewise the United States, Canada, France and Japan, among others. It appears that the day may come when surface transportation would be a real alternative to air travel over medium distance (100 to 1500 km).

Returning to Table 5.7, it is apparent that Japan is far ahead of other countries in high-speed routes and numbers of trains. The system developed for the Shinkansen has implications not only for more extensive high-speed lines in other countries, but also for routing, scheduling, operation, and control of the super high-speed MAGLEV vehicle of the future. By examining the Shinkansen system, it should be possible to point out some major points that will eventually have to be considered by other countries who wish to offer extensive high speed inter-city service.

5.4 Freight Transport

The Shinkansen railway is well known as a modern passenger transport system; however, the question can be raised about the attractiveness of this technology for the transportation of goods. As a matter of fact, the Tokaido-Shinkansen proposal made by JNR in October 1958 had included plans for freight traffic on this new line up to 5.100 million ton-kilometers in 1975.

In fiscal 1975, the volume of Japan's cargo transport was 5.03 billion tons (1.1% decrease from the preceding fiscal year), or 360.8 billion ton-kilometers (4.0% decrease from the preceding fiscal year). The volume of cargo carried by transport facilities other than private trucks and aircraft fell below the preceding fiscal year. A sharp fall from the preceding fiscal year was recorded with railways (Table 5.8).

From the standpoint of commodities, primary products, including mining products, agricultural, livestock and fishery products, increased. The decrease of secondary products became smaller this year compared with the preceding fiscal year (Table 5.9).

Of the total domestic cargo transport (in ton-kilometers), coastal shipping had the share of 50.9%, motor vehicles had 36.0%, railways had 13.1% (of which National Railways account for 12.9%) in fiscal 1975 (Figure 5.18), (Table 5.10).

The volume of interregional cargo transport made 220% increase during the ten years from fiscal 1964 to fiscal 1974. Motor vehicles and coastal shipping made specially large growth. A commodity-based study reveals that the growth of mining products (primary products) became small, but that the growth of secondary products, such as products of metal and machinery industry and products of chemical industry, was large. The interregional cargo transport related to regions other than ones along Tokaido increased by 2.5 times during this period. On the other hand, the inter-regional cargo transport related to three districts along Tokaido increased by 2.1 times. However, the latter accounts for 77.3% of the total interregional cargo transport volume in fiscal 1974.

Taking the figures by modes of transport, the motor vehicle noted an increase of 4.4 times and the coastal shipping an increase of 2.2 times, while the railways showed a decrease to 84%.

The reasons behind the stagnation in transportation of goods by the Japanese National Railways were given by the Ministry of Transport during IIASA's field study in Japan (see Figure 5.19).

Freight traffic was responsible for up to 70% of JNR deficits in 1975. Under these circumstances one would say that the withdrawal of plans for freight traffic during the early stages of design of the Tokaido Shinkansen was a very fortunate decision for JNR. However, the possibility of applying Shinkansen technology for freight transport is still open.

Table 5.8 DOMESTIC CARGO TRANSPORT BY VARIOUS MODES OF TRANSPORT

Mode of Transport	Tons (1 million ton)			Ton-kilometers (100 millions ton-km)		
	F.Y.1974 (A)	F.Y.1975 (B)	B/A (%)	F.Y.1974 (A)	F.Y.1975 (B)	B/A (%)
Total	5,085	5,030	98.9	3,758	3,608	96.0
Railways	206	184	89.3	525	473	90.1
National Railways	158	142	89.9	516	466	90.3
Private railways	48.1	42.7	88.8	8.690	7.705	88.7
Motor vehicles	4,377	4,393	100.4	1,308	1,297	99.2
of common carriers	1,236	1,251	101.2	720	692	96.1
Private	3,142	3,141	100.0	587	605	103.1
Coastal shipping	501	452	90.2	1,924	1,836	95.4
Aircraft	0.185	0.190	102.7	1.399	1.516	108.4

The transport volume of motor vehicles does not include light cars, but include motor vehicles using car ferry services. The transport volume of motor vehicles using car ferry services is estimated to account for 2 - 3% of the total transport volume of motor vehicles (ton-kilometers).

Source: Ministry of Transport, Annual Report of Transport Economy (Fiscal 1976), March 1977

Table 5.9 TONS CARRIED ON CARGO TRANSPORT BY COMMODITY

(Unit: 1 million tons)

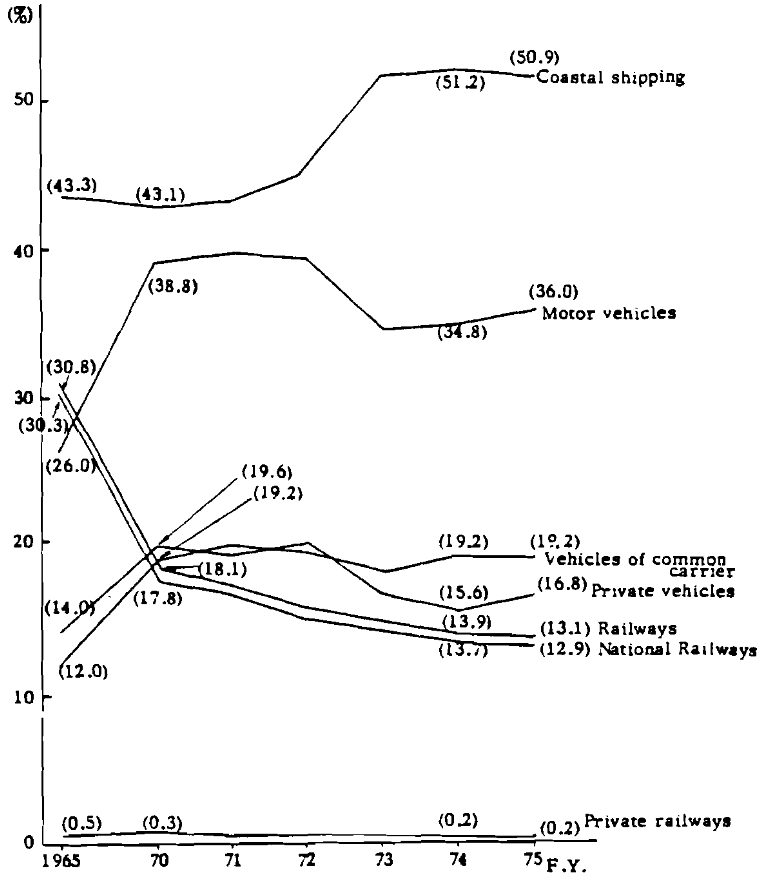
Commodity \ Fiscal Year		1974 (A)	1975 (B)	B/A (%)
Total		5,085	5,030	98.9
Primary products	Total of primary products	2,072	2,137	103.1
	Agricultural livestock and fishery products	230	248	107.8
	(Grain)	(60)	(59)	(98.3)
	(Vegitables and fruits)	(80)	(87)	(108.8)
	Forest products	240	230	95.8
	(Wood)	(232)	(224)	(96.6)
	Mining products	1,602	1,659	103.6
	(Industrial non-metallic minerals)	(264)	(347)	(131.4)
	(Gravel, sand and stone)	(1,255)	(1,254)	(99.9)
Secondary products	Total of secondary products	1,911	1,840	96.3
	Metal and machinery products	542	495	91.3
	(Iron and steel)	(223)	(194)	(87.0)
	(Machine parts)	(201)	(198)	(98.5)
	Chemical industrial products	936	918	98.1
	(Cement)	(102)	(92)	(90.2)
	(Other pottery products)	(370)	(378)	(102.2)
	(Petroleum products)	(296)	(288)	(97.3)
	Light and miscellaneous industrial products	433	427	98.6
	(Food industrial products)	(202)	(200)	(99.0)
Others		1,102	1,052	95.5
	(Waste matters)	(780)	(720)	(92.0)

Air cargo is included in "others" because it is not classified according to the commodities.

Source: Ministry of Transport, Annual Report of Transport Economy (Fiscal 1976), March 1977

Figure 5.18 SHARE OF VARIOUS MODES OF TRANSPORT

(in ton-kilometers)



Source: Ministry of Transport, Japanese Government, Annual Report of Transport Economy (Fiscal 1976) March 1977

Table 5.10 TRANSPORT COLUME AND SHARE OF VARIOUS MODES OF TRANSPORT BY COMMODITY IN TON-KILOMETERS

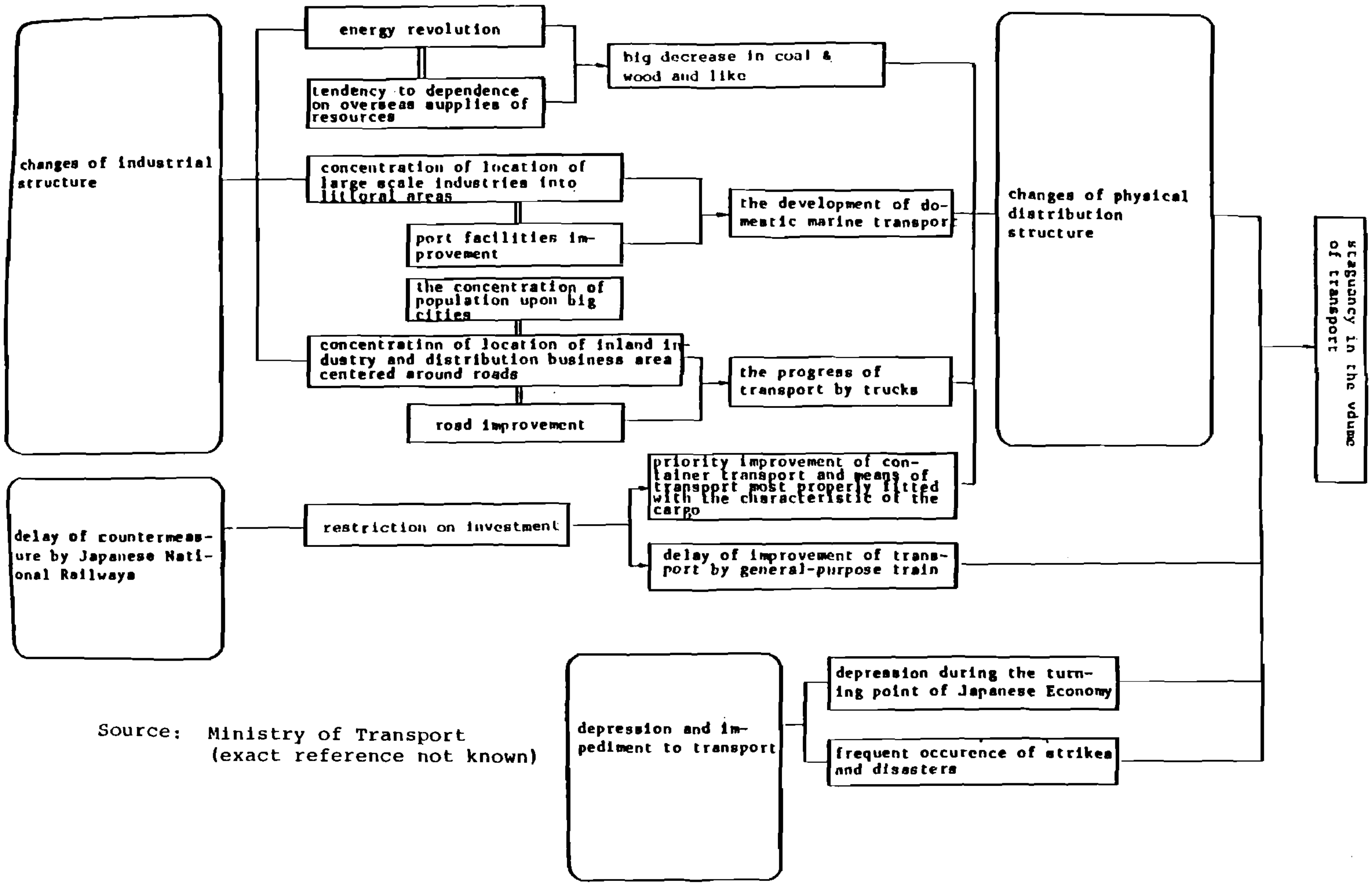
Commodity (Classification / Modes of Transport)		Ton-kilometers (1 million ton-km)			Share		
		National Railways	Motor vehicles	Coastal shipping	National Railways	Motor vehicles	Coastal shipping
	Total	46,557	129,701	183,579	• 12.9	• 36.0	• 50.9
Primary products	Total of primary products	10,886	42,249	67,351	9.0	35.1	55.9
	Agricultural livestock and fishery products	5,333	10,409	1,604	30.7	60.0	9.3
	(Grain)	(2,451)	(713)	(1,380)	(53.9)	(15.7)	(30.4)
	(Vegetables and fruits)	(1,225)	(4,631)	(21)	(20.8)	(78.8)	(0.4)
	Forest products	1,317	7,958	2,504	11.2	67.6	21.3
	(Wood)	(1,289)	(7,804)	(2,502)	(11.1)	(67.3)	(21.6)
	Mining products	4,245	23,883	63,243	4.6	26.1	69.2
	(Industrial non-metallic minerals)	(2,545)	(3,344)	(45,402)	(5.0)	(6.5)	(88.5)
	(Gravel, sand and stone)	(413)	(19,817)	(5,404)	(1.6)	(77.3)	(21.1)
Secondary products	Total of secondary products	22,619	57,116	112,980	11.7	29.6	58.6
	Metal and machinery products	4,638	19,224	29,835	8.6	35.8	55.6
	(Iron and steel)	(1,786)	(4,842)	(24,186)	(5.8)	(15.7)	(78.5)
	(Machine parts)	(2,134)	(8,405)	(3,138)	(15.6)	(61.5)	(22.9)
	Chemical industrial products	11,471	18,311	77,929	10.6	17.0	72.4
	(Cement)	(1,962)	(1,688)	(15,086)	(10.1)	(8.7)	(81.1)
	(Other pottery products)	(1,795)	(7,594)	(1,972)	(15.8)	(66.8)	(17.4)
	(Petroleum products)	(2,590)	(3,108)	(51,774)	(4.5)	(5.4)	(90.1)
	Light and miscellaneous industrial products	6,510	19,581	5,216	20.8	62.5	16.7
	(Food industrial products)	(2,187)	(7,528)	(634)	(21.1)	(72.7)	(6.1)
Others		13,052	30,336	3,248	28.0	65.0	7.0
	(Waste matters)	(-)	(5,711)	(-)	(-)	(100.0)	(-)

(1) The transport volume by private railways and aircrafts was included for the calculation of the shares (•) in the total column. Therefore their total will not be 100%

(2) Records of the fiscal 1975. The figures of the National Railways are tentative.

Source: Ministry of Transport, Japanese Government, Annual Report of Transport Economy (Fiscal 1976), March 1977

Figure 5.19 THE CAUSES OF STAGNANCY IN GOODS TRANSPORT BY JAPANESE NATIONAL RAILWAYS



Source: Ministry of Transport
(exact reference not known)

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6. THE SHINKANSEN AND ENVIRONMENTAL ISSUES

6.1 Introduction

6.1.1 Environmental Expectations in Past Decades

In Japan environmental problems were first generally perceived as a "public nuisance" ("Kogai" in Japanese) during the 1950s and 1960s. These problems were limited to a relatively small area where serious damage to both living conditions and human health was concentrated through heavy industrial pollution. Examples include "Minamata" disease from organic mercury releases into rivers from chemical industries, "Itai-itai" disease from cadmium compounds in rivers from mining industries, and "Yokkaichi" disease from sulphur and nitrogen oxides in the air from a petrochemical complex.

As the degree and scale of these so-called "public nuisances" increased from an extremely local problem to a much wider trans-regional one, the Japanese environmental problem changed gradually from industrial pollution to something more like national pollution. For example, in 1968 a serious accident was disclosed to the public when a poison was taken by more than ten thousand people in the form of cooking oil which had been contaminated in the production process by PCB*. PCB is one of the best chemical materials for the thermal transfer of liquids and widely used in production processes. Although the production and usage of PCB has been prohibited since that time, people had to be alerted to what extent daily foods were contaminated through the natural food-chain process in the ecosystem of the whole country because of the biological accumulation mechanisms of PCB. This information caused panic among housewives in 1973 when they were informed that almost all fish captured around the Japanese islands were more or less contaminated by PCB.

In Japan the pace of industrial development was so rapid that industrial pollution first emerged in the industrialized and urban areas on a local scale, and then later spread throughout

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*White Paper on Environment, Environmental Agency of Japan, 1969.

the country. The next type of pollution was caused by "public investments" such as the construction of roads, railways, airports, etc. This kind of pollution is also called a "public nuisance". As public investment was extended throughout the country in the construction of a national network of development infrastructure wider environmental problems ensued and accumulated. Thus the following distinction should be made between "public nuisance" and "national environmental problems" when discussing Japanese environmental issues (see Figure 6.1, which illustrates this distinction in terms of degrees of space and lead time affected).

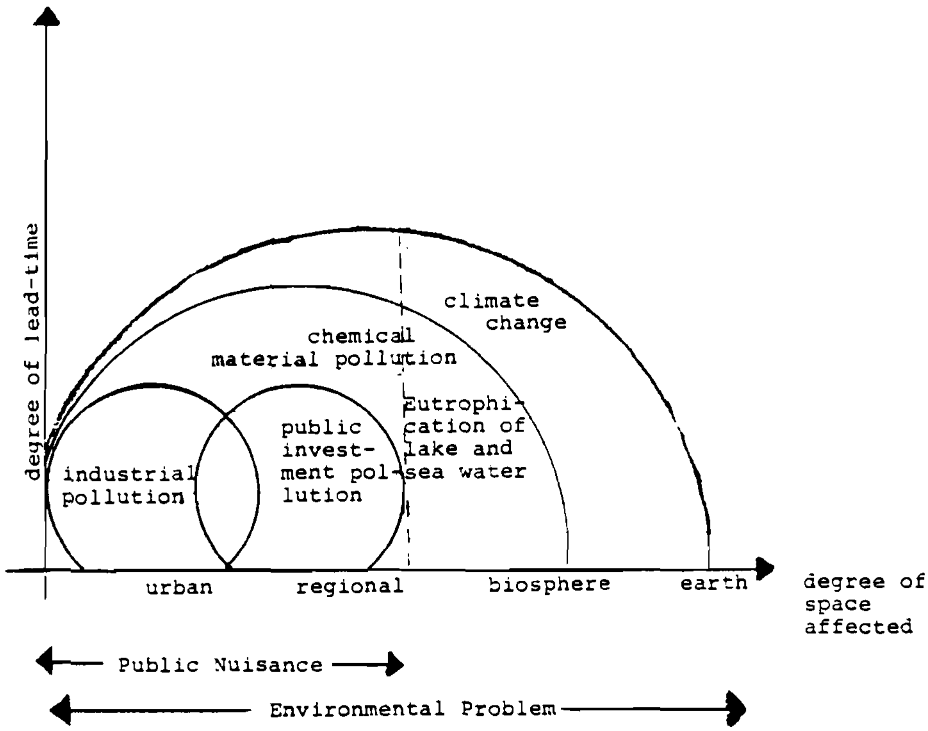

Figure 6.1 <u>THE RANGE OF PUBLIC NUISANCE AND THE ENVIRONMENTAL PROBLEM</u>

However, a gradual change in attitude became evident in that a search begun for a better environment in a more global and long-term manner rather than in shorter-term improvements of the existing environment through such means as financial compensation which is an after-effect. A great deal of research, monitoring and managerial effort has been devoted to polluted areas in Japan. One effort substantially decreased SO_2 concentration in an urban area in spite of the economic burden to society in general.* Emission standards for automobiles have also been dealt with in an advanced way from the environmental protection point of view.

Environmental expectations for the latter half of the 1970s are focussed on how far should progress with global and long-term environmental issues such as ecosystems, non-renewable natural resources, and human ecology problems be carried, given the necessity of a lower economic growth rate. These issues must also be coupled with controlling pollution in local areas in this same era of low growth rates.

6.1.2 Main Causes of Environmental Disruption in Japan

One government report summarized the main factors which contributed to the rapid deterioration of environmental quality during the past two decades as follows:**

1. The high density of economic activities relative to the areas of land available;
2. The accelerated development of heavy and chemical industries;
3. The massive concentration of population and industries in urban areas;
4. The lagging development of social overhead capital.

Furthermore, this report stated that there was a lack of attention given to land use planning, city planning, building regulations,

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*OECD: Environmental Policies in Japan, review report, 1977.

**Governmental Report to OECD Env. Committee: Environmental Policy of Japan (background) 1976.

and preservation of the natural environment compared with other advanced industrialized countries.

Japan has poor natural and geographic conditions in terms of resources for industrial development. It is a mountainous country with a limited total land use area (25% inhabitable from a total of 370,000 km^2). It is no surprise that production and consumption activities are concentrated in the urbanized areas along the Pacific coastal zone (see Table 6.1). This concentration includes such pollution-oriented industries as steel, power, cement, pulp and paper, and petrochemicals, which have played a key role in high economic growth as well as in environmental disruptions.

Table 6.1 Selected Economic Indicators per km^2 of Inhabitable Area, Selected Countries, 1974 or 1975

	G.N.P.[a] (10^6US$) 1975	Industrial[a] Output 1974 (10^6US$)	Energy[a] Consumption (10^3TOE) 1974	Number of[b] Automobiles 1974
Japan	6.05	2.04	4.12	331
USA	0.32	0.09	0.36	27
UL	1.04	0.26	1.00	80
France	0.87	0.25	0.47	47
Italy	0.81	0.24	0.66	74
Sweden	1.67	0.44	1.09	69
Netherlands	3.10	0.83	2.38	146

Sources: a - OECD; b - International Road Federation
World Road Statistics, 1975

Because of the national benefits of a high economic growth policy the government placed a low value on environmental quality in comparison to industrial development.* Any serious effort by

*S. Tsuru, Current Environmental Problems in Japan, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, pp. 51-57.

the government toward tackling public nuisances in a general way did not begin until the late 1960's after an increase in public complaints and pressures from local communities, together with various international movements such as the UN General Assembly in 1968, etc. Figure 6.2 graphs this effect and shows the increasing number of pollution-related complaints relative to GNP and sulphur oxide pollution.

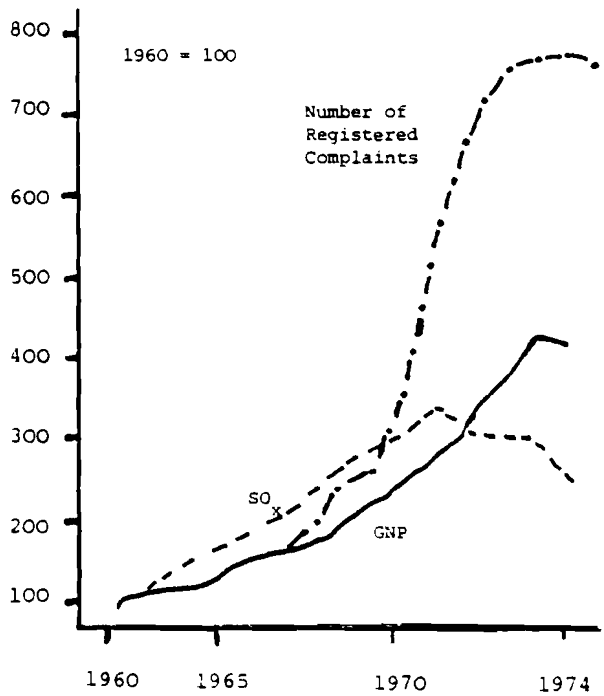

Figure 6.2 ENVIRONMENTAL COMPLAINTS AND ECONOMIC GROWTH*

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*White Paper on Environment, Environmental Agency, Japan, 1976.

6.1.3 The Role of the Public Sector in Economic Activities

The factors accounting for the high rate of economic growth were:

- a well educated, trained labor force
- a high accumulation of capital stock
- technological innovation
- governmental policy support
- good exogenous conditions

One of the most important aspects was the systematic government effort to guide the high rate of economic growth. During the period of the Double National Income Plan (1960-65) aimed at the construction of heavy and chemical industries around metropolitan areas along the Pacific coast, the major share of government public capital was in investment for strengthening infrastructure. Furthermore, governmental fiscal and monetary policy was used to encourage personal savings and private sector investment by industry through providing various special credit measures for the business community. Relatively little money was spent on the increase of such social overhead capital as public housing, sewage systems, etc., during the 1960's and the first half of the 1970's. For example, Table 6.2 shows that investment for environmental matters was approximately 20% of total public investment in comparison to about 35% for industrial infrastructure during the period from 1961 to 1971. Since that time, Japan continued to have one of the highest public investments in the world for aiding the private sector to benefit from the agglomeration effects of public infrastructure.

A shift of economic activities from the private sector to the combination of a public-private sector has resulted in greater environmental disruption. Industrial pollution is now induced and extended by the synergistic impacts of public works with these activities. It particularly occurs in public investments associated with transportation which have environmental impacts of their own in addition to those induced by these investments.

Table 6.2 PLANNED PUBLIC INVESTMENT FOR SOCIAL OVERHEAD CAPITAL*

	LIVING & CULTURE Env., Sanitation, Housing, Welfare, Schools		IND. INFRASTRUCTURE Roads, Railways, Ports		LAND DEVELOPMENT Telecommunication Land Conservation Agriculture		MISCELLANEOUS Adjustments Others		Total 100 Billion Years
	Amount	Ratio %	Amount	Ratio %	Amount	Ratio %	Amount	Ratio %	Amount (price)
Doubling National Income Plan (1961-1970)	33.7	20.9	54.3	33.7	26.5	16.4	46.8	29.0	161.3 (1960)
Medium-term Economic Plan 1964-1968	32.7	18.4	64.7	36.4	38.1	21.4	42.5	23.8	178.0 (1963)
Economic & Social Development Plan (1967-1971)	48.1	17.5	103.7	37.7	60.2	21.2	63.0	22.9	275.0 (1965)
New Economic & Social Development Plan (1970-1975)	107.0	19.5	196.9	35.8	122.0	22.3	124.4	22.4	550.0 (1969)
Basic Economic & Social Plan (1973-1977)	200.1	22.2	308.1	34.2	178.9	19.8	212.9	23.6	900.0 (1972)
Economic Plan for Second half of 70s (1976-1980)	288.4	28.8	312.0	31.2	211.9	21.2	187.7	18.8	1,000.0 (1975)

* "Economic Policy in Japan", reported by Economic Planning Agency, Japan to IIASA Study Group, October 1977.

For instance, construction projects for the establishment of a national transportation network including high speed railroad and highway from Tokyo to Osaka through Nagoya were started in the first half of the 1960's. However, these investments were too successful in helping to induce the high growth and overwhelming concentration of economic activities in the metropolitan areas of Tokyo, Nagoya, and Osaka. The resulting diseconomies of scale were mainly because of overcrowding and environmental disruption which contributed to a changing attitude by residents in these areas in spite of bringing economic benefits to some residents. Thus the Double National Income Plan had to be replaced by the Comprehensive National Development Plan (CNDP).

The continued leading role of the government in the implementation of regional development is based on the Comprehensive National Development Act of 1950 which emerged as the CNDP in 1962 following the Double National Income Plan. The CNDP aimed at the spatial redistibution of industrial activities in the form of growth centers outside of the major metropolitan areas. Much investment was used to induce enterprises to new regional growth centers together with the construction of industrial infrastructure and transportation facilities were developed to link them to the core metropolitan area.

As an example of the environmental problems associated with these new developments three major problems in the Seto Inland Sea area were identified:*

1) Increase in Pollutants:

	1955	1971
SO_x	121.5	1007.5
NO_x	74.4	842.5
COD	283.6	492.8

For water quality about 26% of the total surface of the Seto Inland Sea has more than 2 ppm of COD concentration which is greater than the standard required for fishing.

* White Paper on Environment, 1976.

2) Damage to the Fishing Industry:

During the period from 1955 to 1970 land reclamation around the Seto Inland Sea reached about 16,314 ha. which destroyed breeding conditions for small fish and shellfish. Also outbreaks of red tides (plankton bloom) caused great damage to the fish-farm industry through increases in industrial and municipal wastes.

3) Damage to Landscape and Amenities:

While the Seto Inland Sea is designated as a National Park the increase in land reclamation for development has deprived the residents of recreation land accessable to the sea shore for swimming, shell gathering, fishing, etc. Nearly 50% of the coastal margin of the Seto Inland Sea consists of artificial or reclaimed land (2,488 km out of a total of 5,415 km).

6.1.4 The New CNDP and Transportation Network Policy

It became clear at the end of the 1960s that the trends of urban over-crowding and rural depopulation were continuing in the same direction into the 1970s. An increased national awareness of pollution forced the government to reorganize its planning and policies for regional development, at least formally with respect to environmental conservation and pollution control measures.

For this purpose a new CNDP was adopted by the cabinet in 1969 which included the following goals:

- efficient use of all national land,
- promotion of independent regional development to fit with local conditions,
- appreciation of safety and amenity, and
- creation of harmony between man and nature.

The main policy instrument of the new CNDP was a network development formula composed of a national communications and transportation network designed to provide equal access to all parts of Japan. Although some stress was given to the new values of local diversity, amenity and harmony in a post-industrial society, the greatest emphasis of this plan was placed on the nationwide communication and transportation systems such as the construction of about 4,000 km of super-express railways (extension of Shinkansen), about 7,600 km of express highways and an airway network. Just how the extensions of this infrastructure were to be interpreted with the environmental goals of this plan were not discussed in detail.

This much of the public investment has been used for the construction of the transportation system as shown in Figure 6.3* and Table 6.3**.

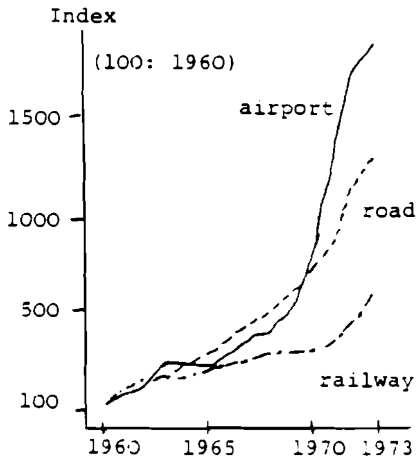

Figure 6.3 INCREASE OF MONETARY INVESTMENT FOR TRANSPORTATION NETWORK

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*White Paper on Environment, Env. Agency, Japan 1974, pp. 66.

**Basic information for National Land No.3 (special issue of J. of Man and Land) August 1977, Soc. of National Land Planning.

Table 6.3 Trend of Investment for High-Speed Transportation

(Billion Yen)

YEAR	TOTAL PUBLIC INVESTMENT (A)	SHINKANSEN (B)	HIGHWAY (C)	(B) + (C) / (A)
1967	4,400	4	115	2.71%
1968	5,080	27	109	2.68%
1969	5,669	65	84	2.63%
1970	7,189	105	133	3.32%
1971	9,054	104	207	3.44%
1972	11,059	238	279	4.67%
1973	12,318	424	323	6.06%
1974	14,870	408	367	5.21%
1975	16,494	346	397	4.50%

These large public and quasi-public projects have brought about not only environmental disruption to the landscape and natural ecosystems, but also greater "public nuisances" to the residents living adjacent to these projects. The noise associated with these transportation facilities have been the main source of environmental complaints among the citizens affected as shown in Table 6.4. Tables 6.3 and 6.4 should be compared to note that the rise in transportation investment triggered a rise in citizens' complaints over the same period.

Table 6.4 Number of Complaints for Traffic Noise* Registered with Local Authorities

YEAR	AUTOMOBILE NOISE	RAILWAY NOISE	AEROPLANE NOISE
1971	479	63	341
1972	527	162	166
1973	961	144	249
1974	819	244	265
1975	844	294	161

* White Paper by Environmental Agency, 1976.

Noise is an especially important pollution because it is the one singled out by the majority of Japanese as being the most offensive. The number of registered complaints for noise exceeds that of all other pollutants impacting upon the Japanese. Although noise pollution is quite extensive in Japan, environmental authorities have not been as active in this area as for other pollutants*. This finding is corroborated by the fact that noise control has fewer officials assigned to it than for other pollutants**. As Table 6.5 shows that noise complaints and noise officials are not in proportion.

Table 6.5 Comparison of Registered Pollution Complaints With Number of Pollution Control Managers

TYPE OF POLLUTION	NUMBER OF COMPLAINTS (1974)	NUMBER OF MANAGERS (1975)
Air Pollution	12,145	11,723
Water Pollution	14,496	14,927
Noise	24,195	256

Source: Environment Agency, White Paper, 1976, p.165 and Environment Committee, OECD Background Paper, 1976, p.25.

In particular, the Shinkansen noise problem became an issue after its opening, especially with an increase in its traffic volume. According to a survey conducted by the Environment Agency in 1972, a considerable part of the residential area (about 15.000 households) located along the Shinkansen line suffered more than 80 db(A) noise levels. Thus the "publicity" or public interest factor of public works became a big issue in judging or assessing the benefits and impacts from development plans. For example, in the case of power development and public transportation, such as the Shinkansen, the general publicity of these projects is being questioned. Residents living near such facilities suffer from pollution and other disadvantages which can often seem to outweigh any of the benefits actually received from the existence of these facilities.

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*White Paper, 1976, p. 165.

**OECD report, p.II-6 and OECD background report, p.25, Contrary to CNDP goals the emphasis on nationwide communication and transportation projects had triggered repercussions against large-scale regional public works. With greater aggravation generated in living environments along with a rapid increase in land prices, local attitudes gradually shifted from enjoying mass consumption and growth of GNP to favoring quality of life, safe living environments, etc. This change in attitude promoted various types of community movements against these public development projects in many areas.* Another crucial change which required the revision of the new CNDP was the substantial change in economic circumstances from the oil crisis of 1973. Thus an overall review of the new CNDP has been undertaken since 1974 with a third CNDP now underway for 1977.

This third CNDP is based on the reality of a low and stable economic growth pattern because of shortages in key industrial materials such as oil. This third plan centers on creating a stable environment for wholesome living rooted in local traditions and regional characteristics. The emphasis on human settlement is a reflection of the stresses imposed on Japan from the outside as well as those emanating from within from past abuses by an industrial growth orientation in government and the private sector.

6.1.5 Establishment of Environmental Legislation and Administration

The first systematic comprehensive measures to combat environmental pollution were enacted as the Basic Law for Environmental Pollution Control in 1967.** This law provided the basic principles for such policy measures as: environmental quality standards, pollution control programs, and compensation procedures. Six pollutants were legally recognized of which noise and vibration were a part. Areas of responsibility were also outlined for industrial firms and national and local governments.

The next stage in environmental administration was the amendment of this basic law and the setting up of the Environment

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*Quality of the Environment in Japan, 1976, pp. 74-76.

**White Paper on Environment, 1972, p. 34.

Agency in 1970 and 1971 respectively. The "64th Special Pollution Diet" passed a total of 14 new laws associated with pollution regulation prompted via court decisions, anti-pollution campaigns by citizens' movements, newspapers and other mass media. The most important amendment to the basic law was the deletion of the clause requiring environmental protection to be harmonized with economic development. Since 1967 this clause had been used as an excuse for giving first priority to economic activities.

Table 6.6 indicates the progress of environmental administration efforts in both organizations and budgets. This table indicates steady growth in both manpower and budget at all levels of government.

Table 6.6 Progress of Environmental Administration*

	NUMBER OF OFFICIALS			GOVERNMENT BUDGET	
	CENTRAL	PREFECTURAL	MUNICIPAL	CENTRAL	LOCAL GOVERNMENT
1970			1,746	82(1.2 †)	374(3.8 †)
1971		2,634	3,411	112(1.4)	587(4.9)
1972		4,568	4,519	169(1.4)	811(5.5)
1973		5,284	5,617	274(1.8)	954(5.5)
1974	996	5,852	6,465	340(2.0)	1197(5.2)

The government environmental management efforts first focussed on strengthening the environmental quality standards (ambient air quality standards for SO_2, NO_x, noise) and various emission and effluent standards (regulation standards for air and water). Another important effort was extended to the formation of pollution control programs and land use plans and to the compensation system for pollution-caused health damage. A detailed discussion of the characteristics of Japanese environmental policy is not given in this study.**

In an attempt to summarize this brief history of environmental policy Table 6.7 has been prepared. This table displays

*Background Paper from Japan to OECD.

**OECD Report on Japan.

†Percentage of the total budget.

Table 6.7

	TRANSPORTATION SYSTEM	ENVIRONMENTAL ISSUES	ENVIRONMENTAL POLICY
1956	JNR SPECIAL COMMISSION FOR TOKAIDO LINE		
1957	GOV. COMMISSION FOR TRUNK LINE INVESTMENT		
	HIGH SPEED NATIONAL ROAD LAW	-FOUR MAJOR POLLUTION VICTIMS AND TRIAL CASES-	
1959	START OF SHINKANSEN CONSTRUCTION	(FROM 1971 TO 1973 COURT DECISIONS ENDED IN VICTORY FOR PLAINTIFFS)	
1964	OPENING OF SHINKANSEN TOKYO --- OSAKA		ENVIRONMENTAL POLLUTION SECTIONS SET UP IN GOVERNMENT, MINISTRIES OF HEALTH AND WELFARE AND INT. TRADE AND INDUSTRY, BASIC STUDY FOR ENVIRONMENTAL POLICY MEASURES
1965	OPENING OF EXPRESS WAY TOKYO --- KOBE		
1967			BASIC LAW FOR ENVIRONMENTAL POLLUTION CONTROL
1968		"PCB" DISEASE AND FOOD POLLUTION	NOISE REGULATION LAW
1969		OSAKA INTERNATIONAL AIRPORT TRIAL	
1970			"ENV. DIET SESSION" AMENDMENT OF ECONOMIC EMPHASIS
1971	NATIONWIDE SHINKANSEN DEVELOPMENT LAW		ENV. AGENCY ESTABLISHED
1972	OPEN TO OKAYAMA	HANSHIN EXPRESS WAY TRIAL	GOV. RECOMMENDATION OF URGENT STEPS ON SHINKANSEN NOISE
1973	DECISION ON CONSTRUCTION OF THREE NEW LINES		

Table 6.7 (continued)

	TRANSPORTATION SYSTEM	ENVIRONMENTAL ISSUES	ENVIRONMENTAL POLICY
1973			ENV. STANDARDS FOR AIRPLANE NOISE
1974	CHUGOKU HIGHWAY PARTLY OPEN-1,240 KM	NAGOYA SHINKANSEN TRIAL	INTRODUCTION OF E.I.A. FOR LARGE SCALE PUBLIC DEVELOPMENT PROJECTS
1975	SHINKANSEN OPEN TO HAKATA - 1,069 KM		ENVIRONMENTAL STANDARDS FOR SHINKANSEN NOISE
1977	GOV. DECISION OF ASSESS-MENT OF SHINKANSEN NETWORK PLAN	INCREASING PUBLIC OPPOSITION TO LARGE PROJECTS*	STUDYING APPLICATION OF E.I.A. TO SHINKANSEN EXTENSIONS
1978	OPENING OF NARITA INTERNATIONAL AIRPORT	EXTREME PUBLIC OPPOSITION**	DISCUSSIONS WITH LOCAL RESIDENTS***

* White Paper on Environment, 1978, p. 76.

** Narita's Birth, Newsweek, May 29, 1978, pp. 26-27.

*** International Herald Tribune, June 7, 1978, p. 2.

the evolution of both transportation and environmental policy, including the environmental issues that gave rise to such policy. The table shows quite dramatically that the basic transport policy decisions were being made in an area that was characterized by industrial pollution-caused diseases and a lack of environmental policy. As high speed transport networks with their associated noise became more thoroughly embedded in a Japanese society that was becoming increasingly conscious of the losses of its environment, the Japanese turned their attention to the noise generated by such transportation systems. As the period of the 1970's shows, the extension of new high speed transportation systems was accompanied by court trials resulting in environmental policies targeted directly to the noise from such systems. Both environmental standards and environmental impact assessments have been applied to these transport systems, including the extension line of the Shinkansen.

Environmental impacts are shown in another section and they testify to the problems of implementing a large railway network. Because of these impacts three key environmental issues began to emerge with the Shinkansen as it was extended or planned in accordance with the Comprehensive National Development Plan of 1969. These issues included:

- noise, vibration and intra-city routing,
- landscape impairments and inter-city routing, and
- internal decision-making process of transportation authorities.

From these three rather basic issues the Japanese have entered into considerable debate over the extension of the Shinkansen to all parts of Japan. This study is one attempt to describe and evaluate the Japanese responses to these issues. The instruments generally used to meet these issues include environmental noise standards, environmental impact assessment and public participation respectively. As this study demonstrates, the record of the implementation of these instruments for the Shinkansen is mixed.

Finally, two further points must be made. First, this study was confined solely to the environmental impacts of the

Shinkansen. No attempt was made to compare the environmental impacts between different transport modes. It is clear that such impacts also emanate from other modes of transportation and that the Shinkansen's impacts could be far less than for other modes such as roadways and airports. Second, one must distinguish between the technology (Shinkansen) and the organization (Japanese National Railways) controlling such technology. No attempt was made to evaluate the Shinkansen technology itself; rather this study focussed on the JNR's responses to the impacts generated by its technology. It may be that the technology is superior from an overall environmental point of view so that the JNR may not see the need to deal with such environmental impacts. Clearly, the JNR has responded to the environmental problems of its technology, and this study is one evaluation of its approach.

6.2 The Question of the Public Interest

A large, concentrated population relative to a small land area can lead to congestion problems, for example, in transportation and housing. These problems are not necessarily complementary within the congestion spectrum but can conflict. These two major conflicting congestion problems are shown in Figure 6.4. Both congestion in passenger traffic and congestion in housing accommodation give rise to solutions that can conflict with each other. This conflict in not inherent in the kinds of solutions to the congestion that each seeks to alleviate, but it results from separate planning activities serving separate goals and separate clientele in separate sectors of the economy. This separation is at the heart of the conflict between rapid transportation and housing in Japan. Within the system of the transportation solution the logic upon which that system is based is impeccable; the same could probably be said for the housing sector as well.

Figure 6.4 displays the nature of the systematic extension of the logic for the development of both the Shinkansen and mass housing. For the evolution of the Shinkansen one begins with the basic set of requirements for passengers and works, backwards

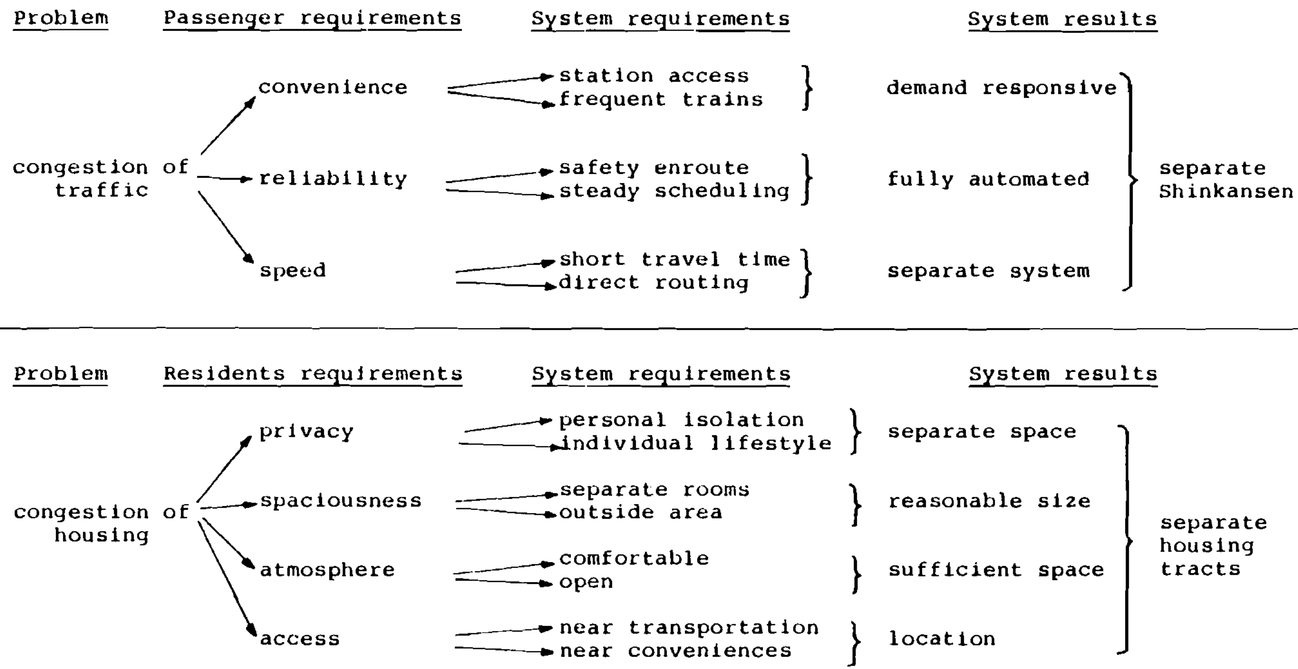

Figure 6.4 CONGESTION AS A FACTOR FOR CONFLICTS BETWEEN SEPARATED TECHNOLOGICAL SYSTEMS

to the system requirements and the resulting separated rapid train system. For the evolution of mass housing the basic set of requirements for residents is compiled and the system requirements and resulting separated apartment blocks or housing tracts evolve. Because these two separate systems require lands not already intensively used for other purposes they are frequently merged at the periphery of cities. But the greatest source of conflict is the routing of the elevated high-speed train directly into the heart of the largest cities thereby passing through densely populated urban regions characterized by mass housing tracts. It is in these locations that the conflicts between the Shinkansen and mass housing areas are evident. In addition, however, there are also conflicts from the Shinkansen as it goes through cities where it penetrates older and less insulated housing stock as well. Given the population pressure on housing space in and around cities every available space is used for housing, including that along existing and future transportation networks. Housing demand is so great that prices of housing do not reflect such disamenities as niose from transportation systems. Even if housing prices were lower from transport noise such housing would be quickly purchased without the full realization of the impact of noise on living patterns over time. Thus the stage was set for conflicts in transportation and housing, even though the Shinkansen and mass housing were seen as logical and important separate solutions to the congestion problems they were to alleviate.

After the initial Tokaido Line was established and operating complaints from the noise and vibration of the Shinkansen began to accumulate. Residents along the railroad and passengers using that railroad had become two completely different clienteles, even though each at one time or another could be both passenger and resident. The passenger is a user of the Shinkansen who receives its benefits, but he is also a resident and concerned about the environment where he lives. The resident along the Tokaido Line bears the costs of the passengers' benefits, but he could also be a passenger and concerned about the service to his destination.

Thus the same person could benefit from the Shinkansen in the day as a passenger and suffer from it at night and on weekends as a resident. This potential role split for both beneficiaries and sufferers of the Shinkansen centers on the fact that the typical Shinkansen beneficiaries may not generally live near this system while the Shinkansen sufferers may not generally use it. Thus, a split or separation can exist between these two groups of society.*

The Shinkansen is a single-purpose system designed to achieve the passenger goals of convenience, reliability and speed. The mass housing tracts are multipurpose systems for living, sleeping and leisure. Most of the potential users of the Shinkansen do not live near the Shinkansen because the population along the route is far less in proportion to the population living away from the route. Therefore, the single-purpose nature of the Shinkansen (time saving), the general type of passenger (businessmen) living in areas away from the Shinkansen, and the wide-spread noise impacts to many varied residents alongside the railroad all contribute to a social inequity. Yet the very raison d'etre for the Shinkansen was its contribution to the overall public interest, and it is on this basis that the Shinkansen is defended against its critics. For example, the noise can be reduced at a very low direct cost via a slow-down in the speed of the trains through populated regions; however, this approach was rejected because it went against the JNR's view of the "public interest."

According to Ministry of Transport spokesmen the public interest in transportation has four aspects:

- assure maximum choice for potential users,
- ensure fair competition between modes,
- ensure users pay full costs in the fare, and
- take lead role if market fails.

It is interesting to note that two of these points are not wholly applied to the Shinkansen. Because of long distances between stations the Shinkansen only indirectly serves the residents in

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* K. Miyamoto, Regional Development, Public Works and Environment, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, p. 84.

the region through which it passes. In contrast, few complaints center on the local private railways even though their noise levels approach that of the Shinkansen, and, although with less number of trains, they operate throughout the night. These same railways, however, offer service to the local residents whom they disturb so that the resident can balance the benefits of access with the costs of noise. Some deterioration is being allowed by the JNR in its local rail services as cash flow has continued as a problem. The JNR had the policy of cutting down on the number of trians and shortening their destinations on existing lines so that often residents were forced to take the Shinkansen and have the inconvenience of changing lines to get to their destinations. Therefore, the maximum choice for potential users is not a dominant principle for the Shinkansen.

Another problem is the amount of the fare for the Shinkansen which is priced to compete with air transport over medium distances. Given its high fares versus operating costs the Shinkansen earns money for the JNR. However, no attempt is made to have users pay an additional fee because of the noise and vibration impacts of the Shinkansen on residents. At present a ¥700 noise fee is attached to the price of all domestic air tickets where these funds are marked for providing sound proofing to houses affected by airport noise. It would be worth examining whether to introduce the same ideas about setting up a special fund account to provide pollution proof measures from the attached fee to normal fares. When asked about such a fee JNR officials remarked that it would be difficult to implement because of the current unified fare system for both Shinkansen and other lines. While Shinkansen fees are higher than for other lines over the same distance, the JNR attempts to get a subsidy directly from the government for its noise protection measures thereby shifting the burden of payment from users to taxpayers.

Thus a major public interest problem exists for such a large-scale public transport project that is principally designed to serve users outside of the areas where it generates social costs. Graphically, this problem can be displayed as in Figure 6.5.

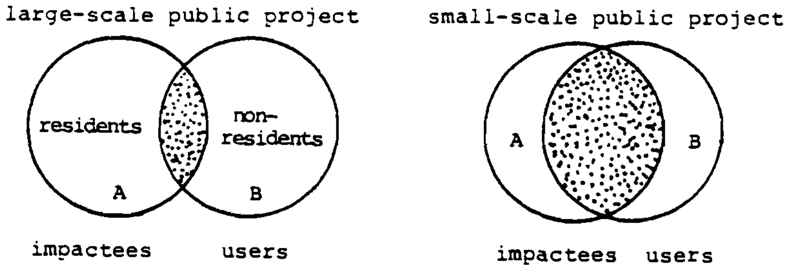

Figure 6.5 COMPARISON OF SOCIAL GROUPS AFFECTED BY DIFFERENTLY SCALED PUBLIC PROJECTS

Greater justification can be made for those public projects where the users and the impactees nearly coincide as in small-scale public projects. Large-scale public projects separate users from impactees and thereby generate separate social costs that must be compensated by the users for a justification of such a large project serving a more limited social group.

Given this separation between users and impactees the JNR cannot wholly claim that the social costs of noise and vibration must simply be borne by local residents on the basis that the Shinkansen provides a service in the national public interest. The characteristics that support this statement include:

- provision of a Shinkansen station reduces complaints,
- fewer complaints directed to local railways than to Shinkansen,
- urban residents with already good access do not generally want additional Shinkansens, and
- not all rural residents with poorer access want the Shinkansen.

Given these features it is clear that the Shinkansen has mixed impacts on different social groups. The problem for the JNR (or MOT) is to achieve a stable balance between the benefits and costs of the Shinkansen via social research and evaluation along with direct, open negotiations with each social group adversely affected.

The prefectures affect land use and hence can influence land prices via the kinds of projects and developments allowed in the prefecture. Because of the scarcity of land any attempt to reserve land available for housing space along a proposed Shinkansen route is met with stiff opposition among potential home owners. In addition, no real control measures exist in the prefecture to stop occupancy of lands adjacent to a proposed route. Therefore, it is considered to be politically more acceptable to attempt to alleviate pollution than to attempt to control residential land use. The problem is the shift in tax burden where the general tax payer is paying for expensive pollution control measures and possible compensation to houseowners via subsidies to the JNR. This shift means that the taxpayer subsidizes the houseowner rather than the user.

Any transportation system is closely linked to the land surrounding it, thereby affecting the quality of life in and the use of such areas. Given the evolution of a pollution conscious society to which the Shinkansen contributes in part, the JNR can no longer assume that the Shinkansen operates in the overall public interest.

6.3 Environmental Actors in Relation to the Shinkansen

The actors that have influenced the extension of the Shinkansen can be characterized in the following format. This array as shown in Figure 6.6 suggests a complete system of actors that could be included in the decision making process:

- Regulator - Prime Minister's Office, Environment Agency
- Developer - Prime Minister's Office, MOT, JNR
- Expert - Environment Agency, Central Council for Pollution Control
- Impactee - prefecture, residents
- Exogeneous - lawyers, courts

The Prime Minister's Office along with the Cabinet is the final arbitrator for all decisions made by the government under the parliamentary system. Represented on this Cabinet is the Minister of Transport as well as the Director General of the Environment Agency. Any major decision with political ovetones is

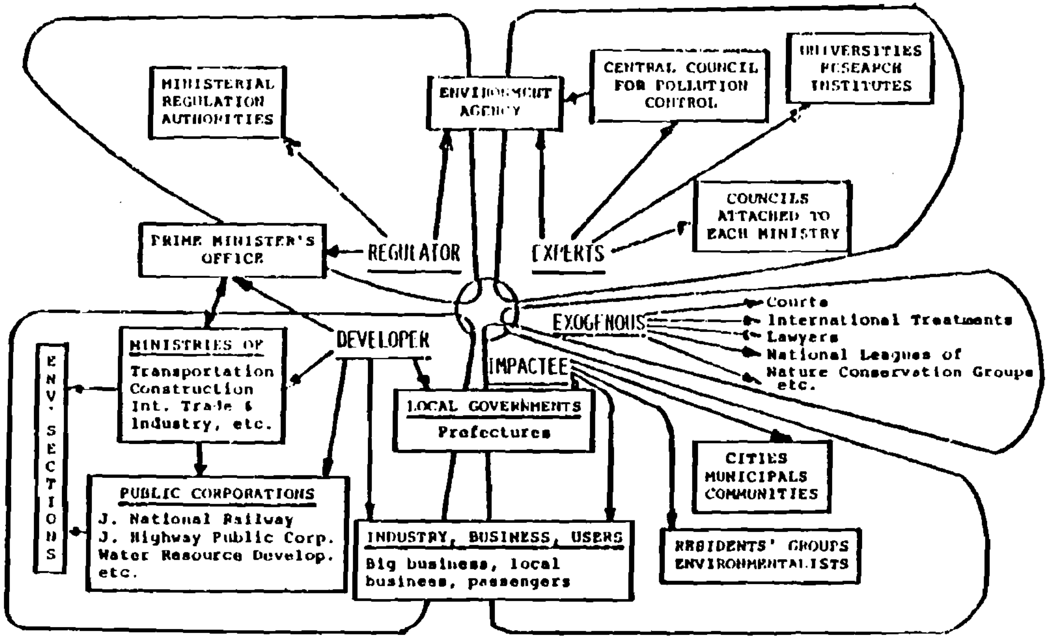

Figure 6.6 DISPLAY OF MAJOR ACTORS

made by the Prime Minister in conjunction with his Cabinet, including the extension of the Shinkansen and the necessity for environmental impact assessments on the Shinkansen.

The Ministry of Transport (MOT) coordinates the development of the Shinkansen. The MOT has an environmental section within it that, for example, generates the guidelines for environmental impact assessments to be done by the JNR on the Shinkansen. The MOT represents the JNR on the Cabinet, including its position on environmental impact. The MOT also represents the JNR to other actors, including prefectural governments and resident groups.

The JNR is the developer and operator of the Shinkansen. It also has an environmental section. This section is equal with all other sections in status and access to the head office, including the construction, operation, engineering and passenger sections. In addition, the environmental section is represented at each major JNR field office. Finally, the JNR has created an Environmental Coordinating Committee which includes the heads of all sections within the JNR. Once the JNR environmental section encounters a specific issue of importance it requests advice from this internal committee in order to achieve a JNR consensus. When the consensus is reached the head office is informed and the decision is made on the JNR response to that issue.

The environmental section in the JNR head office currently has 17 personnel consisting mainly of engineers along with three architects. No multi-disciplinary environmental expertise is currently employed because the Shinkansen problem is now perceived solely in terms of noise and vibration. The budget for this section for 1977 was ¥57 bill. of which the majority of funds go to the prevention of noise and vibration via noise barriers and heavier track. The remaining funds were spent on house removal. This section is chiefly concerned with meeting the standards set for noise and vibration control through innovation in technology and it is increasingly being involved in environmental impact assessment. This section is highly interested in cost effective

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*H. Shoji and T. Yamamoto, Noise Pollution, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, p. 68.

ways for meeting the noise and vibration standards and the impact assessment guidelines. The section also advises other sections of the JNR as to the kinds of environmental data to collect or response to make for environmental problems. Some informal contact is maintained with the Environmental Agency.

The general flow of work in the environment section of the JNR is as follows for any given section of new track:*

- estimate noise and vibrations along the route,
- plan and design countermeasures at the source to include sound barrier walls, heavier track, tunnels, etc.,
- show prefecture representatives the iso-noise lines along the route for each countermeasure considered,
- if the noise exceed 70 db show soundproofing measures for houses along the route, and
- seek acceptance by the prefecture for the proposed plan.

Should a consensus fail to evolve then the JNR may be faced with a court case either to keep it from going through the prefecture with a new line or to compensate for damages for existing lines.

The Environment Agency as the regulating and expert actor was created in 1971 to administer the new and strengthened environmental laws. While the Agency is not a Ministry it still has a place on the Cabinet via the Prime Minister's Office. The Agency's status is not reflected in its title, as the Director-General of the Environment Agency carries cabinet rank under the title of Minister of State. The Environment Agency is one of several agencies housed under the Prime Minister's Office, including the Economic Planning Agency and the National Land Agency.

The Agency concept stems from the recognition of new problem areas needing central government attention. The creation of an agency in the Prime Minister's Office signifies that the

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*T. Yorino, Environmental Preservation for the Shinkansen, JNR paper presented at IIASA, June 1977.

central government officially recognizes the problem and has begun to carry out a program through this agency. If the problem area persists and grows in importance then the agency may be reorganized as a separate ministry. However, its cabinet rank remains the same where an agency head is theoretically equal in power to a minister. Any conflicts between an agency and a ministry are settled at various levels from senior officials through vice-ministers to the cabinet itself if necessary. One distinction between an agency and a ministry is that an agency's responsibility cuts across the responsibilities of ministries while the ministry acts only in a sectoral role. Thus the role of the agency is to act as the focus for the government's effort in the particular problem area, including coordinating the efforts of all other agencies and ministries in the national and local governments as well as taking the lead in implementing policy at these levels.

The Agency has been given responsibilities for not only pollution control matters but also those of a more positive nature such as environmental protection and conservation, including national park management and recreation. All regulatory devices spread among other agencies were also placed under the Agency's purview. The Agency has been divided into several bureaus including planning and coordination (responsible for pollution control administration), nature conservation, air quality and water quality.* Finally, it has one department for health matters and a research arm, the National Institute for Environmental Studies.**

The Air Quality Bureau is responsible for establishing environmental quality standards and for enforcing such standards. Noise and vibration problems come under the aegis of this Bureau in their Special Pollution Division. Soon after the creation of the Agency in 1971 the Shinkansen noise problem was investigated by this Division. By 1975 environmental standards were finally set for the Shinkansen. A key actor in obtaining data for such

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* White Paper on Environment, 1976.

** M. Naito, NIES, Japan's First Comprehensive Research Institute on Environment, Civil Engineering, Japan, 1976, pp. 106-115.

standards was the expert committee on special noise which is an advisory committee of the Central Council for Control of Environmental Pollution. This group serves as a vehicle for outside experts to advise the Environmental Agency in the conduct of meeting its goals in reducing pollution. This Council is described more fully in the section on setting noise standards.

The Environment Agency has the power to set standards for all kinds of pollution control. These standards act as a regulatory brake on all national and industrial projects and operations. The Agency also has the power to enforce these standards through determining emission standards and designing pollution control programs for particular regions. In the area of impact assessment the Agency has no power to require these assessments. Instead, it must rely on persuasive powers in getting the ministries to accept its guidelines for doing such assessments. The Agency does play a lead role in the prefectures where it acts as liaison with local governments by advising these prefectures on technical and administrative aspects of pollution control.

At the national level the process of decision-making involves several actors. The JNR proposes, for example, an extension of the Shinkansen to the MOT which evaluates the proposal. In seeking a consensus among other cabinet-level bodies the MOT obtains the advice of the Environment Agency on pollution impacts. In addition, the Economic Planning Agency coordinates the project among the sectors impacted upon while the National Land Agency coordinates the project among the regions impacted upon. These two coordination aspects are not required but are helpful in obtaining the desired consensus more quickly. Prefecture approval is also necessary and this part is coordinated by the JNR or MOT through their field offices. Finally, once a consensus is reached the Prime Minister and his Cabinet decide on the project.

At the prefecture level the quality of environmental administration varies widely. Urban-oriented prefectures tend to be environmentally conscious while more rural prefectures are often less aware of negative development impacts. Even cities vary in their awareness of pollution. Tokyo, for example, maintains its own Research Institute for Environmental Protection which played an active role in assessing the impacts of the Shinkansen and pursuading the JNR to create remedial measures to reduce noise.* This Institute plays a major role in assessing the impacts of the extension of the Shinkansen through other parts of Tokyo. Isolated and less congested cities in rural prefectures, however, attempt to promote the extension of the Shinkansen into their domain.

Prefecture governments are important actors for the environmental aspects of the Shinkansen because under Article four of the Air Pollution Control Law as amended they can add more stringent pollution control standards to those imposed at the national level.** Even though this added stringency applies to limited air pollutants the precedent has been made for setting stricter standards for noise. The potentiality of this issue has been such that the JNR and MOT seek a consensus through the governor for the area of each prefecture affected by noise along the proposed route. Three problems add to the prefecture's role in responding to Shinkansen impacts:***

- lack of data base and understanding of total impacts of the Shinkansen;
- national government setting limits to the pollutants and range of standards for given pollutants that the prefecture can affect; and
- national government setting limits on corrective orders that can be issued.

These problems become the subject of negotiation for major national-level projects proposed for prefectures with the Environment Agency playing a key role in advising the prefecture.

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* Tokyo Metropolitan Government, Tokyo Fights Pollution, Rev. Ed., March 1977.

** Y. Nomura, Creation and Development of Japan's Antipollution Laws, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, p. 97.

*** Ibid, p. 98.

The Fukuoka Prefecture is currently the farthest destination of the Shinkansen. This Prefecture took a survey among businesses and citizens before the construction of the Shinkansen and determined that its construction would be favorable to it. The greatest concern over the Shinkansen was the increase in pollution but only 19 percent opposed it on these grounds. Over 80 percent approved the extension of the Shinkansen if adequate measures were taken to reduce noise and vibration. Such a survey was used to guide the prefecture in arriving at its consensus. However, no environmental impact assessment was undertaken.

In the Fukuoka Prefecture its departments meet as a "cabinet" to seek consensus on national projects that affect them because without the approval of the prefectural governor no national project can proceed. The governor is an elected official who attempts to convince the electorate on the merits of national projects while, at the same time, he represents the prefectural view to the national level. While MOT field offices do not become involved in the Shinkansen because it is a national rather than a regional project, they do obtain prefecture opinions, consolidate them, and submit them to the MOT at the national level.

The number of environment oriented community or citizen groups have increased from 292 in 1970 to 1249 in 1974, according to the Environment Agency.* the spread of these local citizens groups evolved through the lack of an appropriate interface with their fovernments as well as the kinds of conditions they were experiencing. Large-scale industrial and public works projects have tended to represent the focal point for many concerns of the Japanese people. Table 6.8 lists the key public works projects that have come under criticism by citizens groups and others. Clearly, the Shinkansen is not the only one of many large-scale projects that have come under attack by such groups. Therefore, the experience of the Shinkansen is not an isolated case but part of an overall groundswell of public opinion reacting to specific projects.

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*White Paper on Environment, 1976, p. 76.

Table 6.8 Classification of Large-Scale Public Works in terms of Environment

Items	Project	Developers	Impactees
1. Power Development	Nuclear power Fossil power	industry public corporation	residents fishery
2. Large-scale Development	Industrial base	central authority municipal public corporation	residents nature preserva-tionists agriculture and fishery
3. Public Transporta-tion	Shinkansen Highway Airport	JNR, M. of Trans. local government public corporation, M. of Construction M. of Transport, local government	residents
4. Urban Planning	Waste treatment Sewage treatment Road traffic Housing	industry municipal	residents
5. Nature Conserva-tion Project	tourism, roads	local government industry (tourism)	residents nature preserva-tionists

As Table 6.9 shows that these citizen groups have evolved over time in response to the cumulative impacts borne locally and that they have spread increasingly across the nation. Figure 6.7 shows the geographic spread of court cases involving public works projects. The Japanese have entered a new era that calls for changes in decision making as well as in project conception.

However, it can be an error to focus exclusively on projects because any specific project is only a focal point for a wider set of concerns that go well beyond the scope of the project itself, even though the project is a source of impacts.* The main issues that seem to have motivated the rise of citizens' groups include:

- impacts on health and living conditions including disease threshold and psychological and amenity impacts;
- impacts on environment including access to nature and sunlight, loss of ecosystems and cultural properties;
- lack of integrating the public interest where social equity is not maintained between national and local interests and a maldistribution of advantages exists;
- lack of adequate planning where a faceless bureaucracy substitutes for consensus decision-making and secondary impacts are widely felt;
- lack of compensation being recognized in principle as well as in type, timing and amount.

These issues have found expression in proposed large-scale public works projects which are characterized by their national status, variety of local impacts and technical decision-making at the highest level. The demands of citizens' groups are quite varied and include: asking for compensation for the impact, discontinuing the activity, adequately enforcing the law, and changing or relocating the project. To make these demands citizens have resorted to a variety of means such as: petitions to local government, law suits, negotiating disputes, changing

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* White Paper on Environment, 1976, pp. 74-85.

Table 6.9 Residents Movements and Environmental Issues Associated with Large-Scale Development Projects

	Development Projects	Environmental Issues	Developer	Impactees
1950 Initiative Stage	• Doubling Income Plan • CNDP (1962) New Industrial Cities and Zones	• Four major pollution victims (Yokkaichi SO_2 Minamata Hg Itai-Itai Cd) • City public nuisance	• Industry • Industry local municipality	• Local residents • Regional residents
1964 High Peak Stage	• New CNDP (1969) regional development	• Mishima Industrial complex • Four major pollution trials • Industrial waste treatment (pulp, etc.) • Yokohama freight railway • Narita Airport • Osaka Int. Airport traffic	• Industrial complex • Local municipality • Public corporation	• Regional Residents • League of residnets movements
1970 Extension Stage	• Reformation plan for Japan archipelago	• Road construction • Photo-chemical smogs • Highway trial • Industrial base development	• Ministerial Organization • Public Corporation • Industry • Local government	• Int. Symp. on Environ. Disruption • Nation-wide leagues of residents movements
1974 Stabilized Stage	• Oil crisis • 3rd CNDP (1977)	• Nagoya Shinkansen trial • Nuclear power generation trial • Public transporation facilities • Nature preservation	• same as above	• Int. Institution (UNEP) • Nation-wide association of residents movements

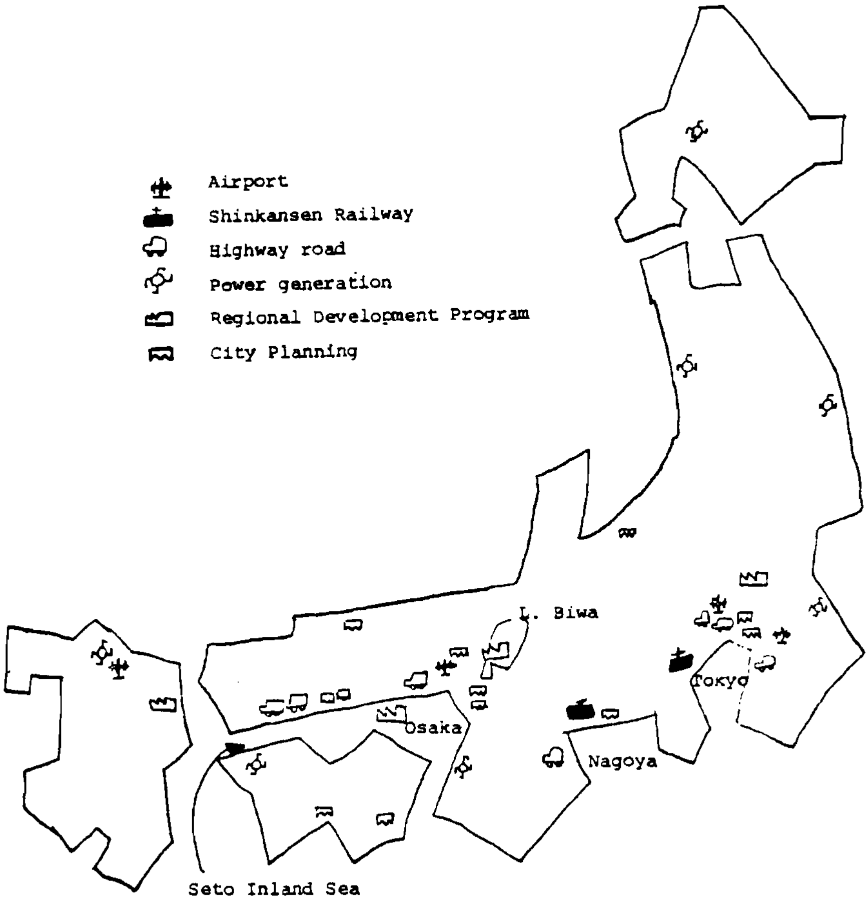

Figure 6.7 MAP OF CITIZENS' MOVEMENTS UNDER COURT TRIALS (1977)

Source: M. Yamamoto, Public Works in Litigations, J. of Japan Society of Civil Eng. Vol 6. No. 7 (1977).

local government, publicity in mass media, and resorting to direct action.* The current problems the government has in attempting to open the Narita International Airport is an example of direct action where local farmers and radical students have teamed up to sabotage its opening.**

One problem with citizens' groups is that rarely do they represent all points of view in a community, city or prefecture. Some groups support the project, others oppose it completely, while others only support it on the basis of certain conditions. For example, the Environment Agency found that the citizens' groups in Takasaki City were divided into seven in response to the proposed construction of the Joetsu Shinkansen extension. These seven groups covered the range noted above from adamant opposition to active promotion.***

The Shinkansen has been most affected through the Nagoya noise trial and the rise of the League Against Shinkansen Pollution. This particular case is discussed as part of the noise standard-setting issue, but the effects of this case have been widespread to other cities and prefectures. For example, planned extensions of the Shinkansen have led to increasing opposition in Tokyo where citizens have attempted to bar survey teams from the proposed route and disrupted meetings in order to demonstrate their concern. While the JNR has not been active or responsive in working with citizens' groups it is being forced to change its approach to decision making and the kinds of alternatives it is willing to consider. An example of their latest conflict with citizens groups is shown in subsection 6.3.1. In order to get the Tohoku Shinkansen line approved and constructed through northern Tokyo and the Saitama Prefecture the JNR was forced to reduce the speed of its trains in congested areas. This decision in 1977 marks the first time the JNR had been willing to consider train speed has a variable in its alternatives. However, the JNR has shown stiffened resistance in reducing train

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* White paper on Environment, 1976, pp. 77, 82.

** A. Horvat, Battle Against Narita, Asahi Evening News, March 29, 1978.

*** White Paper on Environment, 1976, p. 77.

speed outside of the Tokyo region; this point was emphasized by them over and over in interviews.

Lawyers and the courts have been instrumental in paving the way for citizens' groups to affect national and prefectural decision making and project implementation. The four famous pollution trials of the 1960s led to the formal recognition of pollution as a major negative feature of Japan's economic growth. The "Pollution Diet" of 1970 and the creation of the Environment Agency both are partial results of legal efforts and court decisions. Therefore, these exogenous actors to the decision-making process still exercise an important influence on the résults of decisions. For example, the Osaka International Airport Trial resulted in a victory for the residents in restricting times available for flights and recognizing compensation in principle. While the MOT is appealing this court ruling such a precedent will have a direct influence on the pending Nagoya Shinkansen Trial and the JNR response thereto.

Lawyers have also been active on their own behalf in attempting to influence government decision-making. The Japan Federal Bar Association has established an Environmental Law Committee and has a long record in criticizing government development policies. One of the sections of this committee investigated the Shinkansen and made the following findings in 1972:*

1. The existing Tokaido Shinkansen:

   - JNR failed to consider residents being disturbed by the Shinkansen's schedule in the planning stage;
   - JNR not create a buffer zone but only took the minimum land for the actual track;
   - JNR limited environmental impacts to noise ignoring vibration, loss of sunlight, blocked views, changed winds, jammed TV, etc; and
   - JNR assumed residents along the railline should be "eager" to sacrifice their comfort and health.

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*Environmental Law Committee of Japan Federal Bar Association, Environmental Protection and the Role for Lawyers, 1975, pp. 9-12.

2. The proposed extensions of the Shinkansen:

   - JNR continued to be indifferent to environmental impacts in spite of their experience for over a decade;
   - JNR provided no environmental inputs into its decision-making;
   - JNR had no "desire" to listen to affected residents and no intention to publish documents on their proposed route; and
   - JNR limited its response from complaints to more and more construction of noise barriers.

In an attempt to counter these findings the lawyers suggested that an environmental impact assessment be undertaken to ascertain whether or not these extensions were really necessary. They also described the features necessary for a truly adequate impact assessment which included consideration of all consequences from all perspectives, publication of results, simple terminology, revision of plans and an independent review of the assessment, including approval by all affected.*

Figure 6.8 is an attempt to show the linkages between the actors described above. As is readily seen the basic feedback loop in the system of interactions comes from residents, citizens' groups and lawyers whether they act directly or indirectly through their local government. Thus the citizens of Japan are beginning to occupy a key role in the development of public works projects.

6.3.1 Note on the Case of the Tohoku Shinkansen Line (Under Construction)

The current line under construction is the Tohoku Shinkansen which runs from Tokyo to Ohmiya, one of the most congested and populated areas in the Tokyo metropolitan area (see Figure 6.9).

Here are some brief notes on the principal actors, some alternatives and issues, and points of progress:

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*Ibid., p. 11-12

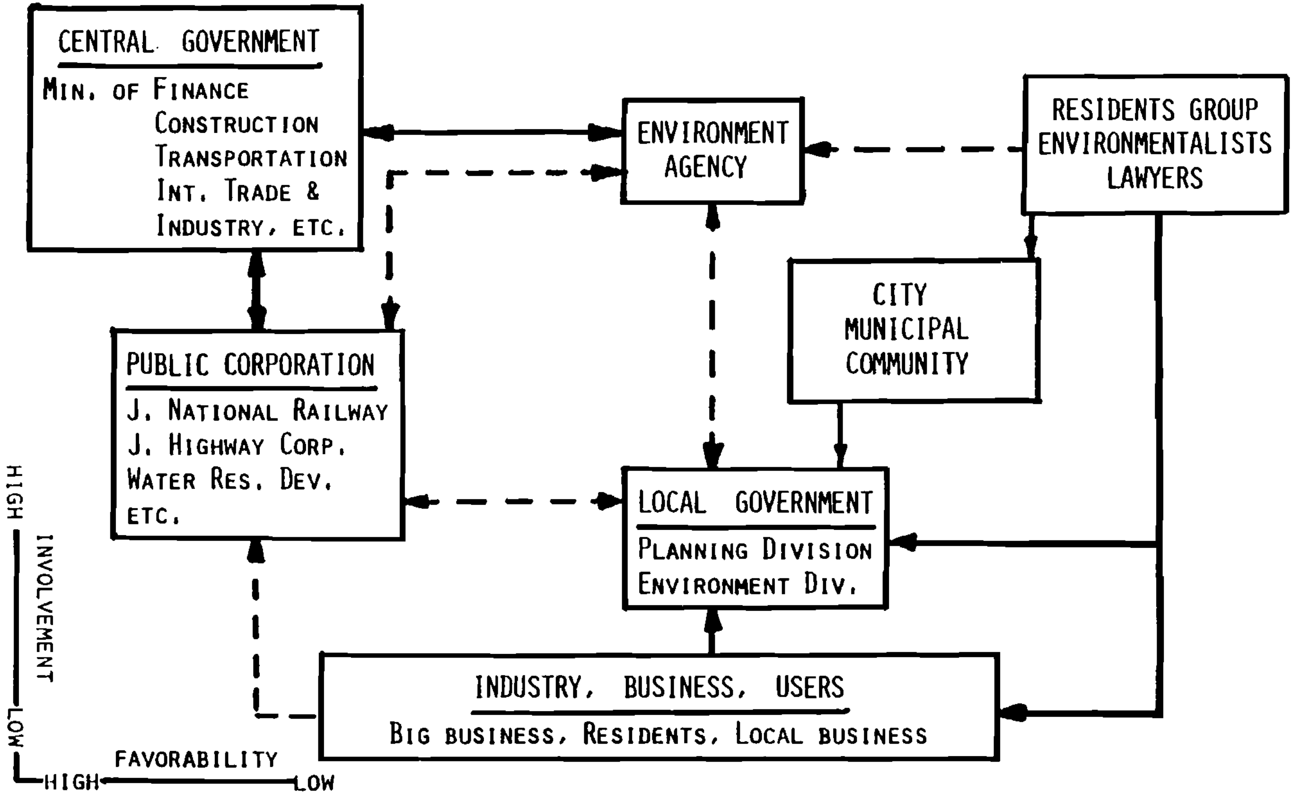

Figure 6.8 SCHEMATIC ILLUSTRATION OF INTERACTION BETWEEN ACTORS FOR PUBLIC WORKS

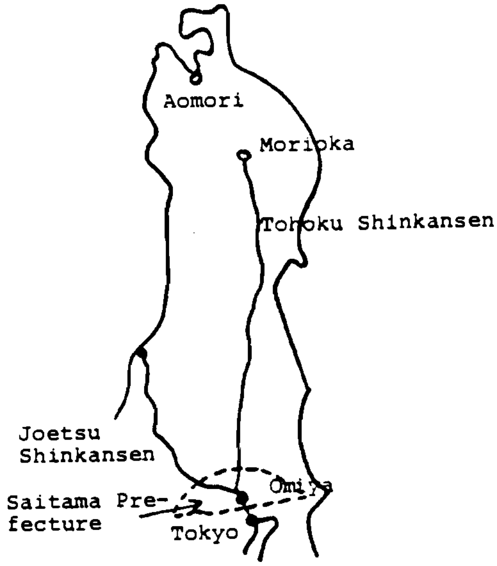

Figure 6.9 TOHOKU SHINKANSEN (UNDER CONSTRUCTION)

Principal actors

Core development actors

- o Min. of Transportation
- o JNR

Allied actors

- o Prefecture Governors in Tohoku region
- o Local industry and commercial circles of the Tohoku region

Users

- o Residents of the Tohoku region
- o Commercial circles near "Uene Station" which is going to be the terminal station in Tokyo

Impactees

- o Committee of Shinkansen matters in Saitama Prefecture (chairman: Governor of Saitama Prefecture)
- o Residents groups in Tokyo (18 groups against the construction in Kita district in Tokyo)

Alternatives and issues from the Tokyo-to-Ohmiya line:

1. terminal station in Tokyo
   - Tokyo station (for the direct connection of Tokaido Shinkansen from Tokyo to Osaka)
   - Ueno Station (current terminal station for Tohoku region)

2. railway
   - elevated: low cost, high noise
   - underground: high cost, less noise
   - combination of the elevated and underground

3. speed
   - speed down (very low speed)
   - speed up (normal)

4. consolidation of the impacted region
   - new line for commuters transportation
   - financial problem

Points of progress

1971: Government decision for detailed construction plan. Organization of special committees for Shinkansen and Saitama Prefecture both for residents and local government.

1972: Associations of residents movement against construction in Saitama and Tokyo requesting a Shinkansen underground from Tokyo to Omiya.
Saitama Prefecture Government requested the construction of a commutors transportation line along the proposed Shinkansen line and underground areas of the Shinkansen.

1974: Organization of associations of Shinkansen pollution throughout the country.

1975: Three residents groups (local cities in Saitama, two residents groups in Tokyo) requested the abandonment of the Construction Plan.
Omiya commercial circle expressed their desire to speed up the construction.
Governors of the Tohoku region asked the Saitama Governor for assistance in the speed-up of construction.

1976: Residents meet around Ueno station to dramatize the need for the terminal to be at Ueno station.

1977: JNR gave the final answer to Saitama Prefecture: "elevated line and low speed driving."

6.4 Environmental Impact Assessment (EIA)

Environmental assessment is the set of procedures which permit an understanding of the likely consequences of development activities on the environment. The objective of such an assessment is the minimization and management of the possible adverse impacts should a project be undertaken. In addition, the assessment could lead to cancellation of a proposed project should the suspected environmental impacts exceed the benefits. A complete environmental impact assessment system would consist of:*

- identification of the planned and possible induced economic activities,
- identification of affected environmental elements,
- evaluation of the initial and subsequent impacts, and
- management of the beneficial and adverse environmental impacts generated by the planned and induced activities over time.

Ideally, an environmental assessment system would encompass all economic activities proposed in a region. Each project would be subject to an environmental assessment which would denote its impacts both beneficial and adverse. Should the project's adverse impacts be deemed too great, as compared to its benefits, by those in authority and those affected by it the project would be modified in design, shifted in location, put off in time or cancelled altogether. In this way such an environmental impact assessment system would act as a constraint on economic growth, much the same as economic efficiency has acted through the use of the benefit-cost assessment in planning for economic activities.

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*D. Fischer, Environmental Impact Assessment as an Instrument of Public Policy for Controlling Economic Growth, IJES, vol. 6, 1974, pp. 233-4.

Benefit-cost analysis has been successfully used to retard projects that were inefficient or cost more than the benefits provided. Environmental assessment as an additional factor can also provide an instrument to retard projects that are environmentally inefficient or disrupt the environment more than they enhance it.

An environmental impact assessment system would require an environmental feasibility study to be conducted simultaneously with economic and engineering feasibility studies. A complete environmental assessment study would be staffed with several disciplines working together as a team who would guide, coordinate and interpret the specialized and detailed studies done by various technical specialists. The actual composition of the team would depend upon the nature of the growth activities to be analyzed. The multi-disciplinary team would bring these diverse studies together and integrate them in an inter-disciplinary fashion. This role will require considerable experience and judgment by team members to think with an inter-disciplinary perspective.

The environmental assessment process defines the problem in such a way as to provide the impactees and the decision makers with environmental consequences of proposed economic investments and alternatives thereto. Accomplishing this task requires a framework which can be applied to any set of economic activities both public and private in any environment with the objective of defining and minimizing the adverse impacts of these activities on the environment. It represents a way of thinking about the environment which is both systematic and wide in scope.

While the Shinkansen provides potential benefits to all residents of connected prefectures it also provides environmental costs for residents along the line in such prefectures. Since the benefits of the Shinkansen are discussed in other chapters this part of the study is devoted to its environmental costs.

6.4.1 Environmental Impacts Associated with the Shinkansen

The proposal to extend the Shinkansen into a nation-wide network will affect the environment in two basic ways. The initial effects of railway (and highway) construction include such impacts as the following:

- noise, vibration and pollution from construction activities on site,
- landscape disfigurement and disruption from digging of construction materials,
- watercourse disruption from tunnel construction,
- traffic congestion and pollution from blocked roads and construction vehicles for transporting materials,
- neighborhood disruption and severance from loss of access to shopping, schools, neighbors, etc.,
- blight effect of uncertainty before actual construction begins due to possible litigation,
- neighborhood disturbance from property demolition and relocation, and
- visual impact of the railway on the landscape and in the neughborhood, including loss of sunlight.

The other set of impacts is associated with the use of the rail (and highway) system during its operation and maintenance. These subsequent impacts include such items as:

- noise and vibration from the passing trains and night maintenance equipment and activities,
- noise, vibration and pollution from induced traffic on other local routes,
- threat to loss of life to non-users from accidents or technological failures,
- disruptions in communications including speaking and TV interference,
- shifts in commercial and industrial opportunities such as loss of local goods and induced pollutants,
- shifts in other transportation opportunities such as loss of local rail services,
- change in numbers and types of visitors to the local area, and

- incidence of all these impacts limited to certain classes of residents living adjacent to the selected route.

Such widespread impacts as the above testify to the complex problem of assessing their effects on local residents and environments. Some environmental effects resulting from trains can be quantified and predicted such as the generation of noise levels. Subsequent impacts create greater difficulty because their effects are only perceived such as noise effects on the person. In addition, lack of preception of these effects may make their impact on the person or environment go unnoticed, leading to greater damage over time. Finally, the aggregate of cumulative effects of all impacts on the person, including his particular susceptibility and living pattern, may cause even worse effects. Thus an initial nuisance effect could over time become a hazardous effect. Therefore, an impact assessment will always be incomplete because of the variety of impacts, their aggregate effect both from the source of concern as well as from other combined sources, their cumulative effect, the different responses both perceived and unperceived, and, finally, the subtle character of many impacts that allows them to go unnoticed.

An extensive listing of the kinds of impacts associated with transportation systems in general is shown in Table 10. This table is self-explanatory and classifies impacts into monetary, environmental and aesthetic. Clearly, a broad ranging environmental impact assessment is required to account for this wide variety of impacts.

The kind of impacts emphasized from discussions in our field study included a much more limited view than that listed above or in Table 6.10. Spokesmen for National Land Agency, for example, noted the following environmental impacts associated with the Shinkansen:

- noise and vibration to residents along the route,
- city and regional conflicts over station location,
- increased division of already small land parcels, and
- increased stress through increased speed.

Table 6.10 Sample of impact classifications: other classes are administrative: community, operational, activity distribution, and social

MONETARY IMPACTS

Agency costs	User costs	Neighbourhood costs	Community costs	Displaced costs
Right of way	Operating	Property values	Income	Replacement costs
Construction	Maintenance	Rents	Production value	Mortgage and investments
Auxiliary facilities	Parking	Assessments	Jobs	Rents
Replacement housing	Insurance	Pollution	Assessment, taxes	Title fees
Replacement of facilities	Accident	Blight	Provision of services	Moving expenses
Maintenance	Time	Accessibility	Regional economy	Clientele loss
Reveune sources				
Relocation services				
Cost of capital				

ENVIRONMENTAL IMPACTS

Air pollution	Noise	Water	Natural resources
Real estate values	Psychological effects	Drainage	Animal life
Material deterioration	Ability to concentrate	Diversion	Animal migratory paths
Power demands	Sleep	Erosion	Plant life
Mental depression	Nuisance	Access to light	Cultivated areas
Balance of nature	Physiological effects*		Uncultivated areas
Dust			Access to light
			Glare
			Soils
			Energy Consumption

AESTHETIC IMPACTS

View of the facility	View from the facility	Natural beauty
Lighting	Location:	Open spaces
dark scary areas	perception sequences	Greenery
cold light	Design:	Park system
monotony	rhythm	Boulevards or gardens
Location:	signing	Lakes
obstruction of sunlight		Wildlife
change of air currents		
visual barrier		
Architectural quality:		
imageability		
dimensional balance		
beauty		
orientation		
psychological barrier		

Source: M.L. Manheim et al., "Community and environmental values in transportation planning: Summary of findings and recommendations to the State of California", vol. I, Cambridge, Massachusetts, June 1972.

* added by authors

According to JNR spokesmen, however, their effort on impact assessment is mainly directed to noise and vibration. No ecological or perceptual studies and no environmental experts from outside the JNR have been used to identify or assess other environmental impacts. The fact that noise and vibration levels lend themselves to quantification and that residents have formally registered complaints on noise and vibration accounts for this emphasis in the JNR view.

Some ways of dealing with the variety and complexity of impacts, however, are necessary for a more reasonable approach to evolve. At present no single approach to assessing for the Shinkansen's impacts has evolved. Concentration of JNR effort has been on noise and later on vibration levels of the Shinkansen.* Disaggregated noise and vibration levels are used and attempts have been made to compare such levels with other sources. However, one of the purposes of such comparisons seems to be to show others that their noise and vibration levels are relative to that produced from other sources which affect residents. No attempt has been made to determine aggregate and cumulative effects of noise and vibration from all these sources on affected residents. Indeed, one recent research report noted that "there is as yet no commonly accepted basis for noise predictions."** Therefore, any decisions made by the JNR on the basis of one technical description of noise impact on residents is likely to be incomplete,*** and even much less incomplete with respect to all of the other Shinkansen impacts on the environment.

For many of the more subtle ecological, aesthetic and perceptual impacts more effort will be required to understand their nature and impact. Not only numbers of people likely to be affected will be important but also the nature, duration and

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* T. Yorino, Environmental Problems and the Shinkansen, paper presented at IIASA, June 1977.

** M. Wigan, the Estimation of Environmental Impacts for Transport Policy Assessment, Env. and Planning, Vol. 8, 1976, p. 133.

*** Areas Around Narita Much Noisier than Estimated, Asahi Evening News, May 26, 1978.

overall effect of these impacts on representative groups. Ways of approaching non-quantifiable impacts are also of importance, especially since the danger exists of using quantifiable data which does not readily register impacts on the person such as noise at source or in front of the house.

6.4.2 Implementation of an EIA System

The implementation of an environmental impact assessment system is not a simple one-time task. It requires perseverence on the part of environmental officials and citizens and it necessitates an understanding of the issues and actors involved in its implementation.

In 1965 the government had decided to begin studies of areas where large-scale industrial projects were planned. Such studies concentrated on the impact of proposed industrial pollution on the local environment and were conducted by the Ministry of International Trade and Industry (MITI). These studies were done in advance of the construction and operation of the planned industries. The waste outputs of these industries were known through the production process employed and the materials required in that process. These known discharges and leakages of waste materials could be tested and evaluated against the known prospective local environment. Thus the findings of this research endeavour served as a guide in industrial siting, design and waste treatment planning. However, no broad definition was given to environmental impacts other than pollutants.

Because of a growing awareness of the environmental impacts of large-scale public projects it became clear that any public project has both benefits and costs associated with it. Therefore, in 1972 the government applied the concept of an a priori environmental assessment to large-scale public works projects as well as broadened its definition of environmental impact to include more subtle impacts such as changes in perception of local residents. In particular, the new Cabinet order required the following steps: *

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* White Paper on Environment, 1976, pp. 85-86.

- identify and evaluate pollution from proposed public works;
- control such pollution and undertake measures to protect the local environment;
- require reports on environmental impacts from the contractors or proposed projects to cover possible impacts, mitigation measures and the effectiveness of such measures.

These rather general features were later made specific with respect to water resource development through a 1973 law spelling out environmental impact assessment in relation to water reclamation projects. A detailed system or process for environmental impact assessment was created and applied to the licensing procedure for public water projects. However, to date no specific environmental impact assessment system has been legislated by the Diet for all public projects including large-scale transportation systems. Instead, the 1972 Cabinet order is used as the basis for the implementation of environmental impact assessment to such projects. This process leaves the actual implementation of such assessment to the individual Ministry concerned. Thus no standardized assessment process exists across projects to allow comparisons since each assessment is ad hoc both by Ministry and by project.

By 1974 the broadened concept of environmental impact was extended to large-scale industries by the courts. All environmental impacts were to now be included rather than limiting assessments to pollution impacts.

The Environment Agency has been attempting for the last few years to place a legislative base under impact assessment by having the Japanese Diet pass on a bill involving such assessments. So far it has been unsuccessful in obtaining the necessary consensus to allow the bill to be passed into a law.* The two major arguments against it come from the Ministries that would be required to implement it. These arguments include the fact that the Ministries are already doing such assessments and that the

*M. Hashimoto, Dir.- Gen., Air Quality Bureau, Environment Agency, October 1977.

public participation requirement is not a necessary part of an assessment. The Environment Agency has countered these two arguments by showing the need for a standardized impact assessment system and by stressing that they want only to see the decision making process become more open to environmental and public inputs. The Agency emphasizes it has not been attempting to shift the power structure to give it a greater role but only to improve the content and hence output of Ministerial decisions by opening them to greater public involvement.

The basic problem in attempting to pass an environmental impact assessment law is the Japanese principle of consensus required at each stage in the legislative process. If one Ministry or other actor objects the process stops at that point and must begin again in the next Diet session after that stoppage has been solved via a consensus. The difficulties of achieving such a consensus can be readily understood since there are six major levels in the legislative process. These levels include the concerned senior officials within each affected Ministry, the Vice Ministers, the Cabinet Ministers, the ruling political party, the Diet and the opposition party and, finally, the Upper House. At each level total concensus is required.

However, the implementation of environmental impact assessment is not completely at the national level. In 1977 four major cities and 19 prefectures listed impact assessment as a priority concern. These local governments plan to institutionalize such assessments.* This growing local interest has stemmed from development impacts being incurred at the local level and from increasing difficulties of local governments in getting a consensus on development projects. With this heightened interest in impact assessment at the local level greater support now exists for a national impact assessment posture. In line with this support the Environment Agency is again going forward to the Diet for a national impact assessment law.

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*Japan Environment Summary, Vol. 6, No. 2, February 10, 1978; Vol. 4, No. 10, October, 1976.

One basic recognition of environmental impact assessment at the national level is its inclusion in the Third Comprehensive National Development Plan. For the establishment of the extended Shinkansen system of trunk lines impact assessment is required to be done in advance, including the development of countermeasures for preventing adverse effects and gaining the understanding of local residents.*

6.4.3 Present Approach to Assessing Shinkansen Impacts

At present the sponsoring agency initiates the impact assessment subject to guidelines developed by its Ministry which in turn can informally negotiate with the Environment Agency. The acceptance of advice from the Environment Agency is completely at the discretion of the Ministry. Impact assessments do not have to be coordinated with the Environment Agency; however, if advice is accepted it is restricted to the procedure itself before the actual assessment begins. The Agency has no power to do an assessment unless national parks or other special nature preservation areas are involved.

Because the Shinkansen's main feature is its rapid speed, this aspect is viewed as its basic public service so that no alterations of its speed are readily considered. The slowing of the trains is not seen as a viable option in alleviating a major source of the noise and vibration impacts. Rather the development of additional technology is pursued to dampen these impacts. In addition, no major changes in routing are considered even though local residents may register complaints. While such complaints are given consideration they are not decisive in route selection. Thus these two basic sources of environmental impacts (train speed and routing) are not seen as negotiable by the JNR and its parent Ministry.**

The present approach is based on achieving a satisfactory assessment procedure, often with the advice of the Environment Agency. After the procedure is determined then it is implemented for a specific project such as a route or a major bridge.

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* Summary of the Third Comprehensive National Development Plan, Second Tentative Translation, mimeo., November 1977, pp. 77-79.

** Interviews with spokesmen at JNR and MOT, October 1977.

Route selection is done without a detailed assessment and without public participation. The basic principle in route selection is to study routing alternatives within the Ministry and to do a general assessment of each. A guiding principle is to avoid congested residential areas if at all possible given the end points in the routing.

Public participation in a routing decision is not seen as viable by the Ministry because it leads to a variety of opinions which makes decision making and hence timing more difficult. Potential land speculation is also seen by the MOT and JNR as a major reason for not opening the routing decision process to the public. Finally, residents are viewed as having confidence in the technical abilities of the JNR. A route is selected on the basis of such criteria as cost, technical problems, convenience of construction and other pertinent physical aspects.

Routing can be difficult because some cities want the Shinkansen and some do not. A key factor in this regional demand for the Shinkansen is whether or not the city will get a station. Should a station be placed in the city then the area receives the benefits of the Shinkansen along with its social costs. Usually the JNR knows which cities prefer the Shinkansen and which do not so that a route can be selected to comply with such wishes, constrained by the end points of the system and its costs. The prefecture governor can play some role in aiding the JNR and JRCC in selecting a route, but this advisory role depends on which prefecture the potential route goes through.

Once a route is selected within the Ministry it is then subjected to an impact assessment. If the Environment Agency is allowed to advise or comment on the procedure to be used it is done in the initial phase before work is begun. The Ministry of Transport (MOT) prepares its guidelines for the assessment to be done by the JNR which is the agency responsible for doing the assessment. The MOT has approval authority for the impact assessment done by the JNR so constant consultations are carried on between them throughout the assessment process. This consultative process guarantees that the final assessment and report reflects a consensus between the MOT and the JNR. Outside environmental experts are not used to work on or to comment directly but they use some experts indirectly on the assessment at their discretion.

The elements or potential impact categories selected for assessment are a key issue. The MOT attempts to select those elements that are pertinent to the Shinkansen such as noise and vibration. Experiments have been conducted to provide a better data base for the assessment of noise and vibration impacts on the environment. However, air and water pollution from construction and operation of the Shinkansen are not seen as much of a problem and so are minimized in the assessment. Other qualitative factors such as aesthetics or the landscape are generally not included in the assessment because of their perceived small role in the environmental problems of the Shinkansen. In the view of the JNR spokesmen no one is even qualified to assess qualitative elements.

The JNR's total reliance on its engineering skill in all areas of endeavor has evolved into a strong confidence in its own ability to meet all of the environmental challenges of the Shinkansen. No environmental disciplines other than engineering and architects are represented in the JNR and outside multidisciplinary environmental experts are not used. The JNR sees itself as basically responding to resident complaints on noise and vibration, whereas no complaints have been registered on the Shinkansen as being a blight on the landscape. This stance on the environment is clearly incomplete. Therefore, environmental impact assessments done by the JNR are concentrated on noise and vibration assessment, and little attempt has yet been made to extend these assessments to preventive planning for nature conservation for the entire environmental impact of the Shinkansen.

While the JNR and the MOT do not favour public participation in route selection some role is accorded to the public for residential areas through which the Shinkansen must pass. However, this public role is restricted to coordination with prefecture governors who, in turn, may call public meetings within their respective prefectures. Each prefecture attempts to arrive at a consensus and then submits its collective opinion through its governor to the JNR or JRCC. The JNR then decides among the different prefecture opinions and comes to a decision. Thus the JNR is the integrating body for all public opinions filtered through the prefecture governors in that it evolves the overall consensus for the environmental impacts of the Shinkansen.

Because of the 1977 Cabinet order requiring an environmental impact assessment for the extension of the entire Shinkansen system it is not surprising that some changes are occurring in the pattern of assessments described above. Indeed the draft plan for this assessment is still under discussion and promises to differ greatly from that noted earlier. One such draft is shown in subsection 6.4.7 at the end of this section. The greatest changes foreseen include larger roles for qualitative elements and public participation in the assessment process.

The new process for development of the nation-wide Shinkansen system consists of three basic phases, each with an environmental component:*

- investigation for construction planning: environmental assessment is informally done and centers around the key problems seen in the route selected;
- construction plan: draft environmental impact assessment done on the plan and shown to the public for their review and opinion through prefecture governor;
- execution of construction: final environmental impact assessment is the basis for guiding the construction.

This short list shows that the environmental aspects of the Shinkansen are beginning to be taken seriously and are designed to affect the construction plan and its execution. However, the

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*Draft Flow Chart of the Procedure of Environmental Impact Assessment for Shinkansen, MOT, October 1977.

draft assessment still evolves on the basis of consultation between the MOT and the JNR or JRCC without outside environmental expertise, unless otherwise requested by them. This draft assessment is now formally publicized (by Cabinet order) and explained by the JNR at a prefectural public meeting. The opinions of the public are gathered and summarized by the prefectural governor who submits them to the JNR. Finally, the JNR notes the conclusions of the prefectures and integrates them into their assessment in order to prepare the final assessment. No outside consultation occurs at this point either. When this assessment is finalized it is applied to the work execution plan and approved by the MOT for construction. Alternatives along with their respective impact assessments are not considered in this scheme except at the very beginning on an informal basis wholly within the MOT. An example of the proposed draft contents of an environmental impact assessment for the Shinkansen are shown in subsection 6.4.7.

The environmental impact assessment for the current Honshu-Shikoku Bridge Project provides an example of how the process is working.* The project calls for building three suspension bridges and three truss bridges with a total length of 6678 meters to connect five islands in the Seto Sea between Honshu and Shikoku. The Cabinet ordered an impact assessment to be done on all aspects of the environment in preparation for the construction of the bridges. The Bridge Authority was given the responsibility to actually do the assessment since it also is charged with constructing the bridges. Because of this Cabinet order the Environment Agency requested a direct role in setting forth the guidelines for the assessment. The Environment Agency developed the appropriate guidelines and forwarded them to the MOT. The MOT and the Ministry of Construction did not want these guidelines because they had already developed their own guidelines; however, they used the Environment Agency's guidelines as a basis for their final guidelines to the Bridge Authority. The Authority is to work on the draft assessment in close collaboration with the local governments involved; however, no outside environmental expertise is

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*Technical Guide of Environmental Impact Assessment for Honshu-Shikoku Bridge Project, MOT, July 1977; Japan Environment Summary, Vol. 5, No. 8, August 19, 1977.

required. Local residents are to be informed via the publishing of the draft report and their opinions are to be reflected in the final assessment. Public hearings may also be held if deemed necessary. The final report is also made public and sent to all main bodies concerned. Any alternatives to the bridges that were studied have not been shown to the public. Only the final consensus plan is displayed to the public.

While the Environment Agency guidelines for the contents of the assessment appear broad and seem to go well beyond the confines of the construction site itself the MOT plans to restrict the assessment to the actual site. Attention is to be particularly paid to noise and vibration effects from construction and operation as well as water pollution from foundation work and earth disposal and air pollution from the possible increase of car traffic. The resultant increased traffic flows with their impacts on Shikoku are not to be fully studied so that a systems view of the change in island access and hence in total impacts is being ignored. The only traffic effects to be studied are those in connection with the use of the proposed bridges such as noise levels from bridge use. The assessment is also irrelevant to site selection as the bridge sites were selected a priori. However, the results of the assessment will be integrated into the design of the bridges and the construction site itself. For example, the MOT plans to use synthesized photographs with and without the bridges as a basis for formulating public views on bridge type.

6.4.4 Public Participation

Public participation has been, perhaps, the major issue in the attempt to establish national environmental impact legislation. The impact of such participation on ministerial decision-making prerogative appears to be the driving force behind ministerial resistence to public participation. The Environment Agency argues that public participation will not change the power structure but only open decision making to public scrutiny and thus enhance the results of such decisions. Resistence from the Ministries continues, however, and there is little prospect of achieving national environmental impact legislation with a provision for public participation embedded in it in the original form which the interim report on E.I.A. by the Expert Committee under the Central Council for the Environmental Pollution Control proposed.

The current approach by the MOT and the JNR is to take account of local resident opinions via the consensus described by the prefecture governor. Just how such opinions are finally reflected in actual decision-making is not clear because it was stated that no major changes in routing or train speed are considered on the basis of resident complaints.

To illustrate that wide public opinion was not fully taken into consideration in the course of the planning, construction and operation process of the Shinkansen is the residents' court suit in Nagoya where the residents sued the JNR over noise and vibration impacts of its Shinkansen. It is of interest to note that these residents attempted to work with the JNR prior to finally going through the courts. The JNR did not admit to the need for any explanation to concerned residents either before, during or after the construction of the Shinkansen through Nagoya. Six years after the opening of the Shinkansen the JNR acknowledged a noise problem and a year later constructed a sound barrier wall along key points. Two years later they finally met with Nagoya residents in a formal recognition of the noise problem. The residents finally resorted to legal action and a court was launched, ten years after the opening of the Shinkansen.* At this point the JNR head office decided to suspend any further contacts with the residents there, pending the outcome of the court case. The details and chronology of this particular problem are described in the section on noise standard setting. It is important to note, however, that JNR spokesmen now say they attempt to work more closely with the prefecture and residents in areas where new lines are being built.

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*H. Shoji and T. Yamamoto, Noise Pollution, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, p. 70.

One feature of interest is the growing necessity for the JNR to obtain an agreement for the Shinkansen to run through a prefecture. This legal agreement can be more strict than any national environmental standards. The terms of this agreement stem from the prefecture consensus as to their collective opinion of its value and impacts to the area and residents involved. In addition, the provision for a local government to raise environmental standards beyond the national minimum can be applied, although at present this local prerogative is restricted to certain specified pollutants.

In some areas, for example in Tokyo, citizens groups have attempted to physically stop pre-siting surveys or even disrupt public hearings in order to prevent the extension of the Shinkansen. In the opinion of the Environment Agency no far-reaching change will be introduced into the present public participation process without the success of court cases such as the Nagoya residents against the Shinkansen.

Even given good will on the part of the JNR toward resident complaints there remain many problems. Some effects are perceived, others not; some affect health, others are a nuisance. It is easy to see that what local residents consider as important will differ from what the JNR considers as important. The use of noise indices tends to underestimate the real impacts on residents, while reliance on resident perceptions tends to overestimate such impacts. Judgment will always characterize the assessment of impacts on health, amenity and the combination of these elements. All parties affected by the Shinkansen clearly have a role in expressing views contributing to an overall judgment of its impacts.

Public participation, as seen in an earlier section, is a growing force in Japan with a long and painful history in the face of official resistance. In its attempts to understand local environmental issues as well as to implement environmental impact assessment at the local level the Environment Agency coordinates with the prefecture level. Greater local experiences in successfully stopping large-scale projects at the local level will generate local support for national legislation for impact assessment with public participation as an important feature of such legislation.

6.4.3 Issues Affecting EIA

As would be expected there are many issues affecting the conduct and further extension of impact assessment in Japan. Such issues are listed below in question form:

- what projects are to be included?
- what environmental factors are to be included?
- what publics are to be included?
- what decision-makers and experts are to be included?

Within each of these four questions many other questions could be raised; however, the overriding issue is the role of public works projects in Japanese society. While it would appear that the Cabinet order extending impact assessment to large-scale public works projects would suffice to generate adequate assessments, each of the major Ministries still resists the extension of an overall impact system because of the "public nature" of their projects. Over and over again it was stressed that large-scale public works projects make significant contributions to the national economy and that local socio-environmental impacts are to be borne or traded off on the basis of this overriding public interest. Many prefectures, cities and national agencies argue that the quality of the environment overrides contributions to the national economy, particularly since the national economic standard of living is quite high while social and environmental goods are less in evidence. Because no consensus on the nature of the public interest of public projects yet exists there is controversy over which projects should be subjected to an assessment. Those favouring assessment argue that the nature and the degree of potential impacts ought to be the deciding point for an assessment, while those opposing assessment argue that the nature, timeliness and the degree of potential overall benefit from projects should count for exclusion from a general assessment requirement.

The environmental factors to be included in any assessment are centred around the "famous seven pollutants": air, water, land, noise, vibration, odor and ground subsistence. These pollutants were specifically mentioned in the 1971 basic law on environment and characterize most impact assessments done to date. Even among these pollutants there is a question of which physical impacts to include in the assessment guidelines. As was noted earlier the JNR centers its assessments on the noise and vibration problems of the Shinkansen while ignoring its construction and other impacts. Other environmental factors not included in assessments involve both qualitative and social aspects of environment. Land use and aesthetics are considered to be quite controversial because of their qualitative nature and so are not often included in an impact assessment. Socio-economic factors affected by environmental changes are resisted on the grounds of their not being covered by the basic environmental legislation. Environmentalists argue that people give value to natural systems so that the impacts of the Shinkansen on people in terms of being disturbed, accessing nature and having a quiet living environment should be emphasized since its impacts on them will affect their enjoyment of all other aspects of life, including the natural environment. Developers prefer to limit assessments to strictly natural phenomena that can be readily quantified by some engineering index. Thus considerable controversy exists over the elements or factors to include in an assessment as well as the degree of analysis accorded to each of them.

The inclusion of various publics affected by the Shinkansen is also fraught with controversy. As emphasized in the last section public participation can be viewed as the most contentious issue in the assessment process. Citizen groups and other publics are not given free reign in expressing their views to the JNR either now or in the course of the proposed EIA procedure for the Shinkansen. Rather the prefecture governor has the dominant role in attempting to achieve a prefectural consensus. Whether or not such a consensus is readily achieved depends upon the kinds of viewpoints admitted into the process; therefore the governor has an incentive to limit viewpoints to those which are not radical in nature. Typically, according to some Japanese observers, few residents who have found the Shinkansen annoying are represented in public hearings or in inquiry commissions. Lawyers and university experts representing residents are also not represented in such meetings.* Government representatives prefer to go for a consensus through the formal hierarchy represented by the prefectural governor while wide-ranging resident groups prefer direct contact with the developer. Therefore, it is clear that the role of affected publics is another area of great controversy.

While the national government's consensus is being reached on certain aspects of the Shinkansen another issue involves the role of the Environment Agency in such a consensus. At present this Agency has no formal role in the decision-making process even though it aspires to such a role. Pressures from the ministries have been successful in keeping the Environment Agency from having a national legislative stance for being included in the environmental aspects of economic development processes, although the Agency has studied the socio-economic impacts to society in terms of the possible economic burden in order to attain their long-term environmental quality goals.** Also local science teachers could play some role in assessing the impacts in the area where they live.***

Other issues center around the conduct of environmental impact studies. For example, a major criticism notes that assessments are done either after the project is planned or while construction is already underway. In other words, the assessments, while designed to aid in project decision-making and planning, are done post hoc after all key decisions are made.

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*K. Miyamoto, Regional Development, Public Works and Environment, Proc. of Int. Cong. on Human Environment, Kyoto, 1975, p. 80.

**Env. Agency, Long-term Environmental Conservation Program, July, 1977.

***Ibid, pp. 81,85.

Assessments are also seen as desk-top studies with only limited field investigation being done. Problems of research design and a proper data base are seen as not being properly addressed. One description centers on the use of an a priori computer model that is fed only limited data such as a three day survey of pollutants which is insufficient for an adequate assessment.* Long-term trends can not be assessed via short-term field studies or data derived from desk calculations.

As a summary of the existing environmental impact assessment system the following critical points have emerged from the discussion:

- Impact assessment is generally a closed system among development actors with little or no formal input considered from the Environment Atency, outside environmental experts and affected publics;
- The JNR as the lead actor is not currently in a position to adequately assess environmental impacts both in attitude and in ability;
- Public inputs are limited to the prefectural consensus;
- Environmental impacts are not given a large role in the process of route and station location selection;
- Environmental assessments are limited to the technical aspects of noise and vibration and to data that are readily quantified;
- Train speed is not generally seen as a variable in reducing impacts;
- The use of environmental assessments is seen to be another hurdle to be passed rather than a vehicle for such suggesting the possible modification or elimination of the project altogether;
- Environmental remedies are centered around new technology which are add-on features to the existing technology which remains unchanged.

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* Ibid, p. 80.

6.4.6 Proposed EIA System

To counter these issues and problems in the current approach to impact assessments the Envirnment Agency in conjunction with its Central Council for Control of Environmental Pollution and National Institute for Environmental Studies has proposed a new national assessment system.* The kinds of projects to be affected by this proposal include:

- industrial park siting and large-scale public works planned by the national government,
- activities requiring permits whether public or private, and
- large-scale complex projects relative to the region of planned location.

The only projects to be excluded from an assessment requirement would be those in a very early planning stage and those which involve only planning such as a study on future energy supply. These exclusions stem from the lack of specificity in their nature at that point in time. Clearly, as these plans ripen into proposed projects their assessments would be required.

The proposed assessment process is described in a series of stages as follows:

Stage 1. Preliminary Stage:
Both the project sponsor and other environmental specialists are to survey the environmental base and to make a preliminary assessment of the project's measure.

Stage 2. Preparation of draft assessment:
These same actors outline each project phase and access and predict the impacts on the environmental base. Countermeasures are devised to meet the impacts for the entire cycle of the project.

*White paper on Environment, 1976, p.89.

<u>Stage 3</u>. Circulation of draft assessment:
The project sponsor publishes the draft report and causes it to be disseminated among affected publics. Public meetings are also held to explain the project and its impacts to both residents and other interested publics. The Environment Agency and local governments are informed.

<u>Stage 4</u>. Incorporation of opinions:
The project sponsor in conjunction with any specialists necessary integrates the findings from the above efforts into national, local and public points of view. No source of input can be ignored since anyone can submit statements as to their judgment of such impacts.

<u>Stage 5</u>. Preparation of final assessment:
The project sponsor adds his own opinion to those generated by the above process. All these integrated opinions are then reviewed and the necessary modifications in the draft assessment and countermeasures are made.

<u>Stage 6</u>. Presentation of final assessment:
The project sponsor again opens the final assessment to public review and comment at all levels.

<u>Stage 7</u>. Assessment effect on project:
The project sponsor assesses the final impact assessment to decide if the environmental changes induced are acceptable to all concerned. If no significant impacts are induced the project goes ahead; if major impacts result then the project must be stopped or additional data are needed.

The outline of this process was first derived by the Environment Agency's Council in December 1975. Given the difficulties of getting this process approved by the Diet, the provision for the wide incorporation of outside views may have to be changed to achieve the necessary consensus. The key role assigned to the project sponsor reflects the political realities in Japan since no assessment system could be legislated that accorded the lead role to the Environment Agency. Since many other actors at all levels are involved in attempting to create an adequate impact assessment system the final proposed form is not currently known, but the above system does reflect the basic thrust. As yet no consensus exists on the format for a nation-wide environmental impact assessment system.

6.4.7 Contents of a Report of Environment Impact Assessment for Shinkansen

FOREWORD

SECTION 1 Construction of Project

- 1.1 Outline of Total Project
- 1.2 Summary of the Plan in the Region
- 1.3 Outline of the Route

SECTION 2 Existing Circumstances along the Route

- 2.1 Existing State of Land Use
- 2.2 Population, etc.
- 2.3 Transportation
- 2.4 The Equipments for Welfare, Education, Culture, etc.
- 2.5 Cultural Assets

SECTION 3 Forecasting and Assessing the Effects of Natural Environment and the Countermeasures

- 3.1 Topography, Geology
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SECTION 4 Forecasting and Assessing the Effects of Living Environment and the Countermeasures

- 4.1 Noise
- 4.2 Vibration

6.5 Introduction to the Problem of Noise Pollution Control for Shinkansen Trains

Like other types of pollution, noise can disturb, irritate, hurt and even damage. But few other pollutants cause such immediate and obvious aggravation as noise. The effects of noise range from slight disturbance of sleep or conservation, over psychological distress, to psychosomatic stress symptoms, and even physiological damage to the hearing system. There is another characteristic feature of noise pollution: people who suffer from noise usually quickly identify its source, complain, and try to stop it. In fact, in the last few years, noise was the single largest source of complaints about environmental pollution in Japan. Statistics show that in 1974 noise clearly dominated air, water, and other types of pollution with 24,000 complaints. As one high official of the Environment Agency summarized: "Noise pollution, particularly of transportation pollution, has become the most important difficult problem at present". (Hashimoto, 1975, p.1).

Hashimoto especially singled out transportation noise because there has been massive action by citizens and political groups against noise from highways, railways, and airports. One of the dramatic cases was a legal battle involving Osaka International Airport which citizens won in 1974. The court put severe restrictions on frequency and timing of jet flights.

Residents also have begun protest action to fight highway noise. A law was filed in 1974 by the residents along the Kobe-Osaka Freeway. In this list of protest targets railways are not missing. In fact, the Shinkansen has been one of the most criticized sources of noise pollution in Japan.

Nobody denies that the Shinkansen is noisy. Presently trains run in five minute intervals along the Tokyo-Osaka line from 6.00 a.m. to 11.45 p.m. with a service speed of 200 km/h. This means that about 230 trains pass a single point every day. Without protection measures noise levels at 25 m off the track are around 85-90 dB(A)* but they can reach up to 110 dB(A), for example, on steel girder bridges. Jet planes (from a good distance) and sledgehammers (from nearby) are louder, motorcycles are comparatively quiet. To give some further reference points: at busy street intersections the noise level is about 70-75 dB(A), in quiet residential areas at night the noise level goes down to 30 dB(A). Between 30 and 60 dB(A) sounds are usually not considered "noisy" unless the environment or the sound itself has some peculiar characteristics.

Residents at a distance of up to 200 meters from the tracks may be substantially disturbed as illustrated in Figure 6.10. Complaints about the Shinkansen noise over the last few years confirm this. Table 6.11 shows the distribution of complaints against the Shinkansen between 1964, the beginning of operations, and 1975 on the highly populated stretch between Tokyo and Osaka. Noise and vibration clearly dominate the picture. But people have not stopped with the complaints. New lines of the Shinkansen like the Tohoku and the Joetsu Shinkansen are sites of residents protests. Particularly, residents in the metropolitan areas have formed organizations such as the "League against Shinkansen Pollution", the "Association against Nagoya Shinkansen Nuisance",

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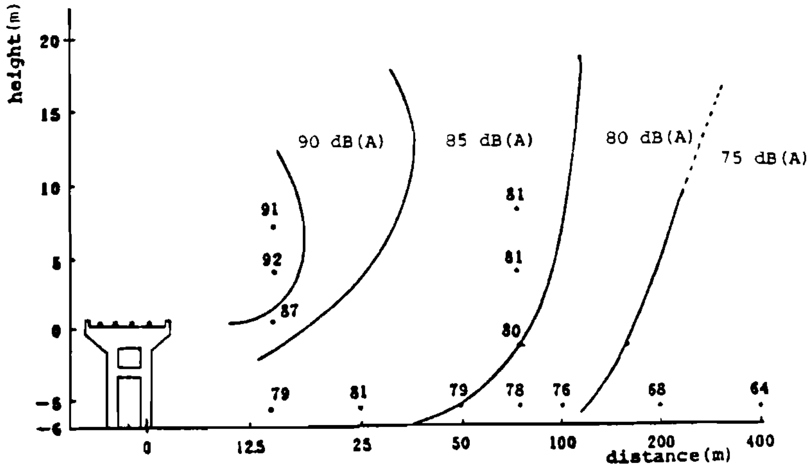
*The decibel scale (dB) is the fundamental measure of noise which reflects approximately the human perception of loudness. Sometimes a weighted scale dB(A) is used which also takes different frequencies of noise into account. Other measures are the phone and the sone scale as well as physical measures of sound intensity. For details, the reader is referred to Beranek, 1971.



Source: Osaka Prefecture BIG Plan, 1976

Figure 6.10 VERTICAL NOISE DISTRIBUTION

Table 6.11 COMPLAINTS AGAINST SHINKANSEN NOISE (Tokyo-Osaka)

Year / On	1964	65	66	67	68	69	70	71	72	73	74	75	76	Total
Noise	9	13	16	6	2	2	1	2	3	6	5	12	13	90
Vibration	11	16	19	9	3	5	1	2	5	1	6	9	0	87
Noise & Vibration	10	13	7	10	5	3	3	17	8	16	36	41	6	175
Wind Pressure	2	4	1	1									2	10
Interference on TV	1	4	4	6	6	1	6	6	1	1	11	10	10	67
Others														
	33	50	47	32	16	11	11	27	17	24	58	72	31	429

Source: Yorino, 1977b

and the "Protest Group Against Shinkansen TV Interference", to represent their interests against Japanese National Railways (JNR). In one word: The Shinkansen has become a major target of environmental criticism and protest in Japan, and a symbol of pollution induced by large scale public works.

The growing conflict between JNR and residents caused regulatory agencies to act. Before the establishment of the Environment Agency (EA) in 1971, several regulatory and legal actions had been taken against noise pollution in Japan, primarily on the industrial and workbench noise sector. With the birth of the Environment Agency, noise pollution control measures were enacted rapidly.

Environmental quality standards for noise in general were set in 1971 but excluded airplane, railway and construction noise because of the intermittent nature of these noise sources. Excluded thus were all major noise sources from large-scale projects. An inquiry into the Central Council for Environmental Pollution Control (the advisory body to the EA) regarding noise standards for air and railways was made in September 1971 by the Environmental Agency. In December 1972, because the problem became increasingly serious with the increase in residents' complaints interim guidelines against Shinkansen noise were recommended by the Environment Agency. The Director General of the Environment Agency asked the Ministry of Transportation to take "urgent steps on Shinkansen noise abatement." In the meantime, a special committee was organized in the Central Council for Environmental Pollution Control to begin studies on the problem of noise pollution from transportation sources. Environmental quality standards of 70-75 dB(A) were finally issued by the EA for Shinkansen trains in 1975.

But the noise standards and JNR's efforts to comply within the given time framework did not end the conflict between JNR and the residents. The "Association against Nagoya Shinkansen Public Nuisance" filed a law suit against JNR which is still pending; the plaintiffs did not accept the EA standards and still request stricter standards and compensation. New construction sites of Shinkansens are again the issue of strong public debate. At present, nobody can predict the outcome of this protest development. It appears that the noise problem, already a major problem for JNR as well as residents and the governmental regulators, may persist and become a main obstacle for further development of the Shinkansen.

In the following sections, the decision process of JNR, the EA, and residents' groups will be analyzed to structure the decision problem of noise pollution control, to describe the decision process of the three actor groups, and to identify sources of conflict. The data for this study was collected during a three week field study in Japan. All major actors were interviewed in depth. No actual measurements were taken, and the quantifications reported are largely from the literature. An analytical approach will be used to structure the noise control problem which has already been applied to studying the problem on chronic oil pollution in the North Sea (Fischer and v. Winterfeldt, 1978; Fischer and Ikeda, 1977). The approach is a structured policy analysis of the decision process which generates a qualitative problem oriented picture of the pollution control problem by answering such questions as: Who is involved? What are the objectives? What are their decision alternatives? These structural elements of the decision making are then put together in an actual description of the information processing, evaluation, and decision making of the actors involved in the noise control problem. The focus will be on the decision making of the Environment Agency when setting environmental noise quality standards and the Nagoya Association in combating Shinkansen noise pollution, since JNR's role in the process seems to be largely reactive to regulatory and citizens actions. After discussing and evaluating the decision process of the Environment Agency, JNR and residents' groups, methods to improve decision making for such pollution control problems will be discussed.

6.6 The Elements of the Noise Pollution Control Problem: Actors, Their Objectives and Alternatives

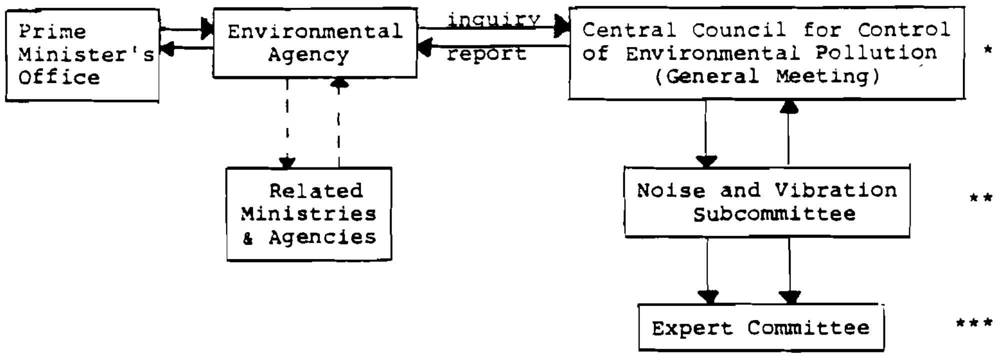
6.6.1 Regulatory Actors, Objectives and Alternatives

The historical, legal, and organizational framework for environmental pollution control in Japan is described in the previous section and in Environment Agency (1976), Hashimoto (1975).

Here, only the two main regulatory bodies involved in noise pollution control for Shinkansen trains will be discussed: The Environment Agency and its advisory body, the Central Council for Control of Environmental Pollution. The Environment Agency reports directly to the Prime Minister and the Parliament. Decisions such as environmental standard setting were made by cabinet order and since the establishment of the Environment Agency are now made by its director. The legal framework for such decisions is formulated in the Basic Environmental Law for Environmental Pollution Control Measures (1967) and in the law for the establishment of the Environment Agency (1971).

The bulk of the information processing, evaluation and decision making on noise standards was performed by the Central Council for Control of Environmental Pollution. This council is subdivided into three layers: the general meeting, the subcommittees, and the expert committees. Expert Committees are the research bodies which sponsor, collect, and evaluate studies on special pollution problems and draft recommendations about standards for the subcommittees. These recommendation drafts have to be substantiated purely on a scientific basis. The subcommittees are the advisory bodies for policy making to the General Meeting and the Director General of the Environment Agency. In these subcommittees final recommendations are made considering the technical and scientific facts and political, economic or other possible factors influencing standard setting. The ultimate decision is then made by the Director of the Environment Agency (EA). Generally speaking, however, both the General Meeting of the Central Council and the Director of the EA will be reluctant to impose any changes on the recommendations of the subcommittee. Figure 6.11 illustrates the organizational setup.

The Council began studies on noise pollution control for Shinkansen trains in 1972. Its subcommittee on noise and vibration control consisted of 15 members, from JNR, the Research Institute of the Ministry of Transportation (MOT), and the Ministry of International Trade and Industry (MITI), business



ROLE		MEMBERS
*	General policy and final recommendations	Experts from various disciplines, scholars
**	Comprehensive evaluation	Experts, scholars, engineers
***	Criteria, technical and scientific evaluation	Experts, scholars engineers

Figure 6.11 ORGANIZATION FOR STANDARD SETTING

associations and local government. The secretariat was provided by the EA. An expert committee was formed in 1972 to study the problem of Shinkansen noise in depth. This committee had 11 members, all experts in noise pollution problems. Six university professors, a member of the National Institute of Public Health, a member of the National Institute for Noise Problems belonged to this committee as well as experts from JNR, the automobile industry, and other industries. For implementing standards the Environment Agency has to rely on local governments and city environmental or police bodies. It should be noted that in this organizational set-up for noise pollution control decision making (as in other environmental decision making cases) no direct participation by the sufferers of pollution is provided for.

The Council strongly shaped the decision on noise standard setting. To understand the objectives of the Council and the Environment Agency in setting noise standards one has to examine the Basic Law for Environmental Pollution Control of 1967. This law provides a common goal for integrated control measures based on environmental quality standards (EQS). EQS have the role of targets, administrative goals, desirable states to be achieved some time in the future. They are distinguished from enforcement standards (ES) which are direct regulatory tools for managing a particular pollution problem by putting enforceable limits on emission or total amounts of pollution. The noise regulation law of 1968 provides the power to set enforcement standards such as for industrial noise, automotive noise and so on (see Environment Agency, 1976).

Considering environmental quality standards for Shinkansen noise first, the goals and objectives for such standards should have the character of desired states of quietness in the sense of "Maintaining and protecting human health and conserving the living environment" (Environment Agency, 1977). More concretely, noise quality standards should be set so as to prevent adverse effects of Shinkansen noise on human health (damage to hearing), psychological well being (increased stress symptoms), and normal human activities (rest, conversation, etc.).

For enforcement standards economic, technical, and political objectives may be considered besides environmental objectives. Improvement of the transportation sector, governmental policy objectives of "balanced growth of the economy," agreement with international standards, reduction of complaints may be among the political and economic objectives of the regulator when setting noise enforcement standards. The economic and political objectives could possibly have an important influence on enforcement standard setting. The national government has formulated a policy to study in depth the environmental impact problems of the Shinkansen before further extensions are to be considered. In effect this means a delay of further development of several years. The major objective behind this move may not only be the concern about the environmental condition, but also concern about whether the benefits of the Shinkansen extensions would justify the enormous load on government spending. Possibly enforcement standards could thus be used to motivate restrictions on further developments of the Shinkansen.

Although the distinction between quality and enforcement standards appears logical and clear, in practice there can often be some confusion. As was pointed out in the report of the OECD (1977) on Japanese environmental management, quality standards are taken very seriously in Japan and strong administrative attempts are made to achieve them. Thus, although quality standards are in a legal sense not enforceable (and, as targets, should not be) in practice they are often enforced by putting time limits on achievement periods, special area restriction, and so forth.

Figure 6.12 is an attempt to structure the potential objectives of the Environment Agency and its Council when setting enforcement standards for Shinkansen noise. The environmental objectives of the upper part of Figure 6.12 should be given priority when setting environmental quality standards. As will be shown later, the actual goals and objectives implicit in the decision making of the Environment Agency and its Council had a different structure, concentrating in particular on the reduction of complaints about noise.

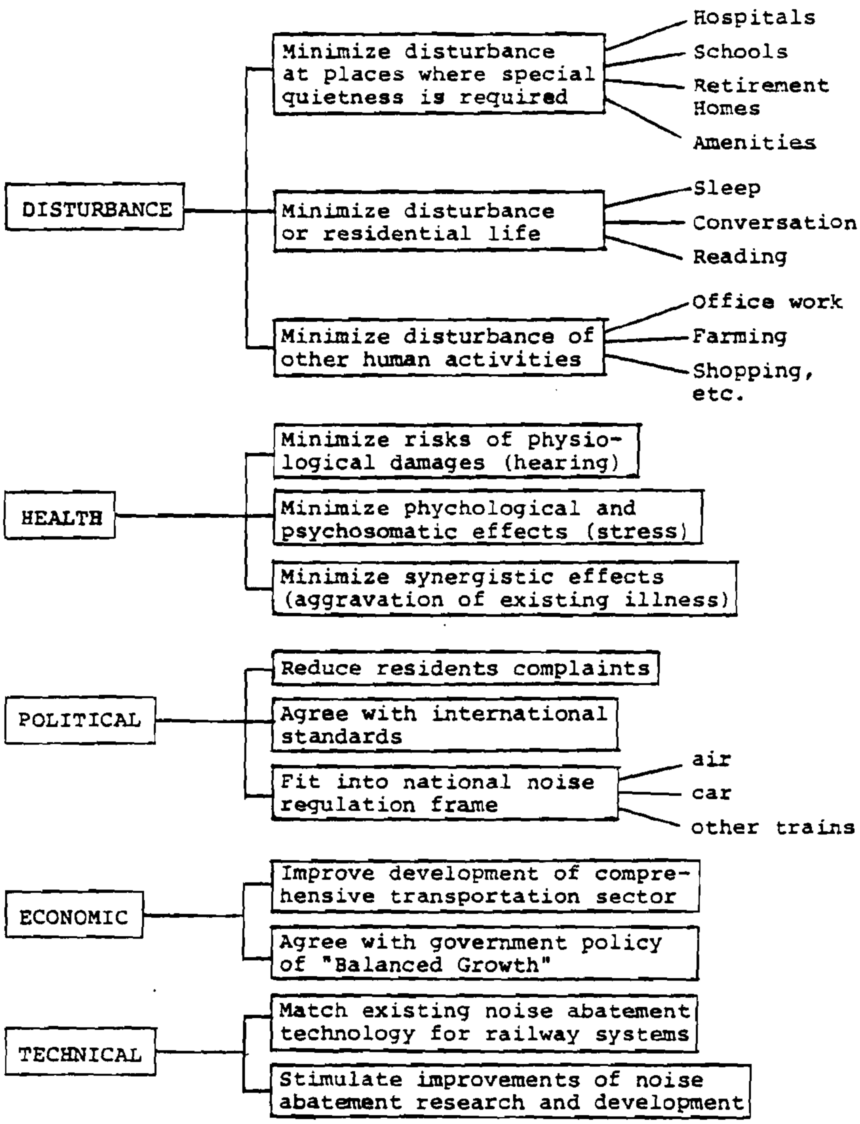


Figure 6.12 REGULATORY OBJECTIVES FOR SHINKANSEN NOISE POLLUTION CONTROL

What are the alternative regulatory means to achieve these objectives? If one considers only standards as a tool the main distinction is between EQS and ES. But there are also alternatives to standards, e.g. financial approaches (incentives, noise fees) and direct intervention (e.g. land use schemes, equipment specifications, or operational control of speed and time of operations). Within the standards category in turn there are many possible choices including the noise measure on which the standard is defined, the actual maximum amount, monitoring and inspection procedures, area and zoning definitions, and time limits for the fullfillment of the standards. Figure 6.13 presents, in a logical alternative tree, some of the potential alternatives for regulating Shinkansen noise. Further alternatives could include:

- differential standards for different areas (e.g. hospitals, light residential, industrial)
- differential target period for achievement e.g. according to the state of construction of a line, or according to the present noise level).

6.6.2 Development Actors, Objectives, and Alternatives

Three main bodies participate in the development of the Shinkansen: the Ministry of Transportation, the Ministry of Construction, and the Japanese National Railway Corporation. The Ministry of Transportation is the main political body responsible to the Prime Minister and the Parliament in questions of planning, development, and construction of all national railways. Both JNR and the Ministry of Transportation are involved in constructing railroads, with JNR usually taking the leading role. Train operations and maintenance are the task of JNR alone.

Noise pollution control for old lines as well as the development of noise abatement technology for new lines is JNR's task. Research and development on noise pollution abatement technology is done largely by JNR's Railway Technical Institute with coordinating roles taken by JNR's environmental department and its environmental committee. The environmental committee is composed of members of most JNR departments. The environmental department has 17 members which are exclusively engineers

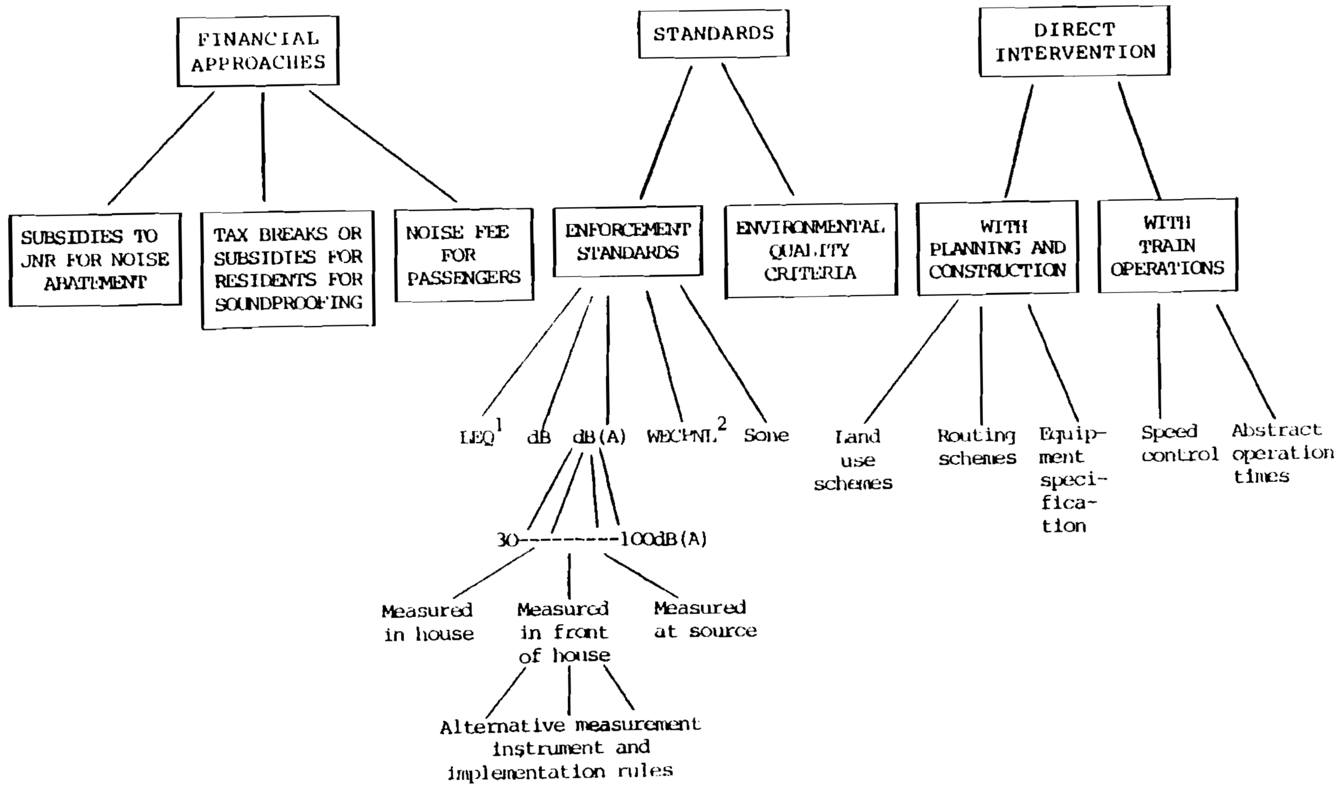


Figure 6.13 REGULATORY ALTERNATIVES FOR SHINKANSEN NOISE POLLUTION

or professionals in technical services. The basis for JNR's pollution control program is described in Yorino (1977b).

The objectives of JNR in the noise pollution control decision making are structured in Figure 6.14. The main distinctions are between service objectives (speed, reliability, visibility), cost objectives (investment and operations), and compliance with regulation objectives.

JNR and the Ministry of Transportation stressed very much the objective of maintaining a high train speed as the essential feature of the Shinkansen. Speed reduction to reduce noise was therefore never considered as a response to complaints or regulations. Although JNR officials claim that noise reduction is a genuine objective of JNR, their decisions indicate that noise reduction measures would not have been taken without regulation. Therefore, the main influence on JNR's decisions to reduce noise is by the regulatory compliance objective which stand in conflict to the cost and service objectives. It appears that JNR reacts to proposed and adopted regulations by first maximizing the service objectives and then searching for solutions which minimize cost. This interaction of objectives tends to push JNR's decision making in the direction of maintaining the status quo and reacting only slowly to outside forces.

JNR officials including those of the environmental department perceive the noise pollution problem as purely technical to be solved by its engineering branches. This fact is reflected in the proposed solutions to noise pollution control which are described in Yorino (1977b). For existing lines measures consist mainly of building sound barriers and sound proofing at the track. If these steps are not sufficient, further soundproofing is done at the receiver, and ultimately houses are being relocated. For new and planned lines JNR has made several research efforts to improve rolling stock, track, and structures. These developments include noise reduction technologies such as vibration proof wheels, ballast mats, slab mats, bridge hooding, etc. (see Yorino, 1977b). There are some more fundamental means to reduce noise pollution which are not seriously considered by

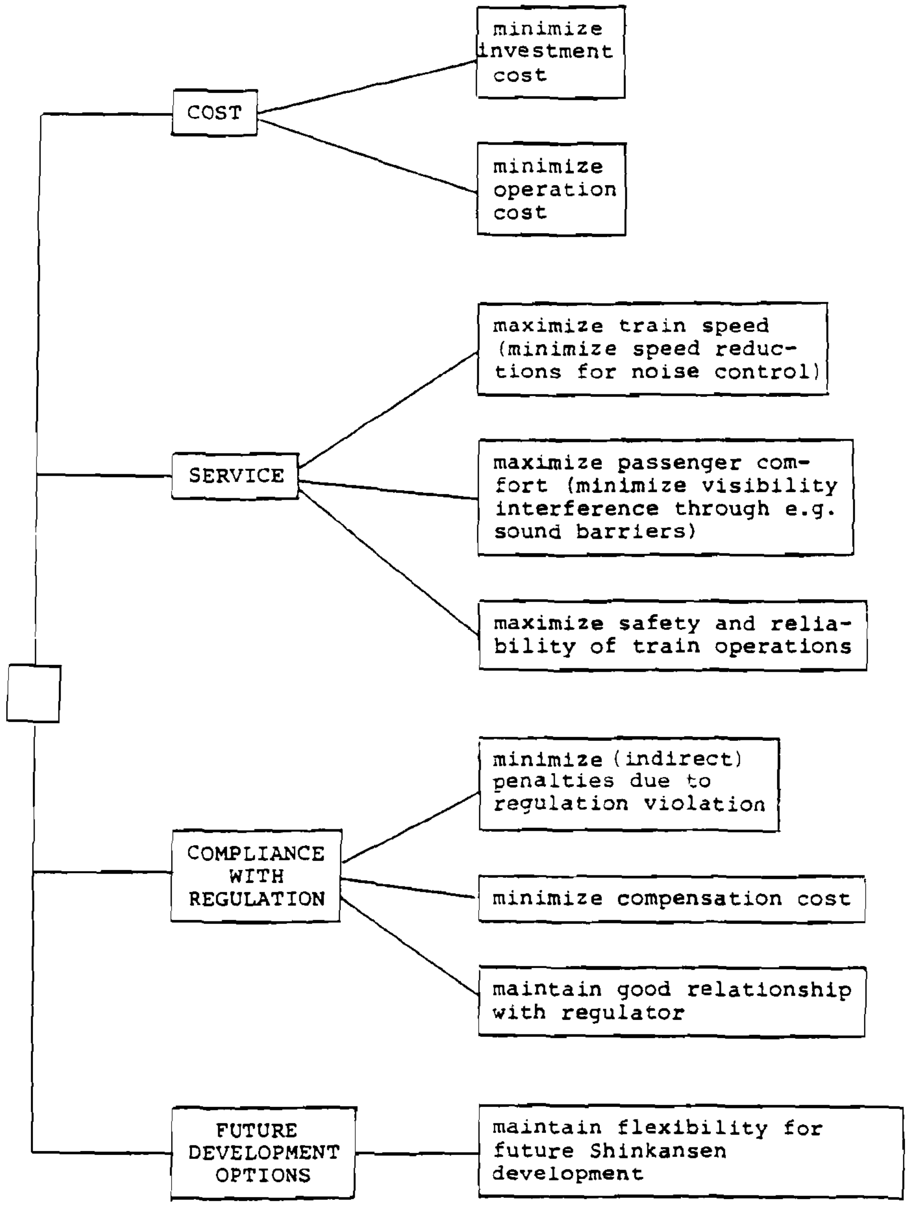


Figure 6.14 POTENTIAL OBJECTIVES OF JNR IN DECISION MAKING FOR NOISE POLLUTION CONTROL

JNR. Speed reduction in highly populated areas is considered to be the technically most simple way to reduce noise levels from the viewpoint of the environmental objectives of Figure 6.12. Routing is another important factor by which exposition of noise sensitive areas could be avoided. At present it appears that JNR has not made any decisions on speed reduction or routing on an environmental basis alone, particularly on operating lines. However, the long controversy and residents' opposition to the new line from Tokyo to Ohmiya (a part of Tohoku Shinkansen) seem to change JNR's attitude to the slowdown proposed.

Figure 6.15 puts together some logical alternatives for noise pollution control (and for meeting possible standards). Further details are given in Yorino (1977b) who also evaluates the effectiveness of the various measures.

6.6.3 Impactee Actors, Objectives, and Alternatives

Impactees are in the first place the residents along the lines of the Shinkansen who suffer from noise pollution. While these residents would benefit from noise regulation, the users of the Shinkansen and local businessmen and governments could possibly suffer from noise regulation. For example, if JNR should decide to slow down the train in highly populated areas, the increased travel time would reduce the benefit to the users. Also, noise abatement measures are costly and may eventually lead to higher fares. Finally, citizens' actions may prevent the building of new lines from which local governments and businesses could benefit. Thus the sufferers of noise pollution and the beneficiaries of Shinkansen operations should both be included in the analysis of the impactees of noise pollution and noise pollution control measures.

The present analysis will, however, concentrate on the residents, since users, local business men and governments will have interests which are highly related to those of JNR, and they act as supporting actors of JNR rather than independent actors with own objectives and alternatives. Although in some cases local governments have entered informal bargaining procedures with JNR (for example to get a Shinkansen terminal in return for an approval of JNR's development plans) there has

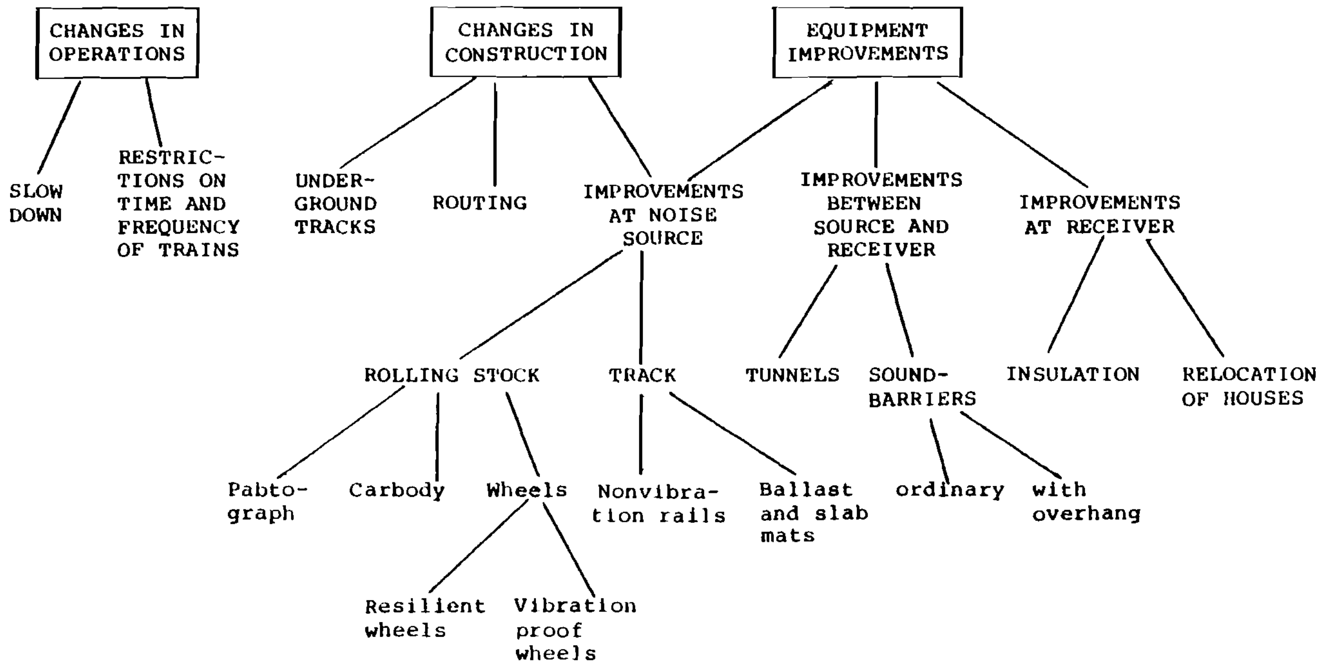


Figure 6.15 ALTERNATIVES FOR SHINKANSEN NOISE POLLUTION ABATEMENT

not been much active involvement of the users and local authorities in regulatory decision making on noise control.

Residents along the Shinkansen lines who may suffer from noise pollution can be identified in various ways:

- those who are exposed to certain noise levels
- those who feel annoyed by Shinkansen noise
- those who complain
- those who are organized in protest groups

Residents within distances of 100-200 meters from the track are probably exposed to disturbing noise levels above 70 dB. There are no precise estimates of the number of residents living within such a band along the presently existing lines, but some indications can be given. In Tokyo, for example, the Tokyo Metropolitan Environmental Institute estimates that 25,000 people in residential areas and 15,000 people in commercial areas live within a 200 meter band. The expert committee in the Central Council for Pollution Control estimated the total number of houses which may require some kind of noise protection measure to be in excess of 130,000. Table 6.12 shows the estimated number of houses along each of the Shinkansen lines which may be exposed to noise levels higher than the announced standard level (70-75 db(A)).

The complaint statistics cited before do, of course, not reflect such large numbers. A better way to identify impactees is therefore by looking at organized groups. The most prominent group is the Nagoya Association (the "Association against Nagoya Shinkansen Public Nuisance"). This association was set up following several individual complaints, petitions, and small organizations such as the "Citizens group against Shinkansen TV interference". The association now represents 2,000 households, settled along a 7 km stretch of the Shinkansen in Nagoya city.

The objectives of these residents are:

- reduce Shinkansen noise to a non-disturbing level,
- aid people with special diseases and illnesses,
- receive compensation for residents who have been exposed to Shinkansen noise.

Table 6.12 ESTIMATED NUMBER OF HOUSES ALONG SHINKANSEN LINE EXPOSED TO A NOISE LEVEL HIGHER THAN THE STANDARD LEVEL

Source: Expert Committee in Central Council for Control of Environmental Pollution.

LINE	OPERATION DISTANCE (km)	NUMBER OF HOUSES TO BE REMEDIED			TOTAL
		RESIDENTIAL AREA	COMMERCIAL AREA	MISCEL-LANEOUS AREA	
Tokyo-Osaka	515	44,000	19,000	14,000	77,000
Osaka-Okayama	161	13,000	5,000	3,000	21,000
Okayama-Hakata	393	22,000	6,000	6,000	34,000
TOTAL	1,069	79,000	30,000	23,000	132,000

While the first goal is another more general formulation of the environmental objective of the Environment Agency (see Figure 6.13) the last two objectives are special objectives representing the self interests of the residents.

The alternative actions by which residents can move against JNR in order to achieve these objectives can be characterized by a series of escalated steps of protest:

- complaints by individuals,
- petitions of groups to local governments, prefectures, the EA or JNR,
- organizations of various forms,
- legal litigation with alternative requirements for solving the noise problem,
- extra-legal protest actions.

6.7 The Decision Process of the Environment Agency to Set Noise Standard

While the previous sections described in a structured way the elements of the noise control problem for the Shinkansen trains (actors, objectives, alternatives), the following two sections will put these elements together in a discussion of the actual information processing, evaluation, and decision making at the hand of two main issues: the setting of noise standards by the Environment Agency, and the legal action by the Nagoya residents. Stress will be put in this analysis on the priorities among objectives selected, the limited view of alternatives, the information base to evaluate alternatives against objectives, as compared to the intentions of the decision making actors.

When the expert committee on special noise in the Council for the Control of Environmental Pollution began its investigation on Shinkansen noise its intention was to set environmental quality standards. In terms of the definition of environmental quality standards by the Environment Agency and the Basic Law on Control of Environmental Pollution this would imply that

- environmental objectives should be given priority to evaluate standards, rather than technical, economic, and political objectives;
- alternatives which characterize enforcement standards (strict time limits for fullfillment, area specifications, penalties, responsibilities of regulatory authorities and industry) should not be key issues in setting environmental quality standards.

It seems, however, that the decision process of the expert committee resulted in some enforcement type standards. This was partly due to the urgency of implementing a standard, and to the shortage of available information required to set an environmental quality standard.

As a first step the expert committee reviewed the present state of Shinkansen noise pollution. These results are documented and discussed, for example, in Environmental Agency (1973), Hashimoto (1975), and Yorino (1977a and b). The general outcome of these studies was that Shinkansen noise levels range between 75 dB(A) and 120 dB(A) at about 25 meters away from the source (see Table 6.13).

Next, the expert committee issued studies on the effects of noise. The primary intention of these studies was to establish the relationship between noise and complaints, not to identify the psychological and physiological effects of the Shinkansen noise. One could of course argue that complaints are an indicator of more indirect and less observable effects, and that the absence of complaints would indicate an absence of effects. Although a general survey of available information concerning physiological and psychological noise effects was conducted, no particular studies on those effects by Shinkansen noise were made by the decision makers involved in the process of standard setting. Rather the noise-complaint relationship was considered a main driving force itself for the standard setting decision.

6.7.1 Noise Evaluation Criteria Used in the Standard Setting Process

It is desirable to have standard and reasonable criteria which can relate the objective measure of noise (e.g. energy level) to a subjective reaction by individuals exposed to it.

Clearly the discomfort people may feel depends on the total noise exposure. But it also depends on their own behavior when exposed to noise, e.g., conversation, sleep, meditation, work, and their socio-psychological conditions.

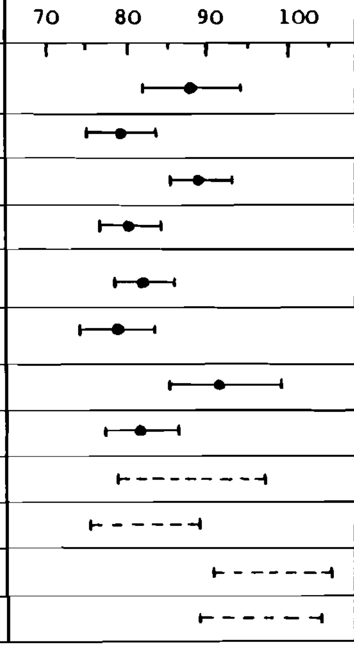
Figure 6.16 sketches the reaction mechanism of individuals when exposed to traffic noise (Jones, 1976).

Total noise exposure can be expressed in fairly exact terms as a function of decibels of the noise intensity and exposure time. The main problems are behavioral aspects of listener activity and socio-psychological factors which interact mutually and depend on their surroundings, but current research techniques ignore the latter factors. In the general case, people's reaction to noise is assumed to be constant from area to area. Other assumptions taken into account when considering noise evaluation criteria are:

Table 6.13 SHINKANSEN NOISE LEVELS

Source: Hashimoto, 1975

STRUCTURE	BALLAST	SIDE WALL	MEASUREMENT POINT	NOISE LEVEL dB(A)	RAILWAY
Banking	Crushed Stone Ballast	Not Installed	Measured Track		Tokaido Line
			Opposite Track		
Elevated Bridge	Crushed Stone Ballast	Not Installed	Measured Track		Tokaido Line
			Opposite Track		
Elevated Bridge	Crushed Stone Ballast	Side wall of 1.9 m high is installed	Measured Track		Sanyo Line
			Opposite Track		
PC Girder	Crushed Stone Ballast	Not Installed	Measured Track		Tokaido Line
			Opposite Track		
Iron Girder	Crushed Stone Ballast	Not Installed	Measured Track		Tokaido Line
			Opposite Track		
Iron Girder	No Ballast	Not Installed	Measured Track		Tokaido Line
			Opposite Track		



1. Measurement was made at a point apart from the center of the tracks by 25 meters and at a height of 1.2. meters from the ground level.
2. ⊢—⊣ and ⊢●⊣ indicate the 90% range of measurement values and the average value respectively. And ⊢- - -⊣ indicates the whole range of measurement values because the measurement points were so few.

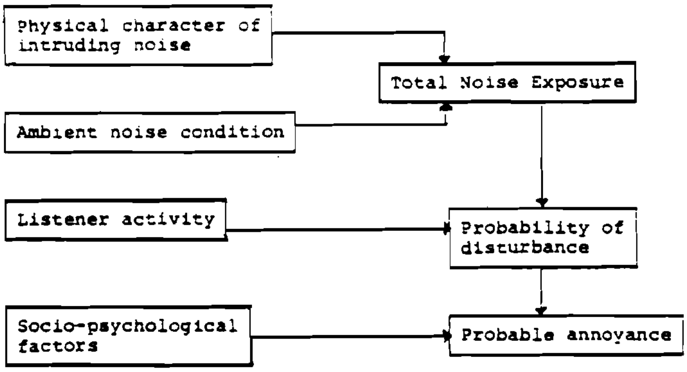


Figure 6.16 SCHEMATIC ILLUSTRATION OF REACTION MECHANISM TO TRAFFIC NOISE

- Noise nuisance can be expressed as a simple continuous proxy variable where response may be termed as reaction.
- Physical characteristics of noise can be represented by noise levels.
- Individual reaction at any given noise level is normally distributed.
- Average reaction is a linear function of noise level.
- Variance of reaction is independent of noise level.

The committee of experts, set up in 1972, mainly concentrated its efforts on the analysis of the specific physical character of Shinkansen noise and its evaluation measures concerning the total noise exposure (as shown in Figure 6.16) in order to be consistent with other types of noise evaluation measures such as road, traffic or airplane noise. No study of the physiological effects of Shinkansen noise has been initiated, because it was the expert committee's perception that physiological effects on human health appears only in higher noise levels than those creating psychological reactions. Thus they relied on the residents' reaction survey data on the noise-complaint relationship instead of initiating basic research on the noise effect to the human being. However, there still exists uncertainty about the long term physiological effects occurring in sleep and mental activities in terms of the change of brain waves when exposed to even lower noise levels than 60 dB(A) of the Shinkansen type noise (Osada, 1976).

Figure 6.17 illustrates the evaluation factors associated with sound characteristics on the Shinkansen noise which the committee of experts considered in their analysis. The sound

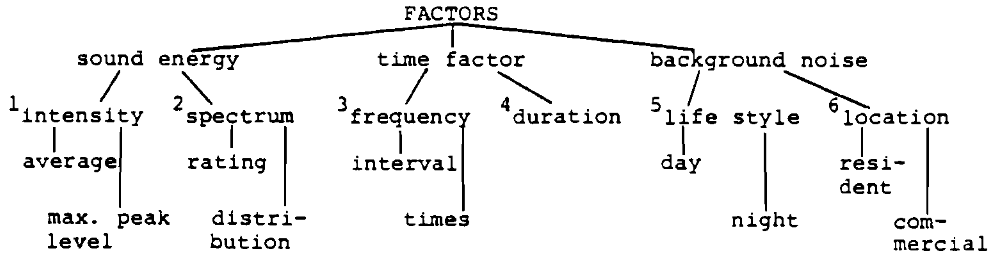


Figure 6.17 EVALUATION FACTORS ON SOUND CHARACTERISTICS USED IN SETTING SHINKANSEN NOISE STANDARDS

characteristics include:

1) Sound intensity: varies a great deal depending on train speed, railway structure, places, etc., as shown in Table 6.13. A typical example is illustrated in Figure 6.18 and, as is easily seen from this figure, a clear peak level is generated.

2) Spectrum characteristics: there is no special component such as specific modal components of low frequency noise, etc.

3) Frequency: in March 1975 the Shinkansen trains operated in the following intervals and times:

LINE	TIMES/DAY	AVERAGE INTERVAL
Tokaido (Tokyo-Osaka)	230	5 minutes
Sanyo (Osaka-Okayama)	100	11 minutes
Sanyo (Okayama-Hakata)	70	15 minutes

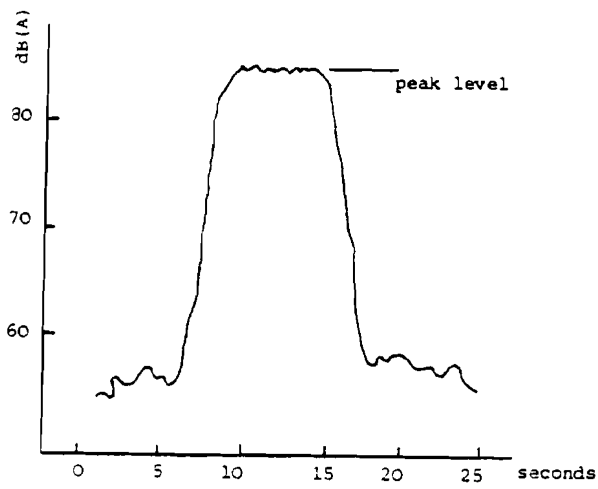


Figure 6.18 TYPICAL PATTERN OF SHINKANSEN NOISE (AT 25 m FROM THE RAILWAY WITH 200 km/h AND NO SOUND BARRIERS)

4) Duration time of noise:

TRAIN SPEED	DURATION TIME OF PEAK LEVEL
200 km/h	7.2 seconds
100 km/h	14.4 seconds

5) Life style: the Shinkansen trains are planned to run from 6.00 a.m. to 11.55 p.m. so that any consideration as to the noise level compensation for midnight operation is not included for setting standards.

6) Location: the land use pattern along the Shinkansen is not necessarily clear enough to allow a definite classification because of intricate land use in Japan.

The prevailing current method of evaluating residents' reaction to the noise is the social survey which consists of asking people who may be affected how far they are disturbed by the particular noise. If a threshold could be found, above which all people found the noise unacceptable, it would define an ideal noise standard (θ) as shown in Figure 6.19. Obviously

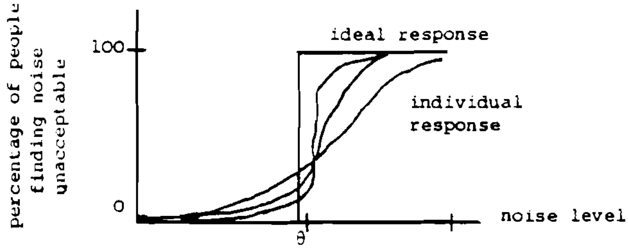


Figure 6.19 AN IDEAL NOISE RATING CRITERIA

one cannot determine this ideal threshold noise level because of the distribution of individual response and uncertainty of threshold θ due to some other factors involved.

The survey of the residents' reaction which the committee of experts relied upon was conducted by the EA and Tohoku University groups. Other surveys such as the one conducted by the Nagoya medical group were not taken into account in their work.

Among the various questionnaire items five major elements were selected as a judgment measure: interference of conversation, interference of telephone conversation, disturbances when falling asleep and during sleep, and sudden startling disturbances. Some of the results are shown in Figure 6.20. The EA determined the general disturbance curve (average value of five major elements) as is displayed in Figure 6.21, although the committee did not discuss the issues based on this general disturbance curve in their report. In these figures, "complaint" is defined as one of the following responses: "occasionally", "rather frequently", and "frequently" experienced disturbances. As is clearly seen from Figure 6.20 and Table 6.14 (which gives the comparison with other reaction data for road traffic and aeroplane noise) a considerable degree of variability in their data exists. It appears that it is quite difficult to determine an absolute threshold of noise level.

Therefore, if one wanted to set standards on the basis of such noise-complaint relationships, one would attempt to either set the standard such that no complaints occur, or such that complaints are relatively stable below that standard, arguing for

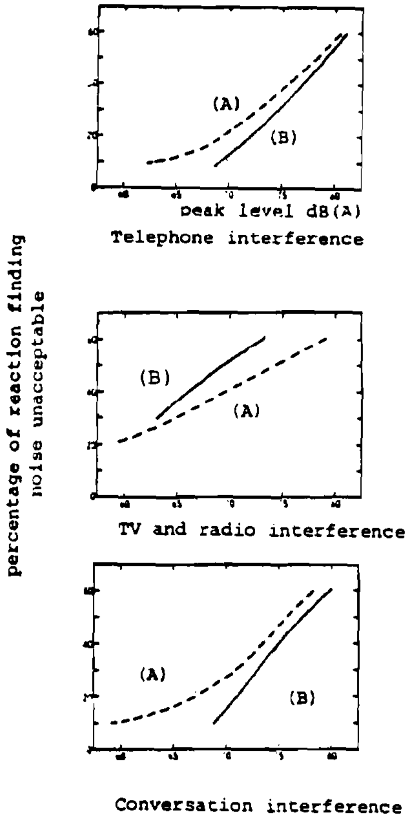


Figure 6.20 THE PERCENTAGE OF RESIDENT REACTIONS EXPRESSED NOISE TO BE UNACCEPTABLE.

(A) Environment Agency (B) Tohoku University

Source: T. Sone et al, 1976.

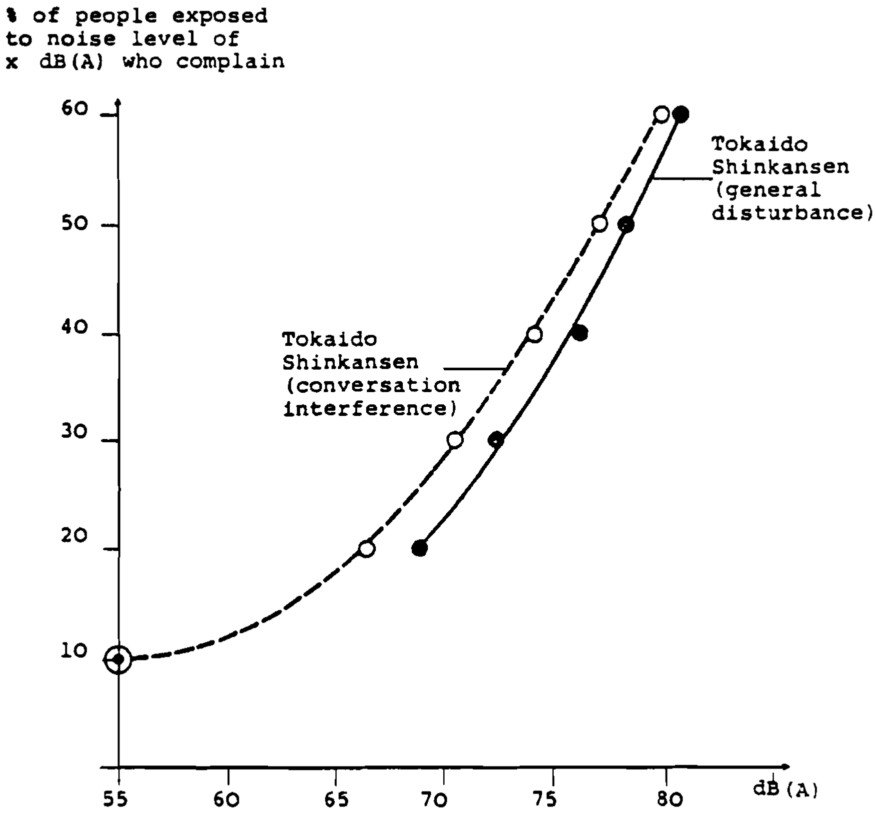


Figure 6.21 COMPLAINTS VERSUS NOISE LEVEL

Source: Environment Agency (1975)

some sort of a threshold effect. This threshold idea was apparently assumed by most of the experts involved in the standard setting, in the sense that they believed that there is a "normal" background level of complaints which has little to do with actual disturbances. With such a position the problem naturally shifts from identifying a noise level with zero complaints to identifying a noise level at which complaints just reach "background"

Table 6.14 RESIDENT REACTION TO THE TYPE OF NOISE AND LEVEL

	Area	Elements Complained	Ratio of positive reaction					Unit
			10	30	50	70	90	
Road Traffic	Tokyo (Downtown)	Telephone	50	60	70	80	-	dB(A) (medium value)
		Conversation	50	65	75	-	-	
		Annoyance	-	47	56	63	73	
Airplane Noise	Osaka International Airport	Conversation	70	77	83	87	90	WECPNL
	Tokyo International Airport (Haneka)	Telephone	74	77.5	79.5	81.0	83.0	WECPNL
		Conversation	74	78.0	80.0	81.5	83.5	
Shinkansen Noise	Tokaido (Tohoku Univ.)	Telephone	69	74	79	84	89	dB(A) (peak value)
		Conversation	69	73	77	81	85	
		Annoyance	60	67	74	80	87	
	Tokaido (EA)	Telephone	61	72	79	84	99	dB(A) (peak value)
		Conversation	60	71	75	81	87	
		Annoyance	55	74	78	82	86	

Source: The expert committee report on "Shinkansen Noise Standards" 1975 rates. Thus, the process of setting standards could be summarized as illustrated in Figure 6.22.

In 1975 the expert committee recommended (and the Council accepted) setting a standard of 70 dB for the mainly residential areas, and of 75 dB for mixed residential and commercial areas. The rationale behind this recommendation was that at a noise level between 70 and 75 dB approximately 30% of the complaints were made. The study group maintained that only substantial reductions of the noise level would lead to any further reductions of complaints. The argument was made that:

i) foreign noise surveys indicate that 5-10% of the people will always complain even in quiet surroundings;

ii) at reaction levels of 20%, there still remain factors other than those stemming from Shinkansen which influence noise complaints.

However when looking at Figures 6.20 and 6.21 one still has to ask whether further reductions of complaints could be achieved with tighter standards. In addition, the question remains whether noise levels leading to the 30% complaint level are actually acceptable from an environmental quality standards point of view.

Another important issue in setting standards was the consistency with other noise standards on road traffic and aircraft noise. The report concluded that a peak level of 75 dB(A) with 230 daily intervals corresponds to the 50-55 dB(A) (medium value) in terms of road traffic noise and 67-72 WECPNL in terms of aircraft noise. It seems that the 30% complaint level was encouraged by this consistency check as shown in Figure 6.23 where L_{eq} denotes the level equivalent to the energy mean of a fluctuating sound.

While these considerations are in line with environmental quality standards, specified target fullfillment periods and area specifications (see lower part of Table 6.15) turned the standards into enforcement-type standards. The Environment Agency accepted the recommendations by its council and the standards went into effect in July 1975.

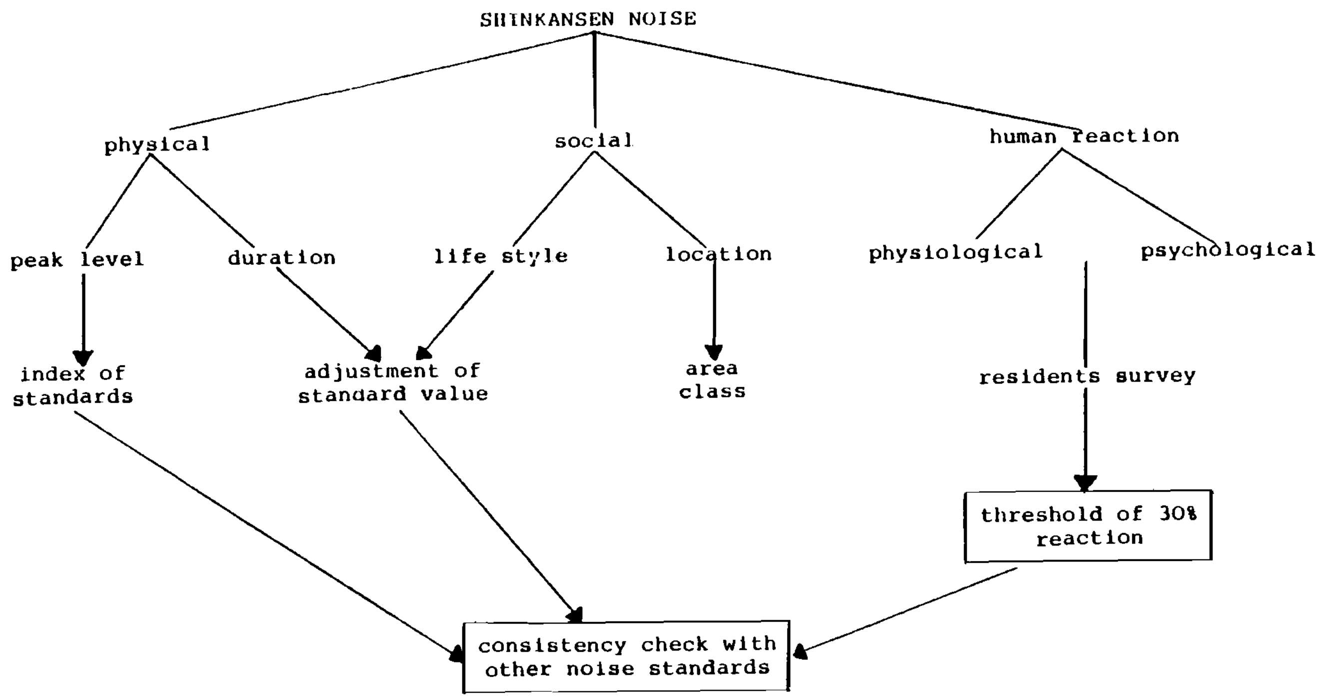


Figure 6.22 SETTING STANDARD PROCESS FOR SHINKANSEN NOISE

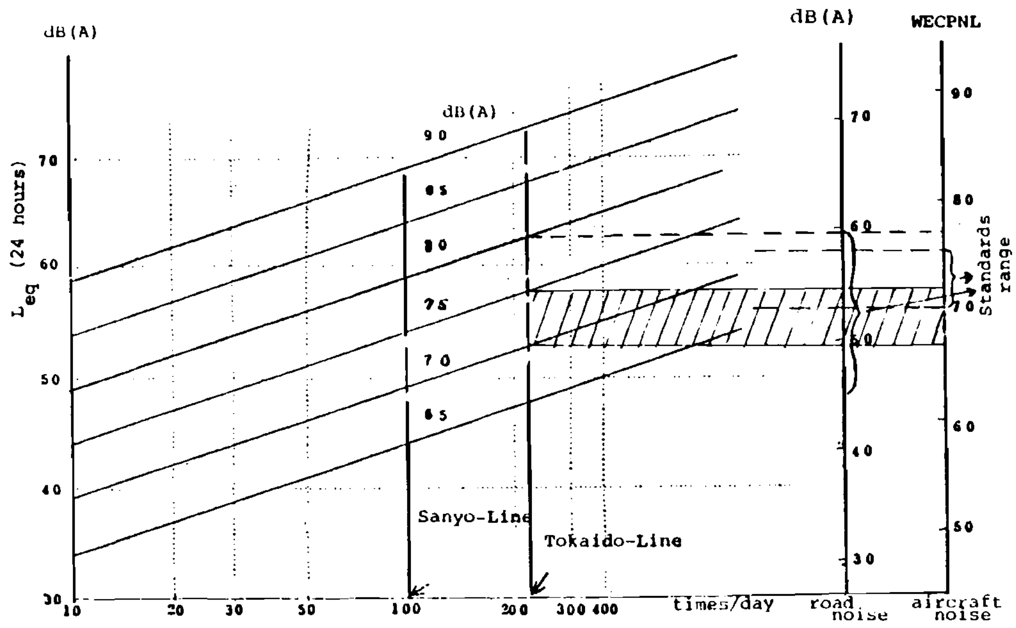


Figure 6.23 THE RELATIONSHIP AMONG THE PEAK LEVEL L_{eq} AND OTHER NOISE STANDARDS

Table 6.15

ENVIRONMENTAL QUALITY STANDARDS FOR SHINKANSEN (BULLET TRAIN) NOISE

Ministerial Order issued by Environment Agency on 29 July 1975, based on Article 9, Basic Law for Environmental Pollution Control Measures

Category of Area	Regulation Level
Class I	70 dB(A) or less
Class II	75 dB(A) or less

Zonal Category	Target Fulfillment Period		
	Areas along existing Shinkansen lines	Areas along lines under construction	Areas along newly built lines
A Areas with 80 dB(A) or over	in 3 years	on start of service	on start of service
B Areas with 75-79 dB(A)	(a) in 7 years (b) in 10 years	in 3 years after start of service	on start of service
C Areas with 70-74 dB(A)	in 10 years	in 5 years after start of service	on start of service

Note: In any area, where it is failed to achieve the standards within above specified periods, in spite of best effort, performance should be completed as early as possible.

The JNR member of the expert committee and the subcommittee had suggested 80 dB(A) as an alternative to the standards which were finally accepted in terms of the "target fullfillment period" and "Note" was attached in the standards. These suggestions were based partly on economic considerations, partly on an evaluation of recent technical studies. JNR especially doubted (and still doubts) that 70-75 dB(A) can be achieved with present technology on "noisy" structures such as steel girder bridges. JNR had, as indicated before, taken a firm stand on not slowing down as a means of reducing noise and apparently such a measure was never a serious issue in the expert committee.

No specific studies on economic, technical, or other questions were issued by the expert committee, which took a rather optimistic perspective of technical innovation. JNR had done some such studies (see Yorino 1977a and b), particularly on the technical feasibility and effectiveness of noise pollution abatement, but JNR's pessimistic attitude towards noise proof technology in ranges below 80 dB(A) did not change the expert committee's opinion. This is, of course, in line with the intention of environmental quality standards, although such studies would have been necessary to evaluate enforcement standards. Cost estimates were made by JNR, although they have not been made public. In individual discussions JNR experts estimated that a reduction of the noise level down to 80 dB(A) would increase investment cost by 9% and a further reduction to 70 dB(A) would increase investment cost by 13-14% (see Figure 6.24).

Studies on the effect of train speed on noise levels existed but were not explicitly considered by the expert committee. Figure 6.25 exemplifies the basic result of such studies: There is an almost linear drop in noise between 200 and 100 km/h and a small rise at levels between 50-60 km/h. At least this is the intuitive impression from looking at the data. The interpretation by JNR and other experts of this data is different: on the basis of a priori considerations about the relationship between speed and noise, these experts hypothesized that the relationship between noise and speed must be logarithmic. A least-squares fit would then lead to the curves shown in Figure 6.25. Such a logarithmic relationship was also a main argument for JNR to refuse slowing down as a tool for reducing noise: JNR claims that the noise reduction would be only slight between 200 and 100 km. If one looks at the fitted curve, this is true. If one looks at the data points above 100 km/h (the speeds at which the Shinkansen operates) it is not. By performing a visual regression as indicated by the dotted lines in Figure 6.25 one can see that about 10 dB(A) are gained from slowing down from 200 km/h to 150 km/h.

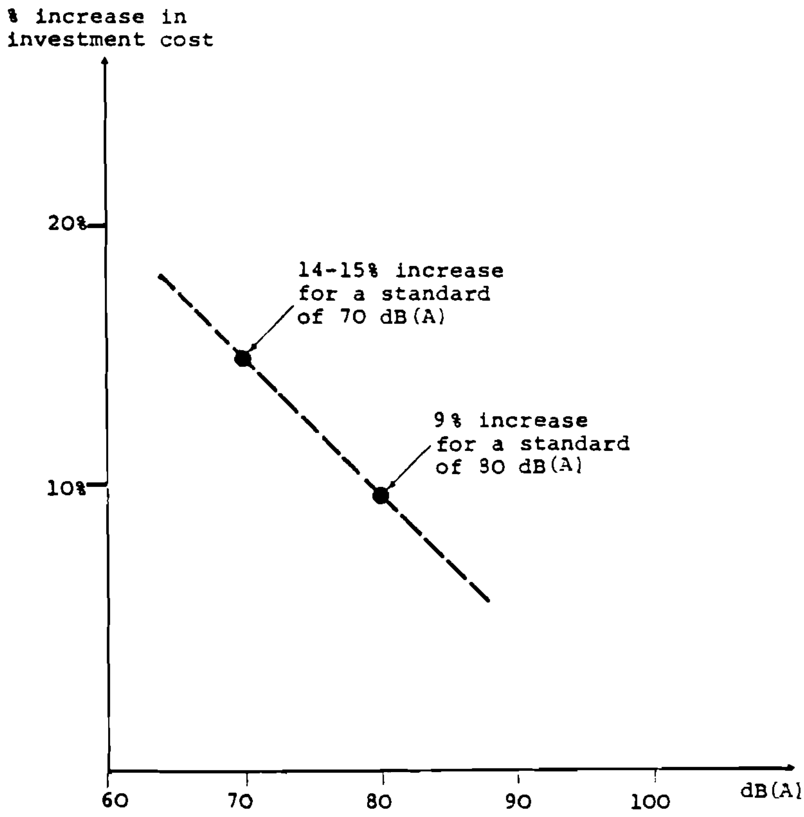


Figure 6.24 INCREASE IN INVESTMENT COST VERSUS NOISE LEVEL (SANYO LINE)

Source: YORINO, Private communication

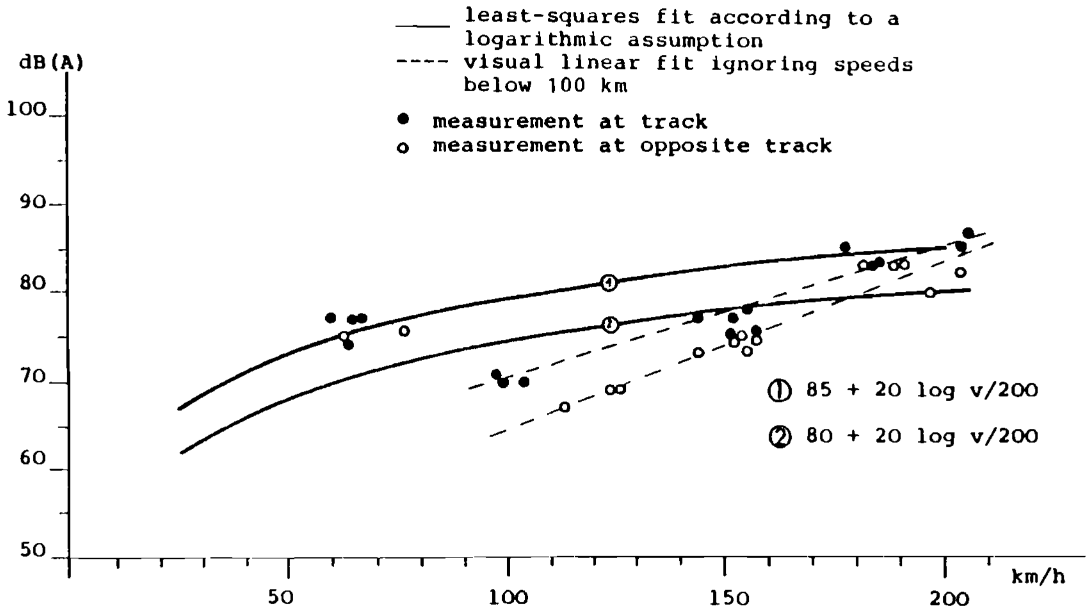


Figure 6.25 TRAIN SPEED VERSUS NOISE

Source: Environment Agency, 1977.

Since the setting of the standards JNR has made major efforts to meet the time limits for the standards in areas with noise levels higher than 80 dB(A). As a first step a string of sound barrier walls were built. In 1974 these efforts cost JNR, for example, 15.1 billion Yen. They reduced the noise level by about 5 dB(A) and JNR estimates that all existing lines now meet a level of 80 dB(A) or less except for some steel girder bridges. As to the future JNR is uncertain whether it will be able to meet the standards in the prescribed period of time.

As is readily discernible there were no direct inputs or any participation by the impacted residents along the Shinkansen lines during this whole process of standard setting. Residents have in the meantime fought a quite different battle of protest and lawsuits. This process will be discussed next.

6.8 The Decision Process of the Nagoya Association to Combat Shinkansen Noise

This section is largely based on a discussion with two lawyers representing the Nagoya Association against Shinkansen Public Nuisance (Yamamoto, 1977). It is a descriptive account of the main steps in the battle between the Association and JNR in which the residents tried to achieve their objectives described in Figure 6.15.

The first complaints by Nagoya citizens reached the Nagoya city council in 1964 shortly after the beginning of operations of the Tokaido line. At issue was a 7 km stretch which is elevated and runs partly over steel girder bridges. In a first significant move, 110 Nagoya residents jointly delivered a complaint and a petition for support to the Nagoya City Council. In 1967 the Nagoya Council, after performing its own noise measurement and confirming high noise levels, asked JNR to take measures on noise pollution abatement. JNR responded in March 1970 by announcing that sound barrier walls would be installed at three points along the controversial 7 km stretch. Meanwhile several small residents' groups organized into associations to fight Shinkansen noise.

In 1971 these organizations united as the "Association against Nagoya Shinkansen Public Nuisance" which comprised about 2,000 households, and is subdivided into seven neighbourhood associations. At the same time JNR began installing sound barrier walls at several points, mainly in hospitals and school areas.

Between 1972 and 1874 several meetings between the Association, JNR, the Mayor of Nagoya, and prefectural officers as well as the Environment Agency took place. The initial request of the citizens was that JNR should increase sound barriers over the whole 7 km length. Later the Association began to take a firmer stand:

- the Shinkansen should be slowed down in order to bring noise and vibration down to non-disturbing levels;
- special measures should be taken by JNR to aid ill and old people.

JNR's offer in turn was to take steps to reduce the noise down to 80 dB(A), but flatly refused to slow down; 80 dB(A) was not considered acceptable by the residents. JNR agreed to examine the special cases of sick and old people, but up to 1977 no such case was resolved.

The local city and prefectural governments took action at the end of 1972 by formally supporting the Association and requesting JNR to slow down in the 7 km stretch. In August 1973, finally, a group of 20 lawyers was set up by the Association to begin legal action against JNR on behalf of 570 residents. The case requested specific measures to be taken, once more raising the stakes in the fight between JNR and the residents:

- noise levels should not exceed 65 dB(A) between 7 a.m. and 9 p.m.;
- noise levels should not exceed 55 dB(A) at other operating times;
- the area to be considered was 100 m of both sides of the track along the 7 km stretch;

- for each plaintiff JNR should pay 1 Million Yen compensation;
- JNR was to carry the cost of the court case.

New residents could join the case provided they lived within 100 m of the track and joined within 3 years after the case was opened. Since the lawyers worked on a no-fee basis costs of joining were small, but there was no dramatic increase in the number of plaintiffs in recent years.

The standards that the Association requested were based on material similar to what the Environment Agency used for their standard setting. No substantial independent research effort was made to substantiate the claim of the residents that levels above 55 dB(A) (or 65 dB(A) during the day) were disturbing. The setting of noise standards in 1975 therefore was a major event in the court case. The Association did not believe that 70-75 dB(A) would stop the disturbance and pursued the case after standards were set. However, there is now some pessimism with respect to the outcome of the case since the lawyers believe that the judge will orient himself towards the EA material on quality standards.

JNR's response to the case in its first court session in 1974 was to deny the request on the ground that they were "totally unreasonable". This tough stand was somewhat toned down in the following months. JNR argued that 65 dB(A) could not be achieved with presently available technology without a slow down and thus a substantial delay of trains (in fact, the delay at the 7 km stretch from slowing down from 200 to 100 km/h would be less that 5 minutes. However, by slowing down an important precedent would be set which is in conflict with JNR's objectives). JNR proposed to remove and relocate all houses within 20 m of the line. After the standards were set, JNR proposed (as the standards require) to implement 80 dB(A) standards within three years.

The case now is still pending. A judgment is not expected before the summer of 1978. But the movement of residents, and local governments has already shown some effects which were not expected. Two of the three labour unions of JNR expressed their support for the Association and asked train operators who are members of the unions to slow down their trains to 100 km/h on the controversial stretch. The result was that 50% of the trains drove at a much slower speed and reduced the noise level in spite of JNR's tactics.

The decision process shows that the residents had quite different objectives and action alternatives in mind than the EA and that they went head on against JNR after initial requests failed to produce any results. It also demonstrates the gradual escalation of both objectives (from sound barrier improvements to standards and compensation) and of tools (from complaints to legal litigation). JNR's role was as reactive in this process as it was in the process of standards setting. It appears that this strategy was successful in saving time, but it clearly raised the stakes.

6.9 Discussion and Evaluation: Toward Modeling Standard-Setting Decisions

The analysis of actors, objectives, and alternatives in noise pollution control was meant to demonstrate the wide span of elements which could or should have entered into the decision processes. Looking at actual information collection evaluation, and decision making of the Environmental Agency, the Japanese National Railway Corporation, and the Nagoya Association it becomes obvious that not all these elements were considered, that information was neglected, that evaluations were partially biased, and that the interactions between the three decision making groups were limited.

In this discussion the decision processes of the three groups will first be analyzed and evaluated in terms of their own intentions entering into the decision making. The discussion will conclude with some suggestions on how decision and game theoretic models may aid regulators and other decision makers in pollution control decision problems.

The organizational setup for standard-setting decisions in the Japanese Environment Agency has some unique features which reflect the original intention of the EA to set Environmental quality standards rather than enforcement standards:

- clear separation in the organizational and institutional sense of expert analysis and expert judgment for questions of health and living environment on the one hand, and the political decision process on the other;
- main location of the decision making in the expert bodies of the Council (noise and vibration committee and attached subcommittee) with consensus forming and checking functions located at higher levels (EA, Cabinet);
- participation of many experts from research institution from universities, government and industry, but exclusion of impactees.

For environmental quality standards this organizational setup seems to work rather well: the main task is for experts to identify risks and hazards, and to recommend acceptable pollution levels mainly from a health and living environment point of view. All other decision layers would then judge the expert recommendation mainly on the basis of political feasibility, and to some extent put emphasis on economic and technical considerations. For enforcement standard setting this process could also work well, if the expert committee would consider all scientific aspects of the standard setting problem including economic and technical aspects. Given this information on environment, health, economic, and technical issues the higher decision making layers could then make trade-offs and political judgments, and make final decisions.

Looking at the information base to evaluate environmental noise quality standards, two main observations can be made

- health effects under long term exposure and detailed psychological effects were not explicitly considered in the decision making of the EA;

- standards were evaluated on the basis of noise-complaint relationships and a relatively arbitrary threshold of complaint percentages was used to set standards.

Looking at the information used to arrive at target fulfillment periods and area specifications by noise levels (lower part of Table 6.15), we can observe further limitation:

- only limited alternatives were considered as regulation means (no explicit consideration of the effects of slowing down, zoning, house removal);
- broader environmental and economic cost and technical feasibility aspects were not considered explicitly.

These shortcomings are to some degree recognized by the decision makers in the EA and JNR. Yorino, for example, states that "this ambiguity [about standards as a target or a tool]* seems to have been not properly cleared at the discussion of environmental quality standards for the Shinkansen noise. It also seems that ... [questions of] ..., the impacts of the national economy in the light of the prevailing economic situation, how far other kinds of noise are controlled, how about the living standard of the nation, etc., have all not been properly studied." (1977b, 18).

In the standard setting process and in its negotiations with the Nagoya Association JNR rarely initiated its own proposals. This does quite well reflect JNR's desire to maintain the status quo and not to foreclose any future development options. JNR's decision making was characterized by the following features:

- the noise pollution control problem was seen as a problem of inventing technical solutions to respond to regulations, rather than as a problem of developing plans and procedures for abating noise pollution;
- routing and slowing down were not considered as noise control measures;

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*Insertion by the author.

- slowdown effects on noise reduction were played down;
- comfort, speed, reliability, and national economic importance of Shinkansen were stressed;
- JNR's alternative suggestions for standards and noise abatement were often made to gain more time.

Once standards were set in 1975, however, JNR acted quickly to implement the measures necessary to comply and to develop research and technical skills to meet the future requirements. Yet this response is still purely technical and no attempts have been made to develop a comprehensive environmental management program for the Shinkansen.

The Nagoya Association probably had the most difficult role in the decision process on Shinkansen noise pollution control. The main obstacle for the Association was the lack of a direct input into governmental decision making on noise standards. It therefore had to fight an independent battle and it is still highly uncertain whether it will meet its objectives. The Association did manage to enlist support from local and prefectural governments and labour unions. It did attempt to interact with a broad array of actors, but it apparently was not very effective in its individual bargaining with the EA and JNR. Perhaps the Association could have obtained some improvements early in the 1970s (suggested by JNR were sound barriers on the whole stretch) but the residents chose to escalate and raise the stakes. The most problematic point in the Association's decision making is the request for fixed standards in the law suit. Since the Association does not have its own research material to back these standards, the judge may well follow the EA arguments and make the official standards a basis for the case. In retrospect it would have been wiser to leave the burden of proof to JNR that the Shinkansen does not disturb at 70-75 dB(A) rather than offering an opportunity for being challenged to prove that 65 or 55 dB(A) are non-disturbing levels.

While each actor group had its own decision making difficulties and shortcomings, the major problem with the decision making on the Shinkansen noise appears to be the lack of comprehensiveness in the consideration of objectives and alternatives, and the lack of interaction between the decision makers involved. Both shortcomings are clearly demonstrated in the difference between what could have entered the decision making (alternatives, objectives, informaiton) and what actually did enter it. One may conceive of various ways to improve the decision making for future standard setting cases, including institutional, procedural, and methodological innovation. Public participation, science courts, decision and game theoretic methodologies could be considered. Possibilities of improving the institutional aspects of standard setting and regulation are, for example, discussed in reports by the Academy of Sciences of the US (1975) to the National Research Council (1977). Formal approaches to improve standard setting decisions are presented for example for the case of water pollution in Dorfman and Jacoby (1970), for noise in Loucks (1977). A decision theoretic model to improve standard setting and pollution control decisions has been developed and applied to chronic oil discharge standards (v. Winterfeldt, 1978a and b). It begins where this paper leaves off: by hierarchical structuring of objectives and alternatives for the three generic decision making groups, the regulator, the developer, and the impactee group. Stress is put in this structuring on breadth and comprehensiveness of objectives and alternatives.

In the quantification part the uncertainties and values of the three decision making groups are then quantified by judgmental probability distributions and utility functions. The main outputs of the model are the optimal (in the decision model sense) responses of the developer and the impactee to a given regulation, the developer's response, and the impactees' response in terms of their own objectives.

The application of this model to chronic oil discharge standard setting showed that there can be some benefit from structuring the problem rigorously: new alternatives are discovered, alternatives included for reference provide interesting cornerstones, attempts to operationalize objectives provide new ideas on the structure of goals. Also, several insights can be gained from quantification and model run: sensitive decision points can be identified, dominated strategies can be uncovered.

But perhaps the most useful application of decision theoretic models and ideas is their use as tools for creating a more rational dialogue between different decision making units. A decision model can aid regulators, developers and impactees to communicate their values and uncertainties in a more precise way, to identify where the sources of conflict are, and to assess the consequences of changing model parameters according to the specifications of the actors involved.

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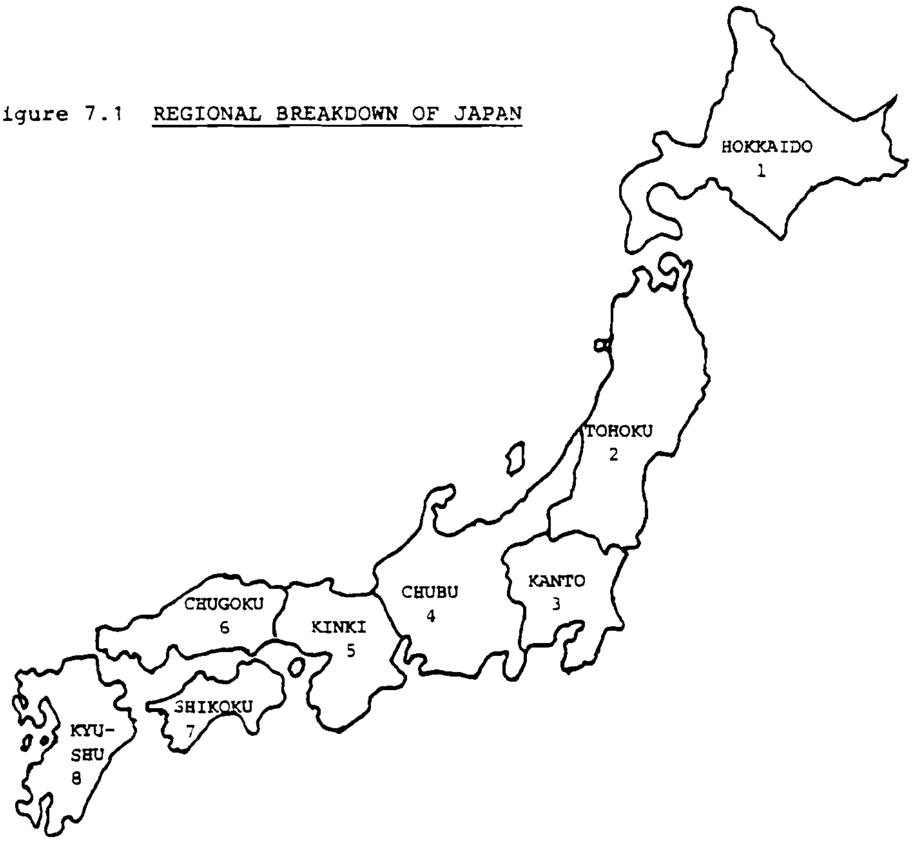
7. THE SHINKANSEN AND REGIONAL ISSUES

This chapter is intended to highlight the problems which arose within the regional subsystem around Shinkansen's construction and operation; how various participants of the societal decision process reacted and tried to shape the decisions pertaining to these problems and the effectiveness and efficiency of the decision finally taken. The effectiveness and efficiency of Shinkansen's contribution to the solution of regional subsystems' problems will be looked at through actual changes in regional economic and social situations. Thus, the analysis borders upon various types of economic and sociological assessments. Besides the assessment of past developments there will be some considerations regarding potential future subsystem changes and options with respect to them.

Regions are understood here as supra-prefectural units according to any of the classifications shown in Figure 7.1. The regional subsystem defined for them comprises all the economic, social and political entities whose characteristics and activities define directly the state of regional economies, and social and political conditions. This subsystem then also contains interactions of these entities, including economic and demographical processes and the societal processes which shape them. (Thus, changes in economic interrelations among regions and interregional migrations belong here, as well as changes in policies regarding regional development and the way they are formulated.)

According to the framework presented in the introductory part of this report it will be assumed that the <u>socio-economic system</u> is shaped by <u>actors</u> (institutions, groups or individuals) through their interaction within the <u>societal decision-making system</u>. Actors are characterized by their <u>values</u> and the <u>instruments</u> they can operate. The scope of problems that actors can consider and the classes of their values and instruments introduce the breakdown of the overall socio-economic-technical system into appropriate <u>subsystems</u>. For each subsystem the values of each actor can be expressed more concretely as his <u>goals</u>, and also their instruments are operationalized into <u>controls</u>. All

Figure 7.1 REGIONAL BREAKDOWN OF JAPAN



8 basic regions† :	Subdivisions:	Alternative or further:
1. Hokkaido		
2. Tohoku	2.1 Kita-Tohoku 2.2 Minami-Tohoku	
3. Kanto	3.1 Kita-Kanto 3.2 Minami-Kanto	
4. Chubu	4.1 Hokuriku 4.2 Tokai	4.1* Hokuriku 4.2* Tosan 4.3* or 5.1* Chukyo
5. Kinki	5.1 Kinki Inland 5.2 Kinki Coastal	5.2* Keihanshin ken 5.3 Keihanshin
6. Chugoku	6.1 San-in 6.2 San-yo	
7. Shikoku		
8. Kyushu	8.1 Northern Kyushu 8.2 Southern Kyushu	
Sources e.g. [8], [9] (non specified in prefectures), [10]	Sources: [11],[12]	Source: [14]

N.B. for sources of "subdivisions" and "alternative divisions" important differences of boundaries, also for higher level division ("basic regions").

† + Okinawa

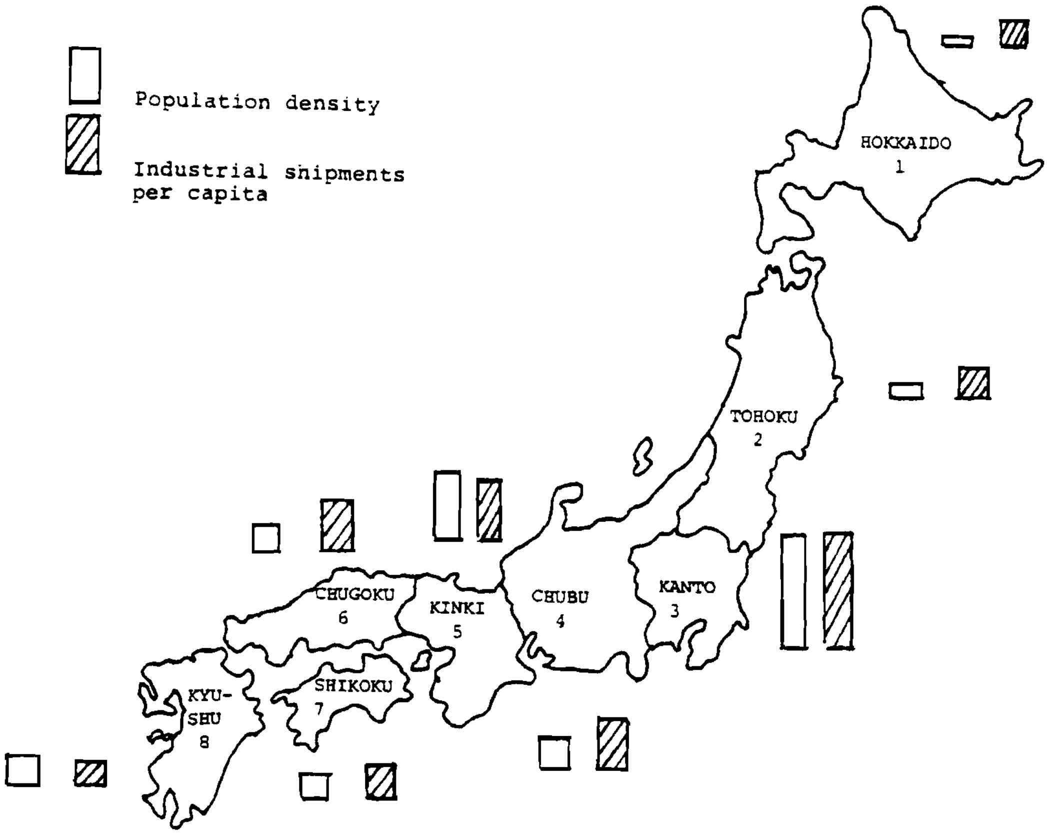


Figure 7.2 DIFFERENCES AMONG REGIONS

Table 7.1 Administrative units in Japan

Prefectures 43	To - Tokyo-to	
	Do - Hokkaido	
	Fu - Osaka-fu, Kyoto-fu	
	Ken - 43	
Municipalities 3,256	Shi (Designated city)	9
	Shi (city)	634
	Cho (town)	1978
	Son (village)	635

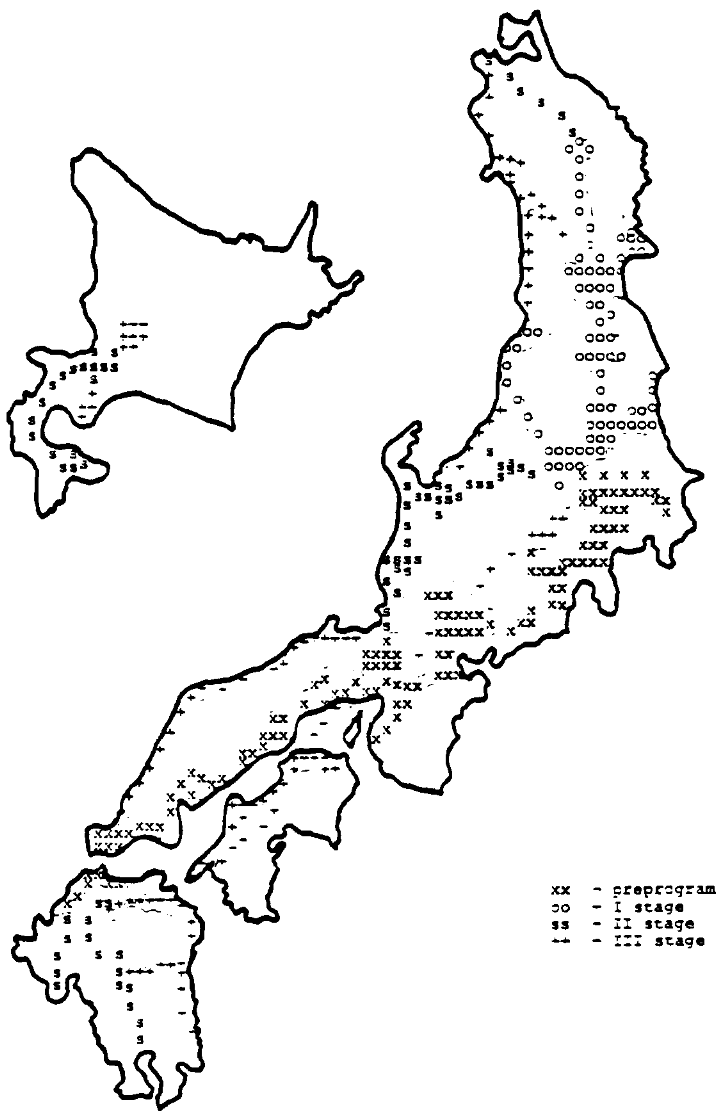


Figure 7.3 THE SHINKANSEN PROGRAM BY STAGES--
ITS SPATIAL REACH

the actors through their interaction define the program under consideration. Issues are projections of the program (e.g., Shinkansen) into the subsystem (e.g., regional). They are those elements of actual or potential subsystem development whose state determines actors' attitude with regard to this development and are therefore the objects of debate, policy formation and decisions. Confronted with issues, actors express their particular interests and eventually undertake an action in the domain of their controls.

In assessing the adequacy of the societal process referred to above and thus also of the resulting program with its economic and social consequences, the effectiveness and efficiency with regard to stated overall societal goals, or objectives, and with regard to performance measures, respectively, will be looked at. To insure that in the assessment an unnecessarily restrained external viewpoint will not be taken, and that effectiveness and efficiency be measured against the whole spectrum of socially relevant values, it will further be assumed that these measures and hence the whole of the decision-making system be comprehensive and integrative. Comprehensiveness is understood as including (both here, in the present, or in any other assessment, for policy analysis purposes and in the organization of the program in practice) all the subsystem's elements pertaining to the issues, especially of all actors and their values. Integration would then mean capacity for conjoint treatment of all elements included, so that they are not isolated or omitted or considered at too late a stage, thus requiring additional effort in going back over steps already taken.

As mentioned at the outset such a framework--also when applied to one regional subsystem--calls for a range of economic and sociological studies. These studies would refer to various issues, various values/goals/interests and eventually societal objectives, as well as various instruments. In particular, it is important to see how economic models and analyses differing by their output indices do correspond to different value measures. Such correspondence, when established, would point out the place of various economic models in societal costs-and-benefits structure and their mutual relations and potential connections. The analysis performed here has therefore two sides: when looking at the societal interactor process one cannot abstract from its actual economic and social consequences and vice versa.

It should be understood that no promise is being made here to provide an overall unitary appraisal for the whole of the societal system's organization and the whole of the program's performance. Rather an effort will be made to show various sides and aspects of the issues touched upon, so as to enable the estimation of adequacy of the whole from various points of view.

In what follows all of the above notions and assumptions will be clarified for the case of the regional subsystem and then used in descriptions and analyses.

7.1 The Main Features of Regional Development in Japan

As in all the other chapters of the report this section is devoted to a historical overview of changes within the subsystem considered. Evolution in the regional subsystem of Japan is presented insofar as the changes are related to the transportation system, and especially to high-speed inter-city passenger transportation. In the course of this presentation gradually all issues and actors will be introduced; they will be considered in more detail further on.

7.1.1 The Situation Prior to the Construction of the Tokaido Shinkansen

In the second half of the 19th century the Meiji Restoration pushed Japan towards the path of modern, accelerated growth. One of the main factors in this major change in Japanese history, besides the gradual opening of new technical, economic and ultimately social ideas which came with the exchange with other countries, was an important switch of focus from particular intraregional policies and economies to national ones. These changes were accompanied by corresponding shifts in values pursued by gradually broadening portions of the society. More and more emphasis was placed on growth, availability of goods--also in the sense of cultural and political changes, and finally on more consumption and mass-cultural import. Concentration was one of the means necessary for achievement of this aim. Concentration enabled reshaping of technical, economic and social structures and the furtherance of quicker, qualitatively different (industrial) growth. This, and the growth triggered, was inhibitive for the values of the previous period, preservation and balance, especially with regard to utilization of basic traditionally high valued resources such as land. Such an attitude has persisted, and has taken on a special importance after World War II, when it was imperative to reconstruct the economy, restore the self- and outside image and catch up (materially) with those who dictated economic terms in that part of the world. Such was the aim of the first economic plans: the Economic Rehabilitation Plan (1949-1953) and the Five-year Plan for Economic Self-Support (1956-1960). Surprisingly good (see Figure 7.4) results of these plans have set a basis for further growth. This situation, coupled with still existing favorable internal and external conditions facilitated attainment of extremely high growth rates during execution of the plans belonging to so-called "high economic growth period" (Figure 7.4, Table 7.2). These plans span the time from 1958 to 1970. It is just in the middle of this period that the Tokaido Shinkansen started its operation. It is, on the other hand, at the beginning of this period that the regional considerations enter economic planning, without, however, explicit formulation of policies in the sense proposed in [1]*.

This appearance of the regional problématique occurred as a result of two differing phenomena, seemingly converging. The first was the growing recognition of the necessity of considering the regional dimension of the economy in the programming of rapid growth. This phenomenon could therefore be seen as an amplification of optimum location appraoch. Secondly, neither the pre-war growth nor the post-war reconstruction, based upon national concentration

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*The policy defined as a pair $\hat{X},\hat{U}$ where $\hat{X}$ is the (planned) temporal development of the system over the time horizon chosen, $\hat{U}$ is the trajectory of policy instruments ensuring $\hat{X}$, and there is a unique two-way relation between X and U.

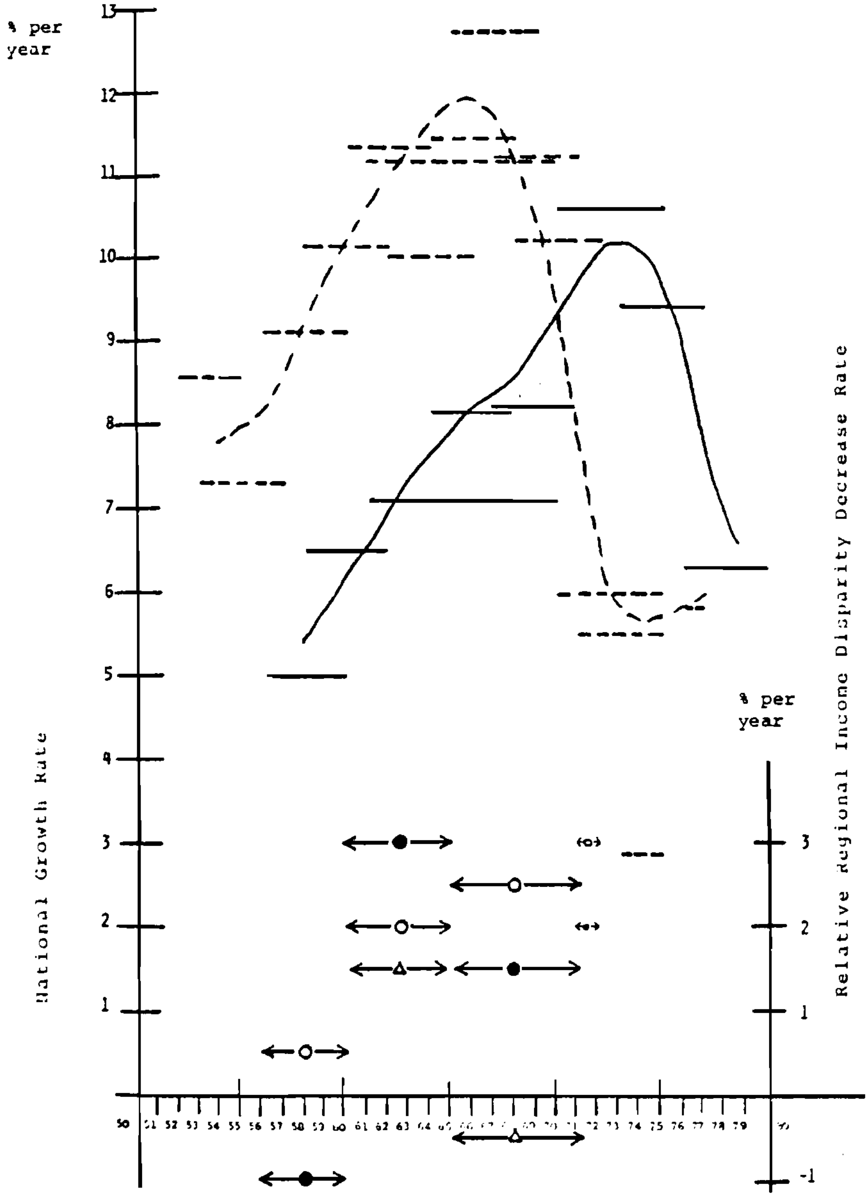


Figure 7.4
NATIONAL GROWTH RATES
AND REGIONAL DISPARITIES

——— plan projections
------ actual performance

} R: national growth rates

• prefectural income per capita
o personal income per capita
Δ production income per capita

} σ_Y : relative regional income disparity decrease rates

Table 7.2: Main initial occurrences in regionally relevant planning and legislation

Date	Plans: Economic	Plans: Comprehensive Development	Development Acts	Local Organization Acts
1870			Hokkaiko Development Agency	
1980				Law concerning the organization of urban and rural prefectures
1920			Law on urban planning	
1945				Local Autonomy Law
1949	The Economic Rehabilitation Plan (not officially adopted)			Local Finance Law
1950		General National Land Development Act	Act on Hokkaido Development, Act on Capital Area Construction	Local Tax Laws Local Public Enterprize Law
1955	Five-year Plan for Economic Self-Support	Japan Housing Corporation		
1956		Japan Highway Public Corporation	Act on Capital Area Development	
1957	New Long-Range Economic Plan			
1960	Doubling National Income Plan			
1961		Industrial Development of Undeveloped and Coal Mining Areas		
1962	Comprehensive National Development Plan			
1963			Act on Kinki Area Development	
1965	Medium-term Economic Plan			
1967	Econonic and Social Development Plan			
1969	The New Comprehensive National Development Plan "Shinzenso"			
1970	New Economic and Social Development Plan		Shinkansen Program Law	
1973	Basic Economic and Social Plan			
1974			National Land Agency	
1976	Economic Plan for the Second Half of the 70's			
1977	The Third Comprehensive National Development Plan "Sanzenso"			

For further details see Tables 7.6 and 7.7 (Councils and Corporations).

overcame discrepancies in development levels of central and peripheral regions. This fact has become increasingly important with continuing growth and availability of its products. Changes in regional discrepancies as opposed to national growth are shown in Figure 7.4. Some clarifications to this figure are necessary. First, the interregional disparity decrease rates σ_Y are relative, i.e. divided by a total mean. Thus, if one wants to assess the magnitude of absolute discrepancy, one has to compare the national growth rates R with σ_Y. If, for a specific point in time R is bigger than σ_Y, then the absolute disparities grow. (It is, though, a matter of value whether the relative or absolute disparity increase is preferred for a given overall growth.) Thus, it is easy to note that only during the deep crisis, decrease in disparity levels out with national growth, i.e. progress in absolute equalization can be expected. This fact points out two features of the efficiency/ equity policies: their low effectiveness and certain inflexibility or persistence. On the other hand, only one type of disparity index catches up in the early '70s with national growth, i.e. the steadily improving personal income index. At the same time the other two indeces, and especially the productivity index, do not show much of positive tendencies. Obviously, the inherent differences between regions which may grow not only in absolute, but also in relative terms (productivity 1965-1972) are being simply compensated for through various kinds of distributive mechanisms. The discrepancies thus generated cannot, however, go on growing. An explicit policy with regard to national/regional balance of objectives should rectify this ultimately paradoxical situation characteristic for many developed nations.

Of course special regional features have to be taken in any case into consideration at least for the rationalization of national policies if not for the region's sake. Thus, because of some political reasons the Hokkaido Development Agency was already set up in 1869. Formally then, Japan could be regarded as one of the first (if not <u>the</u> first) countries to explicitly introduce regional aspects into its governmental structure. Actually, however, the mainstream of region-oriented regulations and laws dates back to just after World War II (see Table 7.2), which places Japan in same rank as other highly developed countries, i.e. the United

States (T.V.A. - 1934), the Soviet Union (the regional aspects of early plans), France and Italy. The initial regulatory and administrative measures, though modest in their direct political and hence economic and social consequences have created conditions for further steps, through the establishment of necessary societal mechanisms (for expression of local interests, data gathering etc.).

It should be mentioned here that the initial steps in regional development, which were made just after World Wat II (Local Autonomy Law, 1947; Comprehensive National Land Development Act, 1950, safeguard against further impairment of asymmetrically utilized land resources, first ideas for Hokkaido tunnel, etc.) evidently coincide with the consequences of the war in the sense of decreased national capacities setting restraints to manoeuvre and thus weakening the positive feedback look: national growth, national concentration and therefore strengthening the importance of regional confederations. When only the national momentum could be gained, between 1953 and 1955, the regional problems came back to their "normal" importance trajectory.

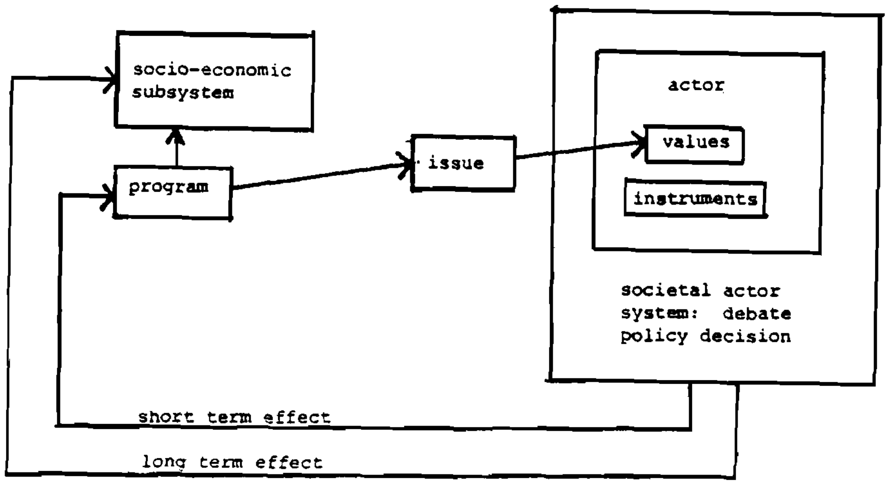
The absolute gap between economic and social levels of central and peripheral regions was still widening up to a factor of two, which in the light of the experience of other countries was not justified by the level of the overall development of Japan and could only be justified by an exceptionally high rate of growth and its constitutional factors. It must furthermore be emphasized that these discrepancies were not driven by major differences in the availability of resources among regions. They were almost uniquely driven by the scale and agglomeration economies. These economies have recently begun to produce tangible externalities which have turned attention to urban and regional problems.

The above considerations exemplify the working of a paradigm that could be used for describing a situation in which regional problêmatique, especially in its interaction with national policies, arises. Evolution of the societal system over time and hence also in the underlying socio-economic-technical system is geared by two major factors: changes in s-e-t system as perceived by actors and by changes in actors' perceptions caused by shifts in their values, expressed by differing formulations of goals. Interrelation between the two is shown in Figure 7.5.

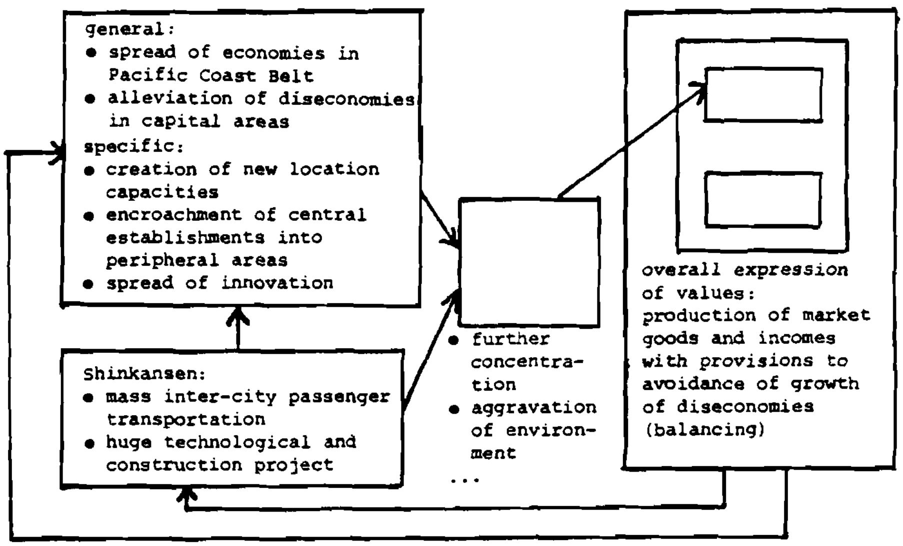
The Paradigm: Temporal Value Changes and System Development

According to actual values actors react to current and potential changes in the s-e-t system or its appropriate subsystem, e.g. inter and intra-regional changes, for instance through formation of a program, but also more generally over a longer time horizon through the establishment of implementation system (e.g. strengthening of sectoral economies in rapid growth period). These actions bring about desirable changes in direction of social development and they have large inertia, once implemented. Their activity also brings about certain externalities, which, negligible at the outset may severely hinder realization of general values underlying currently formulated goals (these goals may not be affected at all by the above-mentioned externalities). Such obvious physical externalities are for example connected with encroachment into agricultural land, pollution and, in general, deterioration of the environment as a result of rapid industrial growth. In economic space, externalities lead to differentiation of structures and development levels among regions. Thus, the need arises for changes in expression of values in explicitly stated goals (broader formulations) and for the introduction of changes into existing programs, their cancellation or set-up of the new ones. The tendency appears to widen evaluation criteria or shift them to most affected aspects of the system.

Thus, for a spectrum of underlying values, when a limited expression through more specific goals is being the object of pursuance a positive feedback loop is established between goal achievement index and its implementation-serving factors (see Figure 7.6, loop I for an illustration of the case of national economic growth and concentration). Simultaneously, however, a parallel loop is established in which inhibitive effects are amplified. Because of the nonlinear character of relations between the loops (resulting from self-purification and carrying capacity levels in environment, and from social stratification--same increments of national income may add to satisfaction of needs of various numbers of people--in interregional equity) there is a negative rapid clash between them at some point of



(a)



(b)

Figure 7.5 THE LOOP OF INTERACTION BETWEEN CHANGES IN VALUES AND IN THE SOCIO-ECONOMIC SYSTEM AND THE IMPLEMENTATION SYSTEM: (a) general; (b) illustration for the first period of Shinkansen construction.

development rather than continuous (linear?) growth of interaction. Such a clash may lead to a switch in value expression and to reconsideration of the implementation system, especially when external conditions are not satisfactory enough for pursuing a (quasi-) full spectrum of values.

In Japan's case there were signs of value expression widening in the prevailing good economic conditions, but the world recession caused retraction to economic values, at least at the highest decision-making level. Does that reflect the state of the two-loop system? Or only the fears of subsistence-level future?*

7.1.2 The Situation After the Construction of the Tokaido Shinkansen

According to the general policy attitude, investment in transportation was treated as direct or indirect productive infrastructural investment. With relation to aims of the reconstruction period mentioned before, these investments had psychological (external and internal image), inductive (accessibility increase) and direct servicing significance. Such evaluation does not only apply to freight, but also to passenger transportation. The result of such investment was strengthening of core regions and their slow progress into peripheral ones.

With the first National Comprehensive Development Plan of 1962 and the activities of regional and region-oriented bodies (Table 7.2) the general policy formulations, also from the side of purely economic planners, got the regional coloration. It took 12 years after the land act to create a basis for forging the regional policies. Such a long period of time was required to change, at least partially, well established attitudes and economic-growth-related convictions.

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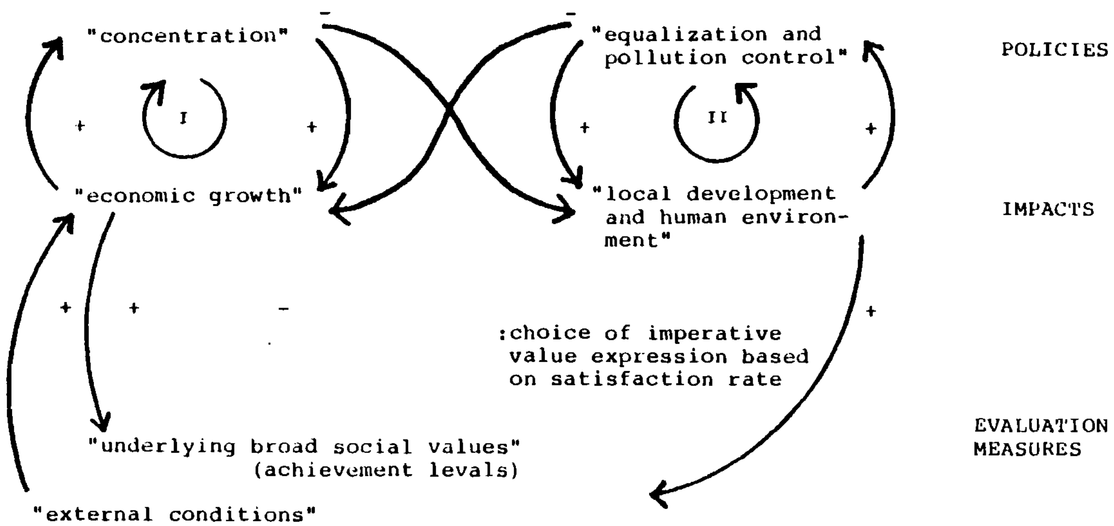
*This raises the question (see e.g., [18] and [19]) of whether the continuing growth will solve or aggravate the question of externalities. It may certainly, for the sake of above considerations, be stated that while growth absorbs or liquidates some "old" externalities, it does, and will produce some "new" ones.



Correspondence of modes of loops' functioning

I: Loop working in the economic growth or stagnation modes

II: Loop working in the "dehumanization" or environmental improvement modes.

Figure 7.6 A DYNAMIC CHANGE MECHANISM FOR VALUE ACHIEVEMENT ADDITIONS AND VALUE SHIFTS. FOR AN EXAMPLE OF RESULTS OF LOOPS' FUNCTIONING SEE FIGURE 7.16.

As mentioned previously, the economic plans of the 60's were aimed to acceleration of growth. With that, however, certain attention was paid to the liquidation of disparities generated by rapid industrial growth, and in order to do it, an increase in social overhead capital (SOC) was planned. Similarly, however, to the preceding period, in the 60's too, infrastructural investment was mainly regarded as directly or indirectly productive. Categories (Table 7.3) and locations of social overhead capital investments were strengthening the general allocation policy (see [2]) of broadening the area of agglomeration economies through the creation of a "megalopolis" along the Pacific coast. This Pacific Coast Belt, and especially its core areas were to absorb most (70% for 1961-62) of public investment and therefore drive the Japanese economy. There might have been background thinking that this was just a first step towards the creation of a Pacific Coast belt axis along the whole of Japan thus involving all regions in the mainstream of national socio-economic life (see Figure 7.3 at the beginning of the chapter). (The turn of Hokkaido, Tohoku and the Japan Sea cost regions came in the 70's). Meanwhile, however, discrepancies among development levels of regions, especially if measured by their productivity per capita as a regional performance measure, grew, despite (quite recent) convergence in income indices (Figure 7.4).

In 1962 the first National Comprehensive Development Plan promoted the growth centers development formula, which was more directly oriented at interregional equity. Differing degrees of success as measured simply by manufacturing output of established centers (Table 7.4 and Figure 7.7) (not accounting for more general economic activation of the adjacent region) point out that more effective equalization would require more effort from the side of national government, and certainly will be out of reach of local governments. The new town and generally new location policy was elaborated with close collaboration of MITI staff. Conditions of industrial locations and the locations themselves had to be filtered through by MITI who set standard normatives and looked at the appropriateness of general pattern. The prerogatives exerted by MITI in that respect were quite exceptional for dominantly market eco-

Table 7.3 Categorization and Trends in Social Overhead Capital

(unit: 100 billion yen)

Sector \ Economic Plan	National Income Doubling Plan		Medium-Term Economic Plan		Economic & Social Development Plan		New Economic & Social Development Plan		Basic Economic & Social Plan		Economic Plan for 2nd half of the 1970's	
	FY 1961-70 (at '60 prices)		FY 1964-68 (at '63 prices)		FY 1967-71 (at '65 prices)		FY 1970-75 (at '69 prices)		FY 1973-77 (at '72 prices)		FY 1976-80 (at '75 prices)	
	Amount	Percentage of Total	Amount	Percentage of Total	Amount	Percentage of Total	Amount	Percentage of Total	Amount	Percentage of Total	Amount	Percentage of Total
Environmental sanitation	5.70	3.53	8.30	4.66	12.70	4.62	31.40	5.71	77.40	8.60	136.40	13.64
Public Rental Housing	13.00	8.06	11.20	6.29	17.10	6.22	39.00	7.09	60.80	6.76	65.00	6.50
Welfare	4.00	2.48	3.70	2.08	5.20	1.89	10.40	1.89	18.20	2.02	21.50	2.15
Schools	11.00	6.82	9.50	5.34	13.10	4.76	26.20	4.76	43.70	4.86	65.50	6.55
Sub-total	33.70	20.89	32.70	18.37	48.10	17.49	107.00	19.45	200.10	22.24	288.40	28.84
Roads	49.00	30.38	41.00	23.03	61.50	22.36	117.00	21.27	190.00	21.11	195.00	19.50
Railways			18.20	10.22	33.80	12.29	55.00	10.00	78.50	8.72	80.00	8.00
Ports & Harbours	5.30	3.29	5.50	3.09	8.40	3.05	19.00	3.45	31.90	3.54	29.00	2.90
Aviation							5.90	1.07	7.70	0.86	8.00	0.80
Sub-total	54.30	33.66	64.70	36.35	103.70	37.71	196.90	35.80	308.10	34.23	312.00	31.20
Telecommunication			17.30	9.72	26.60	9.67	53.20	9.67	65.10	7.23	73.00	7.30
Land Conservation	16.50	10.23	10.60	5.96	18.10	6.58	37.00	6.73	58.30	6.48	69.00	6.90
Agriculture, Forestry Fishery	10.00	6.20	10.20	5.73	15.50	5.64	32.50	5.91	55.50	6.17	69.90	6.99
Total	114.50	70.98	135.50	76.12	212.00	77.09	426.60	77.56	687.00	76.35	812.30	81.23
Adjustments	46.80	29.02	0.40	0.22	5.00	1.82	10.00	1.82	30.00	3.33	20.00	2.00
Others			42.10	23.65	58.00	21.09	113.40	20.62	182.90	20.32	167.70	16.77
Total	161.30	100.00	178.00	100.00	275.00	100.00	550.00	100.00	900.00	100.00	1000.00	100.00

nomies. Throughout the 60's, however, it was assumed that equalization could be achieved as long as it did not distort the efficiency of national economy. Looking at the statistics one easily concludes that only a few of the prompted centers showed net positive results. Heavy investments into slower deploying ones, made for the purpose of enabling them to catch up with the other ones, would cost the economy a great deal without guaranteeing appropriate returns. Agglomeration economies were still prevailing (see production income per employee in Figure 7.4), both for industries and for people, and the diseconomies (dissatisfaction) were not big enough, or not appropriately channeled with the growth centers policy (Figure 7.8 for changes during early 70's, when the policies were supposed to produce tangible results) so that they could not pull the development into deconcentration.

Thus the transportation investment, and hence also (as one of its main elements) the Tokaido Shinkansen with its mass of passengers, customers, employees and directors of concentrated industry, administration and culture, strengthened the potential agglomeration (and certainly the agglomeration economies) along the axis of Pacific Coast Belt. Again, the amplified location approach, translated into more "regional" terms, echoed this. The growth rates soared, the disparities persisted, and the local physical negative externalities appeared as more and more important factors. At a certain point in time it was feared that the latter could break the positive feedback loop between concentration and agglomeration on the one hand, and the economic growth on the other.

From 1967 to 1968 the New Comprehensive Development Plan (the Shinzenso) was being prepared in which the next step was made in the direction of solving the regional problems. Instead of linear, or a tree-like growth center disposition coupled with PCB development pattern, a poly-grid, advanced network formula was proposed (see Figure 7.8 for comparison of meanings). This formula, deemed appropriate for balanced, "sovereign" development of regions around their centers and equalization of accessibility among regions' infrastructures, relied heavily on increase both in quantity and in quality of transportation and of communication so that the regional subnetworks linked up to form one harmonious organism. The ultimate

Table 7.4a. Actual and planned values of manufacturing production in the new industrial cities.

		Manufacturing Production (100 million yen)			
		1960	1969	1970 (planned)	1975 (planned)
●	1. Doou	1,820	5,800 ←	8,220	10,760
	2. Hachinohe	220	1,013	1,080	2,000
●	3. Sendai-wan	643	2,647	2,740	4,190
	4. Akita-wan	322	846 ←	1,450	2,510
●	5. Joban-Koriyama	548	2,391 ←	3,770	5,250
●	6. Niigata	883	2,554	3,110	4,650
	7. Matsumoto-Suwa	815	3,498 →	2,480	3,320
	8. Toyama-Takaoka	1,389	4,640 →	4,210	5,520
	9. Nakanoumi	412	1,419 →	1,380	2,180
●	10. Okayama-Kenna	1,892	9,912 →	9,310	13,650
	11. Tokushima	470	1,936	2,750	4,500
	12. Toyo	1,166	4,144 →	3,500	5,084
	13. Oita	420	1,995 ←	3,340	5,250
	14. Hyuga-Nobeoka	310	1,034	1,550	2,500
	15. Shiranuhi-Ariake-Omuta	1,070	3,207	4,370	6,300
	TOTAL	12,380	47,036	53,260	77,660

← important delay in play realization
→ important acceleration in plan realization

Table 7.4b. Figures showing that within the new industrial cities group the bigger centers grew more rapidly.

Actual average yearly output increase over 1960-69	Planned average yearly output increase over 1960-69
15.99%	15.71%
Actual average yearly % increase over 1960-69	Planned average yearly % increase over 1960-69
15.73%	15.98%

Table 7.4c. Figures showing that within the new industrial cities group the core centers grew more rapidly.

	Average yearly output increase over 1960-69 actual	planned
Overall	16%	15.7%
Pacific Coast Belt + hinterland (7,8,10):	29% of output volume planned for 1975	
	17.9%	14.6%
Overall without 7,8, and 10 (i.e. without PCB and hinterland)	14.9%	16.2%

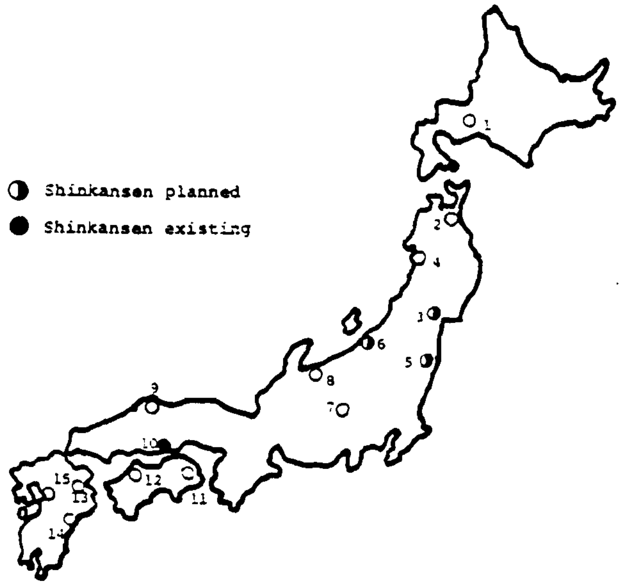


Figure 7.7 LOCATIONS OF NEW INDUSTRIAL CITIES

Table 7.5. The growth of regional economic clusters, standard consolidated regions, and all Japan, 1970-1975.

Source: 16 .

Area	Population (millions) 1975	1970	Percent Change 1970-1975
All Japan	111.9	104.7	6.926
All Regional Economic Clusters	76.6	70.4	8.705
All Standard Consolidated Areas	57.9	53.3	8.716
Tokyo, Nagoya and Osaka SCAs	48.0	44.2	8.659
All Non-REC Japan	35.3	34.2	3.264
RECs as Percent of All Japan	68.42	67.30	--
SCAs as Percent of All Japan	51.73	50.89	--
SCAs as Percent of RECs	75.61	75.63	--
Tokyo, Nagoya and Osaka SCAs as Percent of All RECs	62.89	62.73	--

shortening of distances through an optimal mix of transportation modes, communication and settlement-and-occupation pattern was supposed to solve by itself all regional problems. (Speaking of poly-grid formula and the mix of modes and measures necessary for carrying it out, one should refer to a commission on integrated transportation system working in mid 60's with the Ministry of Transportation whose proposal to proceed with the consequent establishment of such a system was however not taken up on the basis of supply and demand oriented <u>equal footing and free consumer choice</u> principles.) With continuing growth and therefore an increase in externalities, and also with a fuller satisfaction of basic needs, growing emphasis is placed on regional, local and environmental issues (Figure 7.9). This preoccupation, communicated to and utilized by government, peaks in 1971-72 in the so-called "Tanaka Plan," an election program introduced afterwards into the Basic Economic and Social Plan (1973). In extrapolating the ideas introduced by the Shinzenso, this plan went to extremes and proposed the grand design to "reshape the archipelago." These ideas were largely shared, at least by an important portion of the population, which can be exemplified by their introduction into the "national-town" - (megalopolis?) - planning ideology (e.g., of Kenzo Tange's group) as illustrated in Figure 7.10. It should be emphasized though that such designs often represented national interests and feelings as expressed in geographic-spatial terms.

<u>Issues</u>

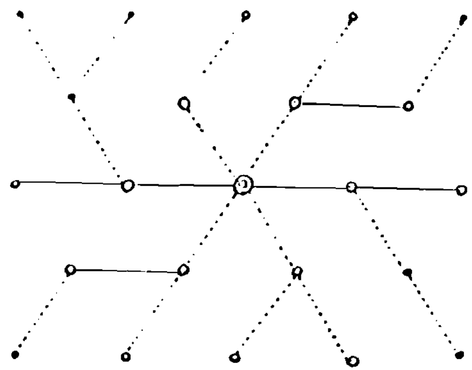
The beginning of the 60's is the period when the regional issues explicitly appeared, also in conjunction with transportation. All the emerging issues within the regional subsystem can be viewed as related to the separation of benefiters and losers. And so for:

- <u>Contribution to national vs. regional growth</u>: who benefits directly from Shinkansen? Who benefits from national growth distribution? and who bears the direct and indirect costs? How can various categories of contribution be measured?

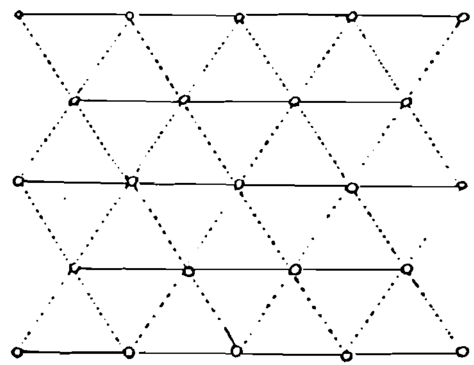
- In particular: should Shinkansen be built "everywhere" and even if it were, what would be its input into societies and economies of various regions?

Figure 7.8 NETWORK PATTERN DEVELOPMENT FORMULAE OF REGIONAL CENTERS SYSTEM

(1) Tree



(2) Poly-grid



Source: [2]

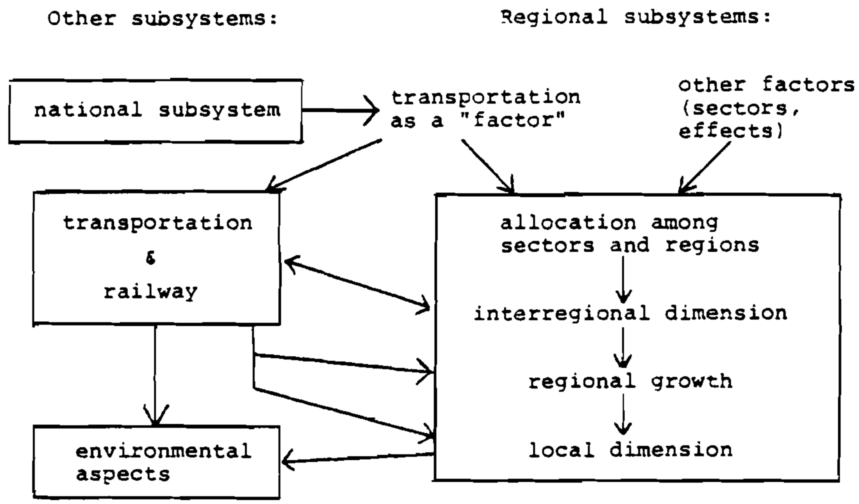


Figure 7.9 CONNECTIONS OF SUBSEQUENT STAGES AND LEVELS OF REGIONAL CONSIDERATIONS WITH OTHER SUBSYSTEMS

- The last question also applies to interregional equity: to what extent does Shinkansen push the spread of distributional effects and economy into less developed regions?

These, and more detailed, partial issues concerning SOC distribution and industrial location policies must therefore be seen through values of various participating/affected actors.

Actors

Also in the early 60's the present set of actors and their temporary and long-term instruments were almost entirely established. Some actors, however, were not yet fully distinct. The Economic Planning Agency (EPA) played the main role in the formulation of long- and medium-term plans, also including Comprehensive Development Plans pertaining to the regional cross-section of the economy. It is significant that one of the major proponents of the poly-grid network formula (see [21]), the former head of a division within the EPA, has become the director in the Agency. Talks over locations with big business were conducted by the Ministry of International Trade and Industry (MITI). Other min-

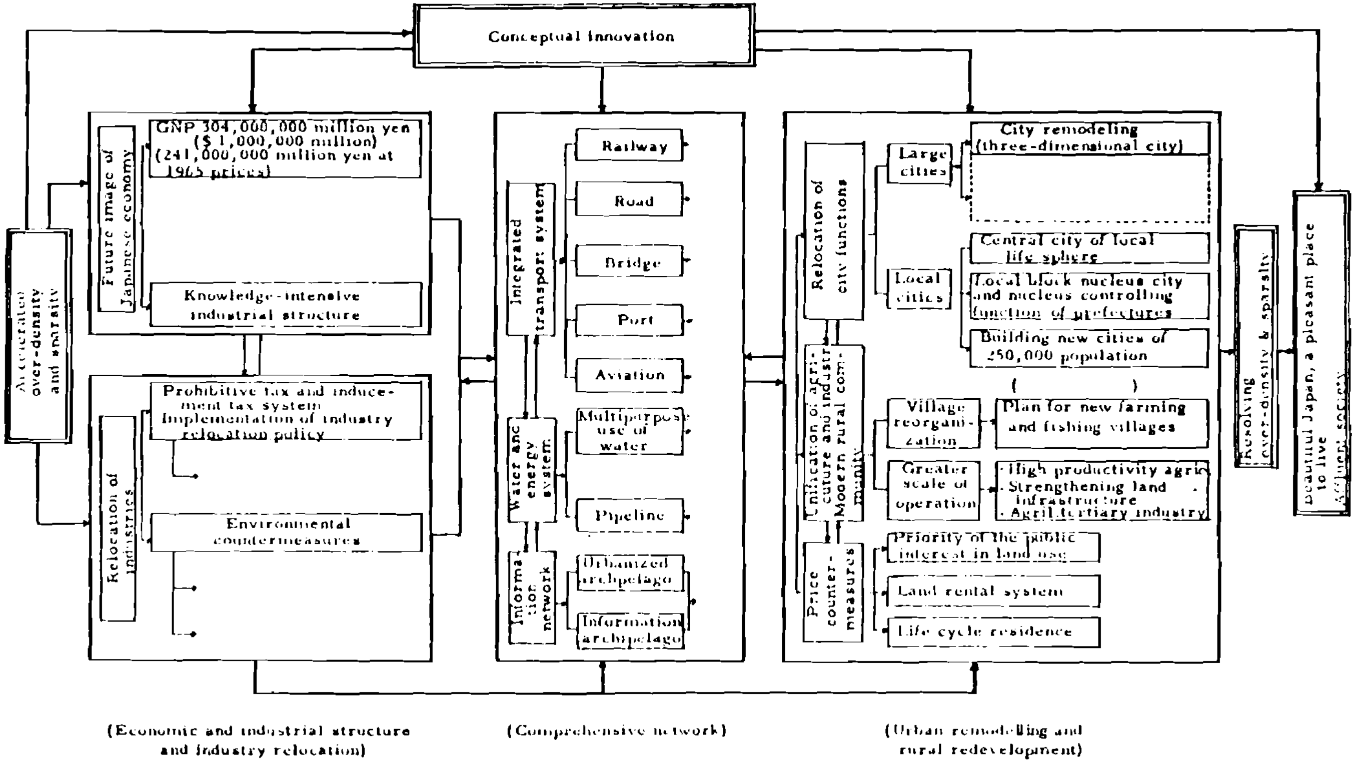


Figure 7.10

INTEGRATION OF "REMODELING OF ARCHIPELAGO" IDEOLOGY WITH SOCIAL, ECONOMIC AND TECHNICAL CONSIDERATIONS TO FORM AN URBAN PLANNING THOUGHT-SYSTEM FOR MEGALOPOLIS FORMATION.

Source: [13]

istries of key importance were: The Ministry of Construction, of Transportation and of Home Affairs. Numerous corporations set up for specific regional or region-bound purposes were connected with these agencies and ministries. Prefectural authorities were working out their style of governing and interaction with central bodies since they were still quite young and limited in capacity.

7.1.3 The Present Situation

General Situation

The dominant preoccupation with particular, regional and spatial issues did not last long. The oil shock came and conditions for the attainment of regional goals became more severe, if not for other reasons, then at least because of lack of important growth momentum, some of which could be used for fostering regionalized solutions. With the growing instability of the world situation, interregional disparities, especially as to the robustness and flexibility of the economic structure, became more acute. The efficiency vs. equity antagonism sharpened its edge. The shift in values, which began ten years previously, persisted however and only got translated into more general terms of stability and balance. These had to be achieved with the low-growth trajectory.

The question then arises as to whether in the new conditions the best strategies may include huge and very selective "shinkansen" investments, or rather rely on a more modest, "decentralized", "incremental" mix of transportation modes. The response to that, in a situation of public demand, especially from smaller agglomerations, consisted of non-resignation and a delay in policy which came about naturally.

External lower growth conditions stipulate concentration (see [3]). At the same time there are latent regional growth potentials (see Table 7.6*), which could lift up and stabilize the growth curve,

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*Latent regional growth potentials, as presented in Table 7.6, are based simply on still available water, land and possible labor indices. Actually, while such assessment is justified by virtual lack of more important natural resources in Japan, the indices should, however, be related to inputs necessary for utilization (investments) of these potentials.

but which necessitates appropriate investment, scarce in the present situation. Can activation of these potentials be achieved in any way other than by (infeasible) direct investment? Do the existing mechanisms point in this direction? There is little to be said in answer to the first question. The answer to the second one is rather negative. The main virtue of these mechanisms is their sheer existence, i.e., focussing of attention on the regional issues. They were established, however, in different conditions and primarily have a breaking, and not accelerating, character.

There is also another question related to "natural" changes in the subsystem, driven by its internal dynamics based upon relative advantages and disadvantages offered by various locations to various users and potential contributions of the users to activation of these locations. This question has already been mentioned when speaking of relative successes in the growth center promotion policy of the early 60's. The trends can be seen in Figure 7.11. They point out the net population deconcentration going on within the metropolitan area of Japan but also still persisting, although declining overall concentration for the whole of Japan. Will these trends retract now? Or will they change the character? Will they be synergistic with the functioning of governmental mechanisms of regional policy, or will they counteract them? These and other questions were faced by authors of the newly formulated Third National Comprehensive Development Plan. Their responses will largely influence future developments in the subsystem.

New Issues

The general issues mentioned before, which were gradually becoming more concrete and detailed:

- stability to external disturbances and internal dynamics,
- accessibility, and
- local balance of impactees' costs and promoters' benefits,

represent the items that were subject to analytical consideration, along with those previously presented, in the early 70's. The picture, composed of results, is highly complex and not univocal.

Table 7.6: Indexes of Regional Distribution of Industry

Region	1970 population (%)	1970 value of shipments (%)*	Inhabitable surface (%)	Potential index (%)**		
				Industrial land	Industrial water	Labor force
Hokkaido	4.3	7.8	14.3	9.6	11.7	7.1
Tohoku	9.0	17.2	24.5	22.7	23.0	22.1
Kanto						
Inland	13.4	12.2	13.8	16.5	10.4	17.6
Coastal***	-	-	-	-	-	-
Tokai	32.3	27.8	9.6	12.6	18.0	16.7
Hokuriku	4.7	4.2	4.7	4.6	6.5	2.9
Kinki						
Inland	7.1	6.1	3.3	5.2	4.7	6.7
Coastal***	-	-	-	-	-	-
Chugoku						
San-in	1.0	2.0	2.5	1.9	2.3	1.9
San-yo	13.4	8.5	6.3	7.2	5.9	3.7
Shikoku	5.0	6.0	5.2	4.7	4.5	4.0
Kyushu	9.8	18.2	15.8	15.1	13.0	17.7
Japan as a whole	100.0	100.0	100.0	100.0	100.0	100.0

Notes: * Value of shipments: output leaving the region.

** The potential index is calculated in the following way:

1) The calculation is based on the suppliable volume of production factors by region obtained as a result of the survey of development potential conducted in fiscal 1973.

2) The volume of industrial land is revised according to the Survey on Land Suitable for Factory Location; the volume of industrial water is revised according to the Comprehensive Survey on Industrial Water; and the labor force is adjusted to the inter-regional labor migration.

3) The suppliable volume of production factors by region is converted into industrial shipment value after taking into account the regional differences in the base unit of each production factor to produce one unit of added value.

4) The results obtained thereby are expressed in region shares.

*** Coastal Kanto and Kinki: as two already kighly over-concentrated and over-congested regions are not taken into consideration, so that the totals do not include their shares.

It is presumed that the adequate responses to these particular issues might bring about necessary resilience into the system, it is very doubtful, however, whether they will activate the previously mentioned latent potentials.

New Actors

One major new actor appeared in 1974: the National Land Agency, responsible now for Comprehensive Development Plans (CDPs), Land Use Plans, and--last but not least--integrated transportation plans. Prefectures also started producing their own CDPs and thus the whole picture is complete.

7.2 Main Actors Involved in Regional Development

This section presents a shortened overview of the main actors in the societal debate, policy and decision process within the regional sub-system. It focuses on transportation policies and projects in their relevance to regional problems. A large portion of the section will be taken by governmental actors and by their relations with other actors. This reflects both the traditional ways, the fact that the Japanese government is "the central, and not federal" one, and also actual input of these actors into development of regions and interregional pattern of relations. Although individual characteristics will not be structured, an effort was made to show for each actor his:

- place in multi-hierarchical societal system,
- distinct features,
- relations with other actors with regard to operable instruments,
- value pursued and changes in these values, and
- how these refer to (perceptions of) actual and potential system developments, seen through trends in the actors' behavior.

Some more details on actors' features will be given in the section on interactions.

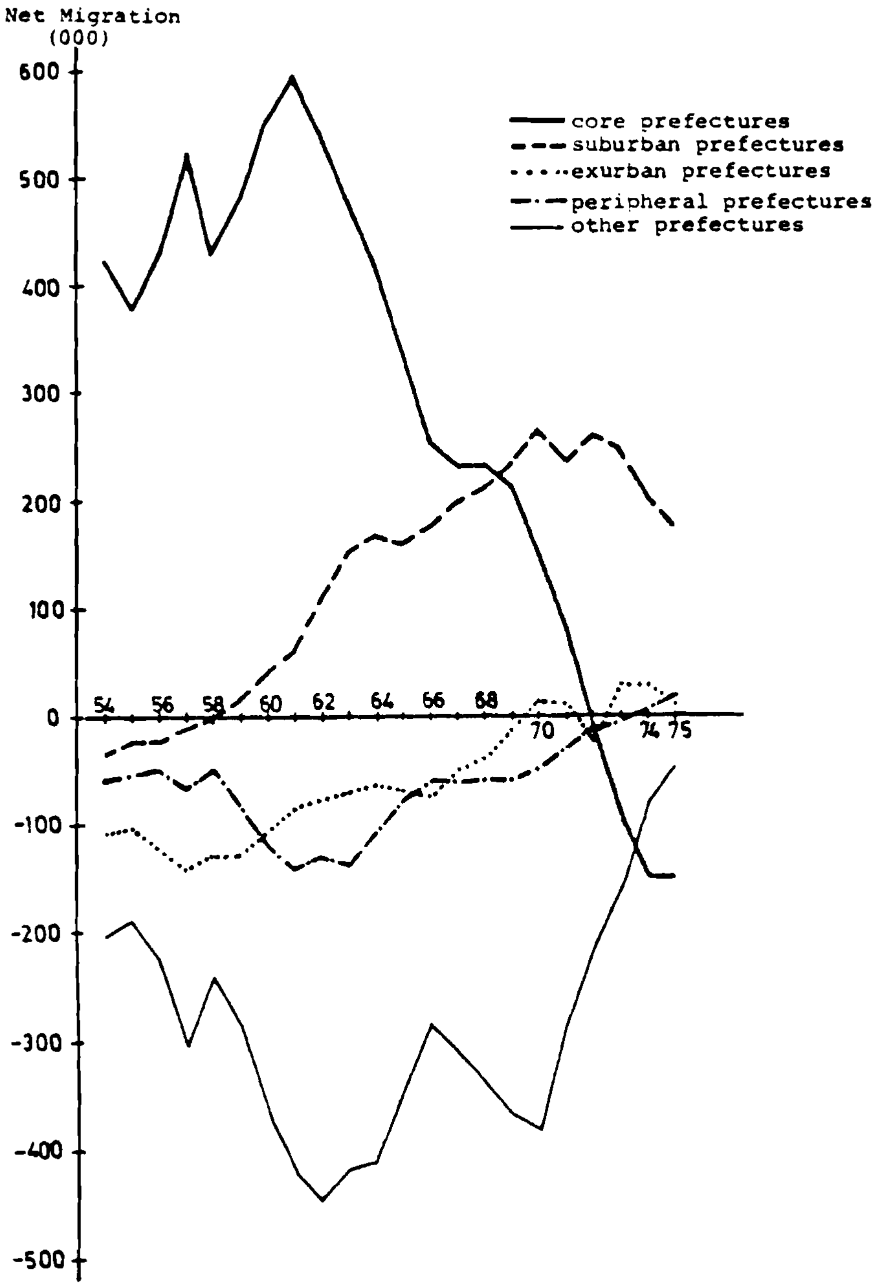

Figure 7.11 NET MIGRATION FOR JAPANESE REGIONS, 1954-1975

Source: [16]

7.2.1 National Government

The Prime Minister and the Cabinet

The Prime Minister is entrusted with the national executive power together with hopes for the fulfillment of a certain election program which may explicitly contain region-oriented items. (An example of this has been cited for Prime Minister Tanaka's government). An important source of orientation, besides the generally recognizable public opinion is the prevailing attitude within the majority party. The election program may or may not be translated into an appropriate economic or comprehensive development plan, but, essentially, it sets a general frame for particular projects and designs elaborated by individual bodies. Thus, the Prime Minister and his cabinet introduce certain intellectual initiative and set the consensus principles.

After the peak in regional considerations of the late 60's and early 70's, more recently the government has been preoccupied with shorter-term economic and financial issues, although pressure and the recognition of importance of regional problems introduced already does not permit their being dropped from the agenda.

The Ministry of Finance (MoF)

Seemingly, this department of the government does not have too much to do with regions. As repeatedly stated, however, it is one of the most (if not <u>the</u> most) powerful governmental bodies. It plays a decisive role in the annual budget allocation and thus, among other recipients, to the prefectural authorities through the Ministry of Home Affairs and to regional projects through appropriate ministries: mainly of Construction and of Transportation. By virtue of its function Finance discounts very quickly (25-35%?)* compared to subsequent actors.

The Economic Planning Agency (EPA)

The EPA is vested with the responsibility of formulating

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*Subjective discount rates were inferred on the basis of plans/ budget time horizons and formulation mechanisms among various governmental bodies dealing with planning.

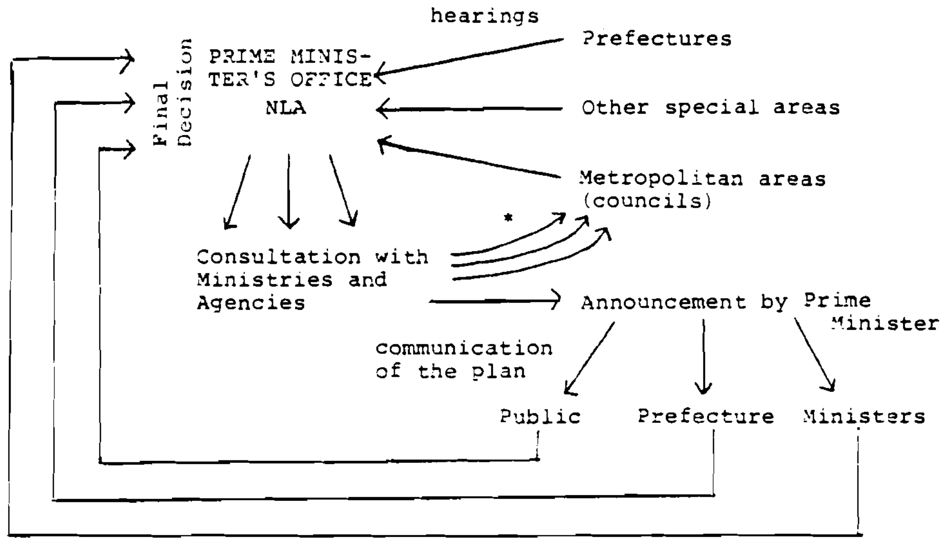
economic medium-term plans (formally: up to 5-year plan - the doscount rate down to 15 - 20%?). The plans themselves undergo a lengthy consensus-achievement process but the main drafting and coordinative role resides with the EPA. For a long time after its inception this agency was a think-tank developing economic long-term formulae for Japan. (As previously mentioned, some of the typically regionally or territorially oriented ideas were generated within the EPA by its outstanding representatives). Certainly, the work done within the EPA has had an important influence upon governmental economic policies whether long- or short-term. (There is now also an annual plan prepared by the EPA, showing projections of behavior and of national economy as a link-up to the annual budget of finance). Until quite recently, however, even the following of the growth path set out in the economic plan was not being done, to say nothing of more practical implementation measures (see divergences shown in Fig. 7.4). Currently the following of the path is reported annually and adequate moves are proposed on the basis of actual performance. Transportation is treated either as a sector, or, with bigger aggregations, as a factor. The Economic Plan for the second half of the 70's stresses the need for stability and (material) safety in an unstable world situation and therefore appropriate accommodation of lower growth conditions.

<u>The National Land Agency (NLA)</u>

Established in 1974 (Table 7.2) and based to a large extent upon the former EPA staff, the NLA is vested with the elaboration of long-term (more than 5 years, in practice: 15 years: discount rate down to actual banking - below 10%?) comprehensive development plans and land-use policies. Being newly formed, this agency has not had enough time to work out completely effective instruments and gain adequate recognition of its role and significance within the governmental structure.

As previously mentioned, within the NLA there is the Integrated Traffic Policy Division (in the Planning and Coordination Bureau). It is very difficult however to assess the role of this group as yet. (Depending on both legal bases for functioning and on modalities of cooperation with appropriate departments and ministries, future plans or proportions elaborated by this division will have differing degrees of detail, applicability and implementability). As far as real capacities of control go, the NLA may be placed together with the EPA, without the latter's experience however.

The consensus achievement process is, in the case of the NLA, even longer and more cumbersome than for the EPA, as both the sectoral and the prefectural cross-sections are involved (see Figure 7.12). Two bureaus of the NLA are of special importance here: the Metropolitan Areas Development Bureau and the Regional Development Bureau. There the plans or (more appropriately) the "prospects" are elaborated for various areas of the country, constituting regions in the eyes of planners from NLA (the problem of regionalization will be discussed in more detail when speaking of individual issues).



* the longest negotiation loop

Figure 7.12 FUNDAMENTAL DEVELOPMENT PLAN (A FRAME FOR SUB-REGIONAL CDP's) PREPARATION PROCEDURE

Source: NLA

It is important to note that the present (Third) Comprehensive Development Plan is the first one elaborated within the NLA. It encounters a far less advantageous situation for the promotion of particularized growth and therefore sets out modest goals for rectifying basic problems and slowing down the pursuance of previously stated policies.

<u>The Ministry of International Trade and Industry (MITI)</u>

This ministry (for comparison: about 10,000 employees, while EPA has above 500 and NLA below 500 employees) is responsible for promotion and (whenever possible) control of industrial growth policies. MITI is therefore the focus of all contacts with big business, also for locational problems. (This is dealt with by the Industrial Location and Environmental Protection Bureau of MITI). A number of legal acts (Table 7.2) give provisions for positive influencing of the industrial locations (new cities, special areas), mainly through the investment of central governments and local bodies, which are largely shaped by the MITI. As previously mentioned, MITI elaborates location standards and other technico-economic normative indices which shape the pattern of the location and constitute a countermeasure against chaotic and spontaneous growth, burdened with externalities. This body of expertise and legislation serves also as a basis for negotiation and pursuance with regard to industries. In this job MITI fully utilizes its capacities in the collection of industrial data, so that for instance it was one of the first places to introduce the interregional I/O tables in order to assess the future direction of optimal development, potential (also transportation) bottlenecks etc. There are also some instruments operated uniquely by MITI, e.g., the law on the survey of conditions of locations of industries, giving full control if proposed locations of bigger industries to MITI, although rather in the sense of non-allowance for undesirable locations than enforcement of proposed locations.

In each of eight basic regions MITI has its regional bureaus which do not have any policy role but rather administrative and information roles.

All previous reservations as to the change of picture with the oil shock do of course fully apply also to MITI. It has become more difficult to couple economic viability with social and resource-wise balancing of growth.

The Ministry of Home Affairs (MHA)

This ministry is an administrative link between local authorities and the central government. One of its main roles is the redistribution of funds to local authorities. This is done primarely according to certain predetermined rules, deviations from which are unimportant, so that the policy decision margin residing with the Ministry of Home Affairs is relatively narrow.

The Ministry of Construction (MoC

The regional significance of this ministry stems from two facts: firstly, from the introduction of projects into regional economies, and secondly, from the provision of facilities, effected through various corporations. In the case of roads, for instance, there is a clear division of competence with local governments as to the construction of certain important roads. Besides sheer division there is also another way of dealing with local bodies: financing of prefectural and city departments working on MoC projects. MoC has its regional bureaus in 8 basic regions.

For the purposes of this study MoC is essential both because it deals with an important portion of transportation investments and because (in regional changes) it participates in the construction of big new centers.

The Ministry of Transportaiton (MoT)

This ministry not only deals with various sorts of railways from high-speed inter-city (Shinkansen) to intra-agglomeration commuting lines, but also with intra-city transportation through the coordination of bus, street-car and taxi fares. It thus deals with virtually all commercialized passenger transportation and additionally through its aviation and shipping activities, also with a large part of cargo transportation. In their search for optimal integration of transportation modes, regions have to refer to the MoT since the Integrated Transportation System policy of the NLA has so far not been formulated and no prefecturally relevant details have been specified. It should be realized here that the proposals on integrated policy and planning in transportation reported in connection with MoT some 15 years ago were not considered because of free-market arguments in view of changeable demand. Like MITI and MoC, the MoT has eight regional bureaus for land transportation.

Councils

A number of councils (see list in Table 7.7) exist dealing with general and more specific regional problems. Councils are advisory, coordinating bodies. Because of a lack of clearly specified instruments and intervention procedures they will not be taken into account here.

7.2.2 Public Corporations

The most important public corporations that should be mentioned here are the Japan Housing Corporation (supervised by MoC), the New Town Development Public Corporation and the Japan Regional Development Corporation (supervised by NLA and MoC), in a general urbanal regional category. In addition to these there are a number of companies (mainly construction) set up for specific projects or areas (see list in Table 7.8). At the other end of the spectrum of interest there are the Japenese National Railways (JNR, supervised by MoT) and the Japan Railway Construction Corporation (JRCC, also supervised by MoT).

It is characteristic of the Japenese implementation system that attainment of a physically tangible goal within a broader policy area is usually ensured through the introduction of a corporation after having enacted a law defining the administrative prerogatives within the policy area. These measures are often complemented by the formulation of a special plan, or relevant specifications within a wider plan. Thus, with the first two, action in both administrative and corporate domains is secured, while the third provides the goals for this action. Corporations do not conduct their own policies, unless very powerful (JNR: Shinkansen!)--but even then they are still entirely subject to their supervising bodies in main decisions (e.g., fares: Until the end of 1977 the Diet approval was needed to change the transportation fares, since then only the Transportation Minister's

Table 7.7 Table of Councils relevant to regional development

Source [17]

Affiliation	General purpose councils	Specific purpose councils
Prime Minister's Office	Comprehensive National Land Development Council National Land Use Planning Council Regional Industry Development Council Regional Water Resources Development Council	Regional Development Councils: Tohoku, National Capital, Chubu, Hokuriku, Kinki, Chugoku, Shikoku, Kyushu Council for the Measures of the Snowy Areas Islands Development Rehabilitation Councils: Amami, Ogasawara
Hokkaido Development Agency		Hokkaido Development Council
Okinawa Development Agency		Okinawa Development Council
National Land Agency	Land Appraisal Committee	
Ministry of International Trade & Industry	Industrial Location and Water Council	
Agency of Natural Resources & Energy		Coal Mining Area Development Council
Ministry of Construction	Central City Planning Council Housing and Building Land Council Building Council Road Council	
Ministry of Home Affairs	Local Finance Council Mediation Commission of Local Disputes	

approval is needed), and largely dependent financially--they rather pursue their own corporate goals and eventually work on broadening of their roles. Thei response, however, to the outside market is usually very limited.

7.2.3 Private Sector of the Economy

Different roles are played by two distinct actor groups in this category: big manufacturing, trading and retail establishments which represent core areas of PCB on the one hand, and medium and small industries and trading firms of local character on the other. It is often said that there exists in Japan a deep structural and market-presence dichotomy between the two groups. Together with a tendency towards the concentration and growth of huge multi-branch, multi-activity concerns (accounting for the vast majority of Japan's output, facilitating the introduction of new technology, managerial techniques etc.), there is a persisting presence of a multitude of small establishment, especially in peripheral regions. The latter utilize techniques and procedures often unchanged from generation to generation.

Capacity and mobility make from the first group the main driving factor (national!) gorwth. It is their investments, output and employment that activate the economy. They can also respond positively to government regional policies. Without inducing big business, the success of such policies is impossible, at least in direct physical and monetary measures.

The vision of Tanaka's Plan was accepted by big business, and this also constituted its success, although the acceptance was given, not so much to the spatial, as to the scale and technological advancement dimension of the plan. It must, however, be remembered that even if "relocated", such businesses administratively, culturally and also profit-wise tend to the center and may, in the long run, not contribute to an essentially regional activation. They have all the advantages of agglomeration economies and expand down the PCB and into hinterlands. New Towns, if providing enough prospects, cal also constitute a new frontier. As already mentioned, Shinkansen with its unique passenger transportation constituted such means of "enlarging the center" and was welcomed by big businesses though not by medium and small businesses.

Table 7.8 Table of Corporations Relevant for Regional Development

Source: [17]

Classification	General Purpose	Special Purpose
Kosha	Japanese National Railways	
Kodan	Japan Railway Construction Corporation Japan Highway Public Corporation Japan Housing Corporation New Town Development Public Corporation Water Resources Development Corporation Agricultural Land Development Public Corporation (Japan Regional Development Corporation)	Tokyo Expressway Public Corporations Hanshin Super-Highway Corporation Honshu-Shikoku Bridge Authority New Tokyo International Airport Corporation Keihin Port Development Authority Hanshin Port Development Authority
Jigyodan	Small Business Promotion Corporation Smaller Enterprise Mutual Aid Projects Corporation	Hachirogata New Community Development Corporation
Koko	Housing Loan Corporation Finance Corporation of Local Public Enterprise Small business {Finance / credit insurance} corporations	Hokkaido and Tohoku Development Corporation Okinawa Development Finance Corporation
Tokushu Gaisha	Small Business Investment Co., Ltd. (3)	Tohoku District Development Co., Okinawa Electric Power Co., Ltd.

Medium and small industries provide social, cultural and, in peripheral regions, also economic complements which were valuable and necessary for a balanced social life. In fact, appropriate activation of such local establishments, e.g., through adequate infrastructural changes as coupled with the introduction of big business, may have really long-lasting consequences for the region.

7.2.4 Local Government

From 1947 on (see Table 7.2) governors of prefectures have been elected and no longer appointed. The personality of the governor chosen in a direct election (very often several times running) constitutes an important element in Japanese regional and national political life. Local bodies in prefectures and municipalities can enact by-laws and regulations and levy local taxes. They can (and do on an important scale) organize public work corporations, public enterprises and render administrative services. Many prefectures formulate their own Comprehensive Development Plans taking into account national plans and regional needs and thus try to force their own policies. Although the autonomy of localities has progressed since World War II, there is a certain amount of dissatisfaction with the speed of this progress in the regions.

An important percentage of staff comes from central institutions (e.g., a number of heads of planning departments). Local tax ([4] and Table 7.9 here) covers about 33% of the local budget, while about 35-40% has to come from the central government, not only through routine redistribution, but also along with certain assigned functions. Such (average) level of financial assistance is often (in regions) said to be sufficient to ensure dependence of localities. Economic operations of localities are strictly regulated and confined to the direct execution of prescribed works and functions. Their sphere of competence in transportation and other infrastructural activities seems to be restrained by the intervention of the MoT and the MoC to local items of low interregional significance. As far as higher priority projects are concerned experience says that the localities have been able to change some of its features, but never taken part in active preparation. Vetoes have been imposed by inhabitants rather than by authorities. Although much effort is devoted to land-use and urban planning there seem to be few controls on the implementation on these plans. Perhaps only in the domain of the environment do local bodies find appropriate conditions for the formulation, implementation and propagation of their own policies.

Such a two-sided view certainly does provide adequate dialectics for the dynamization of relations between the central government and localities. In reality, the margins available to local bodies have evidently been large enough to provide an opportunity for gaining strength and social recognition. It is a more and more widely spreading view that, in order to effectively formulate and implement regional policies, prefectures have to be merged or to form coalitions representing coherent regions, significant with regard to the country's structure, e.g., Pacific Coast Belt and its components.

Table 7.9 Level and Percent Distribution of Revenues for Cities, Towns and Villages, 1970

	(billions of Yen)	(percent)
Total Revenue	4,535	100.0
Local Taxes	1,485	32.74
Transferred Tax for Local Government	14	0.30
Local Allocation Tax	835	18.41
Treasury Disbursements	529	11.67
Prefectural Disbursements	245	5.41
Local Bonds	431	9.51
Rents, Fees and Changes	169	3.73
Miscellaneous	827	18.24

Source: [4]

7.2.5 Citizens

It is principally assumed that the values of inhabitants, whether in areas served by Shinkansen or other areas, should be adequately represented by some of the previously characterized actors, manipulating instruments adequate for the effective integration of these values into final policies and decisions. Actually, in many cases citizens have to resort to more general mechanisms, judicial or analogous. Demands or complaints are being deposed with appropriate bodies. In the more serious cases a group court trial against a disruptive project may be organized. Further even than that--extra-legal actions may be organized by impactees and taken up by opposition movements, as happened in the Narita airport case.

As previously mentioned in the paradigm presentation the change of value expression has covered the nonlinearly growing portion of the population (Figure 7.13). The bifurcation point,

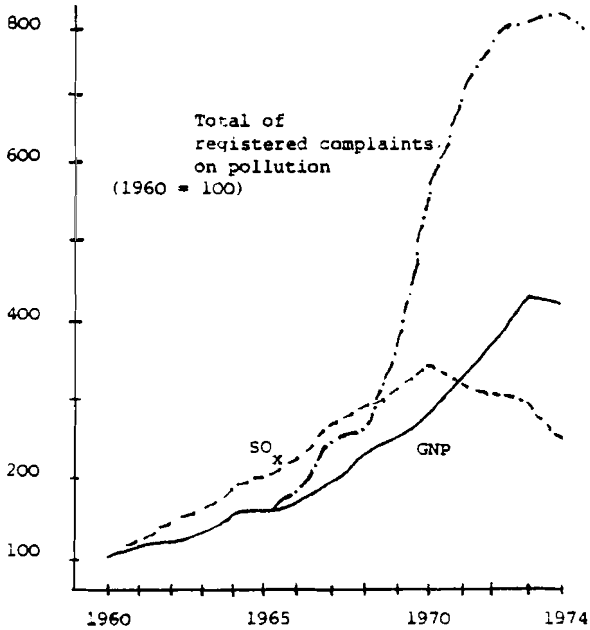


Figure 7.13 CHANGES IN REALITY AND IN VALUES

Source: White Paper on Environment, Environmental Agency, 1976.

it seems, has not been passed, however, and a difficult compromise of securing steady growth together with a habitable environment and autonomous social and cultural governability will have to be achieved. U-turns and movement into suburban hinterlands may be highly correlated with a wish to preserve the same or an increasingly traditionally conceived level of life.

7.3 Issues

In the overview of seven distinct issues--as for actors--without explicit structuring an effort was made to represent the:

- relation of a given issue to others characterized;
- the main promoters and impactees (with reasons for being positively or negatively affected);
- the main "operators" influencing the state of this issue;
- and finally, dependence of the state of this issue upon the Shinkansen development.

Throughout the section references will be made to the paradigm introduced at the outset of the present chapter.

7.3.1 National vs. Regional Growth (Efficiency vs. Equity)

As already mentioned when giving a rough introduction of issues appearing with the growth of economy and the progressing construction and planning of Shinkansen, most of the problems can be looked at from the perspective of the separation of benefiters and losers. In this particular issue such separation finds its reflection at the highest level of aggregation, in the sense of aggregating users and beneficiaries vs. impactees and losers across societal groups and across geographic dimension and comparing their costs and benefits with those pertinent to the whole of national economy.

The above two goals have been given varying importance over the course of time. According to the paradigm, their mutual inhibitory influence grows with the achievement of the higher placed one. Historically evolving difference of priority between the two to some extent reflects this mutual influence. Starting with the Meiji Restoration one can see how distance in priorities gets larger, reaches a certain plateau and then slowly declines with a sharp downwards dive just after World War II when there were unfavorable conditions for concentrated national growth. The two goals' evolution lines get rectified afterwards but increasing externalities in the economic sense of the word cause their steady convergence which in the early 70's almost reaches identification of the two goals both in their priority and, more important, their significance. (This points out the moment when expression of values becomes more uniform.)

At present, there exist two opposing views on the subject. The first one is connected with the Shinzenso and subsequent long-term development formulae and postulates that equity will at present not hinder national efficiency. For an effective equity-promotion policy the efficiency in terms of national output can be lowered by about 2-3 percentage points according to this opinion. Such a situation would indicate the feasibility of a "promote equity without hindering efficiency" policy, reported to have existed in the late 60's and early 70's. This policy would not be feasible, however, if the second opinion, heralded by another group, were true--i.e., that an effective equity-promotion policy would yield a loss of 15-30% in growth [20]. This amounts to evidence that concentration and subsequent urbanization have not yet (in spite of soaring indices far higher than for other developed countries) entered into the phase of diseconomies (see the behaviour of the disparity index of production income per employee in Figure 7.4 for corroboration of this view). What these two opinions mean to the state of other issues can be seen easily from the formulation of these other issues further on. Anyway, in the present lower growth situation the gap persists.

Of course, the economies and diseconomies differ for various actors and only through their social and economic interrelations may they ultimately move in parallel through the paradigm-generated time sequence though not at the same levels and not quite in the same phase. Therefore, the proponents and impactees of various policies with regard to Efficiency vs. Equity differ even within the same regions. While it may still be argued that for the big business and for effective sectoral economies concentration may still offer important advantages; the increments of growth thus generated will not add sufficiently to the well-being of inhabitants so as to offset the negative phenomena (congestion, pollution, domination). It applies to interregional distinction to an even greater extent. In a characteristic way this situation is reflected in options offered to the JNR and the JRCC, both representing MoT. While the second could incline very favorably to the construction of new Shinkansen lines, as fostering its strength and activity, the JNR could not be so favorably since the distant lines will incur further deficit. The medium-scale or even small localities however are on average very positive to the introduction of Shinkansen, mainly for reasons related to image and not necessarily because of economic or social cost/benefit considerations which may show a risk of net loss or even instability. Thus, while central areas refute further unconditioned concentration and growth and the costs incurred are rising, the peripheral areas welcome often the acceleration and they offer important latent capacities, shown in Table 7.6. This adds to a change of potential in the Efficiency vs. Equity controversy.

7.3.2 Industrial Location

This and some of the following points may be treated as supplements or sub-points to the previous more general one. They are distinguished here because they have a clear, easily analyzable character and are often treated as self-standing policy areas.

The pattern of industrial location (and by that we mean here the location of big industries) is one of decisive factors in defining the state of the first issue. It is this factor that closes the feedback loop: based on the opinion as to generalized efficiency/inefficiency of concentration/dispersion of activities the locational policies are formulated. Once these decisions are made, they shape the opinions as to the state of E vs. E problem, and when implemented--through increments to agglomeration (dis) economies--the real state of E vs. E.

As mentioned already, the major role in this domain in the shaping of opinions and the execution of policies is played by MITI. Its policies may coincide or clash with the existing trends of various actors. Insofar as it relies, to a large extent, on such indices as labor efficiency and improvements in the production functions through capital investments and innovations, this will not, in general, counter the trends of big industries. Normally, amendments will be made where necessary to offset these negative externalities which may be overlooked by industry thus promoting accelerated technical change and the spread of concentration. The Shinkansen has contributed to this spread of concentration and creation of new locational capacities by raising the limits (or pushing up the saturating curves). This broadening of the locational margin applies, though, more to capacities in place than to the opening of new sites. The latter may perhaps be applicable to big wholesale retail or service activities. (The minor importance station-front location capacities do belong here insofar as they lead in the big central service and leisure-time establishments, since for the local small and medium scale business the new capacities opened are fairly limited and do not provide any development push. As such they will be touched upon indirectly in issues of stability and local separation of benefits and losses). There is no practical experience showing evidence of correlation (whether in planning or in actual developments) between Shinkansen and the performance of new cities, consolidation areas or other deconcentration policies based on creation of adjacent or self-sufficient growth poles. Shinkansen does not apparently directly relocate big industry as it does not carry freight and its passengers are not the everyday labor force commuters. It nevertheless facilitates inroads into the periphery (in future plans), and through indirect influences--innovations, general activation--may ultimately lead to preparation of new siting capacities for an invasion from the centers.

7.3.3 Redistribution of the Social Overhead Capital

Social Overhead Capital (SOC) represents another factor shaping the E vs. E issue. According to previous discussion on the significance of SOC it may act in either direction, depending on the category (Table 7.3) and regional allocation. SOC represents various types of infrastructure and as such can be estimated for its contribution to production functions, both for the whole of the country and for individual regions. Although physically necessary for any development it has, it seems, less input into the production function then the technical progress. Translated into Japanese reality the question may therefore be asked, whose capital investment and other input is more important (once a minimal level has been guaranteed for starting the growth curve)--MoC's and MoT's or MITI's? What are their relative weights and what are the substitutability rates for significance in national vs. regional growth? This clear cut problem is however, somewhat complicated by at least two-way relations between the two domains. The first is the creation of siting capacities through infrastructure investments and the channeling of innovations by existing infrastructure and by the very fact of its construction. It is the recognition of the strength of these relations that made the "Tanaka Plan" relatively popular with big industry.

As outlined in the historical overview, initially SOC, although heralded as an instrument of social policy, has had significance of indirectly productive investment (Table 7.3). The emphasis slowly moved towards "more social" SOC categories. It is imperative, for appropriate investment inducement and innovation enhancelemt, to program a comprehensive and integrated SOC policy with regard to various categories and mix of modes within the categories and their mutal interrelations. It should be added here that such an "ideal" SOC composition would not be intended to lead to a complete homogenization of regions, as there are differing regional characteristics at stake which offer various development potentials, to be opened by the injections of appropriate SOC package.

7.3.4 Interregional Accessibility

This issue is a derivative (or strictly speaking: integral) of the previous one and provides a link to the first issue mentioned here. Accessibility, if treated formally, may be entered as disembodied into the production function (see [5], both for national and regional outputs. Its contribution to the E vs. E controversy depends upon actual configuration, i.e., real possibilities of utilizing facilities from other regions (on the physical level) or utilizing information and other abstract assets of other regions.

Of course, with the increase of SOC volume and the spread of the distribution area, the accessibility rises and location capacities also increase. For any deemed optimal growth rate or minimum level of accessibility with specified configuration, there exists an optimal mix of transportation and communication media, and therefore an optimal program for SOC volume and distribution over time. Limited implementation possibilities add an important aspect to this (again, seemingly clear-cut) problem. Because these limitations (as compared to evolving goals) will persist at any point in time, but the social situations and technically feasible options will change, it may not be necessary or even optimal to force an absolute minimization of average accessibility time for some available mode mix (e.g., maximum of Shinkansen and air transport so as to decrease travelling time between any two points in Japan 3 or 4 hours). This, again, brings one back to the question of integrated transportation system planning or the question of cptimal influencing the (quasi-) market development of transportation business. Besides the problem of mix, there is also the problem of geographical configuration and geographically varying needs as to accessibility expressed by various actors (e.g., citizens of capital and core areas vs. big central business vs. local business, three different accessibility valuations). It is in this perspective that the interaction of the future (7000 km? 9000km?) Shinkansen with users and with other modes should be analyzed.

7.3.5 Urbanization and Urban Sprawl

Urbanization, although presenting similar associations with the "habitat pattern" of the chapter on national problems, is understood here in a more modest manner: not as a prescriptive image of the whole of Japan, but rather as a local phenomenon, following a certain path of the growth of the nation, certainly not directly affecting national subsystem and controllable through regionalized measures.

This issue is closely related to concentration: it is a side-effect. As such, it results indirectly from the state of issues 2, 3 and 4 characterized before, which means that it is not a subject of policy choices, but rather their weakly-related product. Urbanization in itself does produce a part of agglomeration economies for industries and certainly some advantages of inhabitants. These advantages for inhabitants are being gradually offset by overdevelopment of the positive feed-back loop in concentration. The increasing negative effects are individually dealt with by inhabitants which triggers off urban sprawl. The positive growth feedback is weakened. While it is obvious that relative differences among regions in growth potentials (economies) get diminished, there is very little evidence that the general spread of economies actually occurs (see Fig. 7.4: behavior of production income/employee index). Appropriate channelling of concentration is supposed to find a balance between economies and diseconomies of an agglomeration. Certainly, the optimum interregional and intercenter channelling strategy would yield different magnitude for inhabitants and for industries. It is in the context of such channelling that the role of Shinkansen is to be seen. Shinkansen certainly contributed to the urbanization of Pacific Coast Belt along the trends of natural changes, as illustrated by Fig. 7.11, i.e., persisting sharpening of absolute discrepancies between core and peripheral areas, but with growing significance of hinterland. Shinkansen addresses itself to a hierarchy of centers: spreading the core centers' influences (of big establishments), it transmits through medium-size centers influence and functions (see Fig. 7.14). Conversely, it adds to very high diseconomies of capital and core areas' inhabitants. However, the urbanization effect on small centers, because of the small

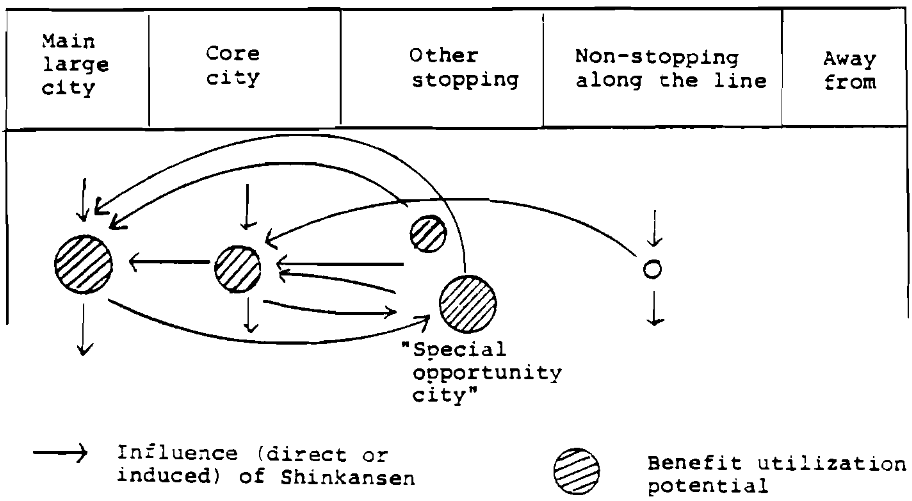


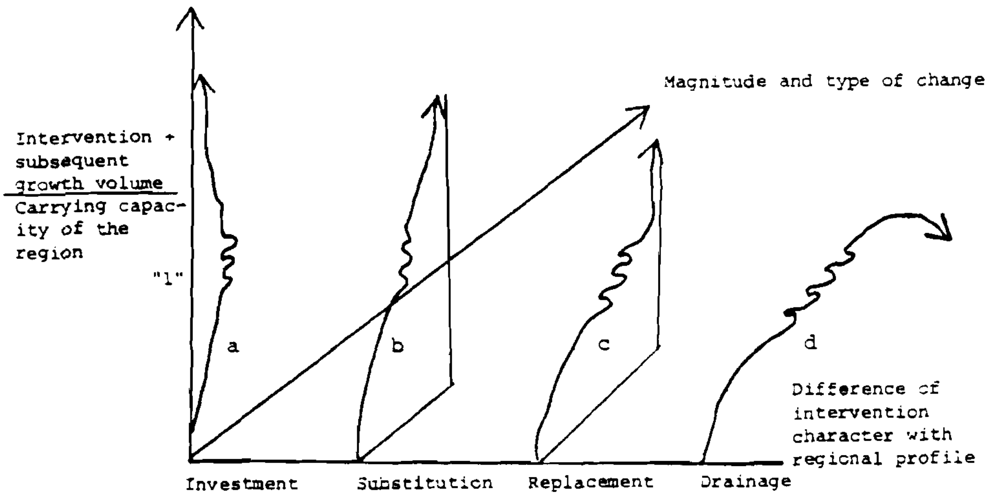
Figure 7.14 HIERARCHY OF CENTERS AND THE SHINKANSEN

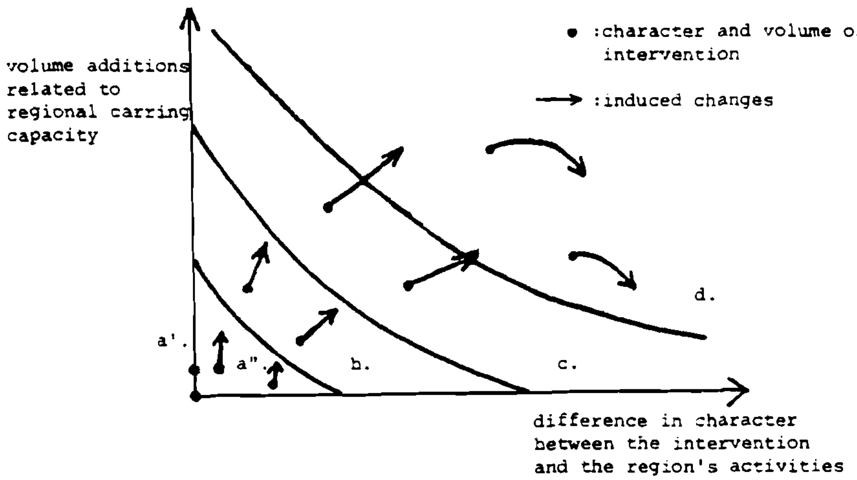
margin of routine influences (information, culture, administration) largely depends upon specific situations and opportunities of the center.

The narrow and central role of Shinkansen makes its influence upon the urbanization of core areas very indirect and marginal. The same "volume" of influence may, however, be decisive for small and small and even medium-sized cities.

7.3.6 Regional Stability

The previous issue touched the problem of influence which an external stimulus (infrastructural investment and operation of a project) exerts on the internal dynamics of the regional subsystem. Such external intervention may be applied to appropriately drive (control) the dynamic behavior of the subsystem. This, however, poses the question of subsystem's stability with regard to these external stimuli. (Certainly, there also exists the question of stability in the absence of such stimuli. More general policies, in this case concentration, may have severe regional stability implications in terms of dynamic behavior of urban economies and diseconomies. Questions of this kind, though, are too general, and do not constitute the object of the present study.) Observed over the time span of 10-20 years the subsystem may move along a certain relatively stable trajectory, in which the introduction of a Shinkansen-like element may provoke important perturbations. Such perturbations, if great enough could, over a long period, entirely destabilize the subsystem (see [6] for a modeled example of a virtually complete drainage of higher functions from a smaller city on the Shinkansen line to the core city nearby--100 km--and [13] for some actual corroboration of this possibility). It can therefore be inferred that there is a certain degree of socio-economic resilience inherent to the subsystem and when this is surpassed then a catastrophe results in the sense of qualitative change within the subsystem. This qualitative change may, however, have two different characters: in the first case the "Shinkansen" introduces and induces inflow of elements which constitute the basis for the "new" subsystem and the catastrophe mentioned, marks the passage from the "old" into the "new" system structure and behavior. In the second case instead of injected infrastructure the "old" system collapses to a subsistence level and the "new" one does not emerge (see Figure 7.15).





a. Quick growth with capacity perturbations (investment into existing activities).

b. Quick growth with transition period (shift over to substitutive activities).

c. Quick growth with restructuration activity replacement (may lead to catastrophe first type).

d. Abandonment (catastrophe type two - drainage of activities and factors).

Figure 7.15 CATEGORIES OF HYPOTHETICAL LOCAL CHANGES: VARIOUS TRAJECTORIES ALONG INTERVENTION AND INDUCED GROWTH VOLUME

Of course, the second type of catastrophe is not advantageous for any actor; in the case, therefore, of a risk of surpassing the resilience threshold, precautions should be taken to ensure that the "old" system absorbs the stimuli or that the changes force the system into the new mode. As pointed out by several studies ([6], [7]) and also by actual experience, there may be cases where ensuring of no-overall-net-loss behavior may be difficult. Very characteristic is the opposition in the cases of Kyoto and Nagoya. While representatives of Kyoto were not very favorable towards Shinkansen, existence of a treasury of non-importable goods in the city and its vicinity secured a steady inflow of benefits. On the other hand, Nagoya, the center of a dynamically developing area in the late 50's and in the 60's, welcomed the Shinkansen, which turned out to be a negative factor, depriving Nagoya of the importable higher-level functions. With regard to these functions a collapse could therefore be registered. This however, does not preclude a possibility of taking appropriate measures against such occurrences, and also it does not preclude continuation of other kinds of growth (e. g., population, labor force), which can in a long-range perspective constitute the basis for "rebirth."

In addition to questions asked for the accessibility issue, as related to both general location and SOC issues, there is therefore the question of Shinkansen vs. centers hierarchy programming that would yield optimal economic results still ensuring adequate stability.

7.3.7 Local separation of benefits and losses

The question of stability was addressed to certain aggregate categories, such as change of modes, inflow of capital, shifts in activities and in land-use pattern, outflow of customers and the like. Now, besides these aggregates there are other, more particular expressions of interest which add to the stability issue, but also partly to urbanization.

The most explicit case is for the station-area trade and service establishments as opposed to inhabitants of areas adjacent to the line and far from the station. The situation of the latter is dealt with by compensation, relocation etc. procedure, costs of such actions may go as high as 12 - 13% of investment for Shinkansen (which is, however, topped by 20 - 33% for expressways). This money, however, cannot just be regarded as being given away to rank-and-file citizens. It is, in a way, an investment into mostly benefitting industries and other establishments. The problem therefore arises of securing that the investment results in an appropriate distribution of benefits among the local's residents.

This situation is, obviously, a simile of E vs. E controversy. The disadvantages produced by growth-promoting elements must at least be compensated to "previous-conditions" level. This alone, however, does not ensure equal distribution of positive growth effects. To what extent the equalization should be forced [more compensation (the present issue of local separation) or more regional investment, the issue of efficiency vs. equity] without hindering the growth itself, and how to channel agglomeration economies and alleviate congestion and other highly-urbanized area problems are the questions which are repeated at this lowest level of social and economic phenomena. Balanced policies must be found for each case separately, with due check-out as to whether they can at all be found with rational outlays for an intervention into local system of the Shinkansen's scale.

7.4 Interrelations

The perspective taken in this study stipulates that there be no attempt made at a unitary assessment of the regional subsystems development related to Shinkansen program based upon a chosen unique criterion of program's efficiency and effectiveness. Rather, the variety of possible evaluation criteria pertaining to differing interests of actor groupings is implied. These actor groupings, illustrated in Figure 7.16 are directly related to some broader value areas (with which the actors' values are consistent) connected mainly with the levels of socio-economic organization that can be addressed by appropriate economic analyses.* Thus, the analysis of termporal changes in inter- and intra-regional rela-

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*National macro models operating on GNP-type indices as pertaining to "national" actors, interregional I/O and I/O surrogate models with interregional allocation and shift indicators referring to "interregional" actors' interests, urban or regional growth models, etc.

tions may show what impact these particular actors had and/or will have to bear under given functioning of the economic mechanism. The latter, however, is to a large degree dependent upon economic instruments operated by the actors. Existing models and economic analyses do not point out possible ways of functioning of the inter-actor instrumental interplay and that is also why the present study, besides emphasizing the multi-value character of socio-economic changes generated by a program, also stresses the necessity of identifying the dynamics of societal decision processes. An outline for the analysis explicitly taking into account both of these with some illustration for the Japanese case is given in Appendix 1. Such a study is necessary if an attempt to evaluate and design the program and its management is made.

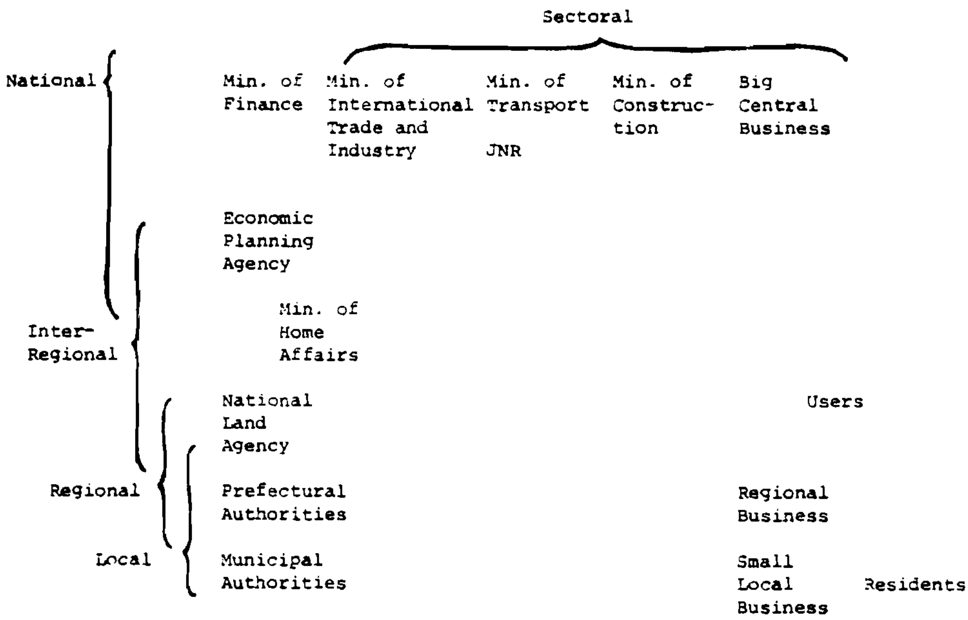


Figure 7.16 VALUE AREAS AND THEIR REPRESENTATIVES

For an external expert it gives the only change to evaluate the system if he does not want to use his own arbitrary evaluation criterion insofar as it allows for assessment of internal consistency of the system (program shape and management) with existing values and instruments. On the other hand, for internal purposes adequate recognition and inclusion of various actors' values and instruments and impacts borne by them resulting from changes in states of issues brought about by program's functioning can safeguard against costly modifications in on-going or even finished projects when overloaded or bypassed groups over-react to late-perceived threats.

If the above view were taken, one of the subsequent conclusions would consist in stipulating an appropriate representation of all constituent value areas. For the subsystem looked at in this chapter this would first of all mean adequately strong representation of regional interests.

Place of Regions in Interaction Structure

The first difficulty one meets with in assessing the above is connected with the very definition of the regions of Japan (see Figure 7.17). Besides the "basic regions," their "sub-divisions" and "alternative" divisions shown in Figure 7.1 together with corresponding sources, there is further evidence of uncertainty and variety of opinions as to regions definitions.

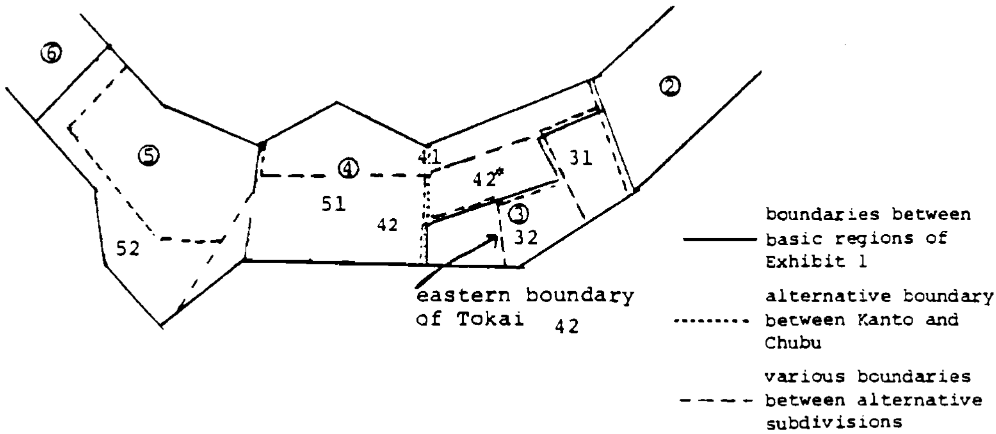


Figure 7.17 SOME EXAMPLES OF OVERLAPPING IN REGIONAL NOMENCLATUR

2.	Tohoku				
3.	Kanto	31.	Kita-Kanto	32.	Minami-Kanto
4.	Chubu	41.	Hokuriku	42.	Tokai 42*. Tosan
5.	Kinki	51.	Chukyo	52.	Coastal Kinki
6.	Chugoku				

Firstly, as stated in [8], p.22, the regional and prefectural data are not quite final and correct because of "areas in dispute." In [5], p.14, a procedure is outlined for setting the boundary disputes between prefectures and such disputes are reported to be numerous. Being, on the one hand, a proof for a relatively high degree of autonomy of local bodies in Japan it may be a marginal problem for determination of regions, though only inasmuch as the disputes may not occur on regions' borders. "Assignment," however, of prefectures to regions is by no means definite, which adds to inter-prefectural uncertainty in making the regional delineation fuzzy. Besides differences mentioned in Figure 7.1, one may cite a footnote from [21], p.13, stating that "Kinki and Chubu regions overlap in three prefectures: Fukui, Shiga and Mie." On the top, there is the differing number of regions, even obviously treated as "basic ones," e.g. distinction of Hokuriku ([22] and list of councils here, Table 7.7) or its inclusion into Chubu (or/and Kanto)--see [9].

Perhaps, however, the above uncertainties do not play any major role, and, even more, they point out the relative insignificance of region's delineations. In fact regions are not accounted for here as actors. They appear only as aggregate planning and statistical units (it is certainly difficult sometimes to list and easily read statistics for all of 47 prefectures), based on certain traditional prerequisites. The two main ways in which they administratively appear are: regional bureaus of some ministries that, as indicated, do not have any policy influences, and the regional planning division within NLA, elaborating (Fundamental Development) plan drafts and issuing opinions with reference to main highly developed regions. The latter bodies although having a definite input into policy formation, are entirely cut off from the implementation. Appropriate councils act over a loop that is still more distant from actual decisions (see Figure 7.12). For some special regions there also exist development promotion corporations (see list of corporations, Table 7.8). As can be seen easily from the above sketched picture the individual links of region-oriented societal system do by no means form a coherent chain. A capacity for creating such a chain from separate links could be created if prefectures, "belonging" to a region (where "belonging" would be defined by measures analogous to the ones applicable to prefectures themselves as outlined in [15] could have more direct input into regional plans of NLA. This sould at the same time constitute a connection between prefectural CDPs and national plans and will largely facilitate the coordination of prefectural prospects with ministerial planning. (For a multi-level system theory inspired analysis of the problems in Japanese regional planning systems see [33].) Furthermore if the "ministerial" regions corresponding to competent areas of their regional bureaus coincide with the above mentioned definitions of regions, then the coordination could be carried out down to the check-out of feasibility and actual implementation. Otherwise there can be no consequent and implementable regional policy, also with regard to transportation, as there could be no clear instruments for shaping the policies both from above and from below. The existence of regions as intermediate policy-formation-focuses is necessary for the appropriate shaping of the transportation system, especially in the case of Shinkansen, as the competence and influence of prefectures in Shinkansen planning can only be utterly local, marginal to the whole of the program, entirely centrally designed.

7.5 Conclusions

In this final short section a number of remarks will be set forth concerning the working of various regional policies in Japan formulated and implemented in the last three decades, and also the working of Shinkansen in pre-program and program stages as one of the instruments of regional policies. It is of special importance to see how Shinkansen (devised and implemented as a project in its initial stages and then transformed or upgraded to a national program in the period of rapid growth) and other instruments can function with the situation of lower growth and creeping changes in value expressions.

7.5.1. Regional Policies in Japan and Their Performance

Throughout the chapter a number of legislative, indicative or fully inobligatory moves or formulations have been mentioned which can be treated as utterances of certain policies.

Policy Expressions

1. Autonomy (direct election and taxation system)
2. Social Overhead Capital distribution
3. Planning (Comprehensive Development Plans,
   Basic Development Plans,
   Prefectural Comprehensive Development Plans)
4. Acts on land utilization, special areas and zones
5. Development centers and zones
6. Poly-grid formula
7. Shinkansen (transportation, communication)
8. Integrated regional growth?

The above are listed in chronological order; they do obviously belong to various categories, however. And thus 1 and 3 above represent subsequent steps of organizational policies while the other ones are meant to directly control concentration and movement of economies and thus foster "better" growth.

To these policy expressions certain goals correspond which can be translated into the language of issues introduced in this chapter.

Policy Goals	Awaited Direct Issue Changes
1. Political equity; decentralization of power	Equity↑ Regional stability↑
2. Improvement of infrastructure conditions	Efficiency and Equity↑ Location↑ SOC↑ Accessibility↑ Urbanization↓
3. Rationalization and coordination	Overall indirect improvement
4. Control of land use	Location↑ Urbanization↓
5. Spread of economics	Efficiency and Equity↑ Location↑ Urbanization↓
6. Involvement of the whole country in the qualitative change	Efficiency and Equity↑ Location↑ Accessibility↑ (Urbanization↓)
7. Spread of innovation, activation of peripheral regions	Accessibility↑
8. Fostering of internal solutions	Equity↑ Regional stability↑ Local separation↓

Actual performance of policies can be measured against specific indices oriented at issue change measurement. These indices correspond to some extent to perspectives taken by various actor groups in their evaluation of possible systems developments seen through issue changes. As such, they should be taken into account in the planning and design of the program both in its physical contents and in establishment of the management system. Their conjoint consideration stems not only from socio-technical necessities, but also from their actual interrelations (contribution, complementarity, substitution, competition, etc.) within the broad social value formation context. The information contents aspect of various indices should not be overlooked either (aggregate vs. specific indices).

Policy Performance Measures

a. Efficiency: GNP, GNP / capita additions vs. investment, etc.
   Equity: discrepancy measures (standard deviation, the Hoover index, etc.) of regional personal and overall incomes, of output and productivity. (Figure 7.4)
   Efficiency vs. Equity: mutual marginal costs over time.

b. Location: spatial distribution of private investments, growth and productivity of various centers (Table 7.4).

c. SOC: shares in public investment and spatial distribution (Table 7.3).

d. Accessibility: traffic and communications volume, general mobility (see Transportation and Railway chapters in this report as well as [5]).

e. Urbanization: urban growth in populations and in areas, migrations (Table 7.5 and Figure 7.11).

f. Regional Stability; regional output and productivity increases, diversification of regional economy, especially the export base, its sensitivity to outside conditions (prices).

g. Local Separation: numbers of users and impactees, consumers' surplus vs. (potential) compensation.

   (More data on the above are given in Appendix 2 dealing with models.)

As the more detailed considerations were already presented in the text only an overall assessment will be given here, centering around the measures listed above.

The changes in Japanese regional subsystems are marked by progressing deconcentration, spread of economies and of urban areas within and on the frontier of the Pacific Coast Belt and metropolitan regions serving for maintenance of high national economic efficiency, accompanied by persisting disparity between these country's core areas and the rest of it. The gap is slowly being bridged in some important, but economically superficial inficators (incomes), while actual differences in regional economies (productivities) are still there. Such a situation, which cannot be looked at as a fully positive one, certainly results partly from the fact that the internal system's forces (economies, implementation systems) were far stronger then the policy instruments meant to control them. Actually, the policies worked much better (production, trade and service, population growth) where they coincided with the "natural" internal trends and worked inefficiently where they had to "fight back" these trends because they reached too far beyond the frontier of economies. The "natural" trends cannot be regarded as negative per se, they should rather be appropriately channeled through creation of infrastructural bases for the spread of economies, so that with the least investment and least marginal and nuisance externalities the largest growth rate can be achieved. This presupposes, however, that the mutual cost of growth and its externalities are established and made explicit. An adequate result of this kind can only be obtained through consideration of multi-value inter-actor societal relations.

More tangible results of the regional policies could probably be addressed if more direct and indirect investments were put into them. If, however, the investment were to be used more efficiently then either they would have to be coupled with stronger controls or, even more importantly, they would have to be made with full recognition of spatial and temporal changes in economies.

7.5.2 The Shinkansen as a Regional Policy Instrument

When speaking of a new transportation mode as a policy instrument one should recall that transportation has two distinct systemic functions: the homeostatic one, for relieving tensions arising in the system and the strategic one, participating in the reshapement of the system in preparation to events which have not yet caused the tensions to rise. The first function has, to some extent, triggered the introduction of Shinkansen to the Tokaido line: the supply/demand situation there was at the verge of a bottleneck. Further extensions, though, did not aim at the immediate resolution of supply/demand inbalances. They were aimed at strategic policy implementation. The sense of distinction of the two types of functions can more clearly be seen when one regards the relative significance of Shinkansen in its various stages. The effects of the Tokaido and Sanyo Shinkansen lines can hardly be retraced on a macroeconomic level (the level of importance for Japan of the agglomerations through which it was routed), although its importance in purely traffic terms is immense. The future lines of Shinkansen will have much less traffic flow and will not be that necessary for the liquidation of bottlenecks, but their significance for deserved areas will be far greater then in the case of the first two pieces of line. Progressing development of the "New Trunk Lines", which initially made a contribution to national growth, will gradually contribute more (Table 7.10) to regional growth up to a point of relative saturation of multiplier effect. To assure the appropriate contribution to the regional growth, however, the Shinkansen program implementation must be adequately coupled with other accompanying and complementary transportation and infrastructural investments. Otherwise, while triggering certain growth, the injection of Shinkansen may provoke undesirable phenomena related to stability (whether with regard to own regional dynamics or external disturbances). (Necessary precautions, relieving and opportunity-preparation steps can only be made with sufficiently competent and persuasive regional bodies having the capability of real program shaping and infrastructural adjustments in cooperation with industries. The argumentation presented when considering the uncertainty of regional delineations also went in this direction.) In its slow shift of contribution from national to regional growth, Shinkansen would therefore be following the main-stream of value expression changes in the societal system.

It is with regard to relative regional tangibility of further extension of Shinkansen that it is essential to know with which schedule and accompanying/complementary actions the 7000 km Basic

Plan will be executed. Delays, as mentioned earlier may hinder the regional development in potentially "Shinkansenizable" areas to some extent, but may be beneficial to "non-Shinkansen-resilient" locales (let alone the budget).

As far as further extensions go, one may refer here to ideas of "reshapement of the archipelago" in which an all-pervasive Shinkansen, coupled with other transportation means and communication facilitation played an important role. These very ambitious ideas (i.e. the schedules and the future structures) were feasible only with steady and very high growth rates (perhaps even higher than the ones prevailing when the ideas formulated). It is quite possible, on the other hand, that pursuance of such policies with full force, i.e. transferring the core's growth-output to the whole of the country might not have given net ultimate benefit because of too big a discrepancy in relation to the pace of spatial economies and diseconomies. Thus, perhaps, a better time horizon could be chosen for the ideas by moving the achievement of the new shape further into the future. This has happened in reality, a feasible, but distant vision has been delayed simply by a less advantageous external situation. Decrease in free capacity and quicker discounting moved the new shape further off but then also introduced more flexibility into a practical realization of the idea. In relation to Shinkansen it may be said that new techniques could be available for the new time span (LEM), better coupling with other developing modes will be made possible and the realization of an all-Japan Shinkansen network will continue as it will parallel the development of societal trends.

For a full, and not point-wise (considering individual locations and individual actors within the area) assessment of the regional (but also national) significance of Shinkansen we must wait until the whole response gets deployed for these lines where it can really be retraced. In particular the response must be clearly seen through the recession effects. This response period must be sufficiently longer than the infrastructure injection time in order to get rid of the transitory period oscillations (see Figure 7.15). Because of all this it may be assumed that in about 1985 (at the earliest), following the example of Stage I of the program, some definite conclusions will be reached and will facilitate better realization of the subsequent stages of the national program with regional effects.

Table 7.10 Contributions to Issues made by Shinkansen Additions

Issues / Shinkansen stages	National vs. Regional Growth (Efficiency vs. Equity)	Industrial Location	Social Over-head Capital Distribution	Interregional Accessibility	Urbanization & Urban sprawl	Regional Stability	Local Separation of Benefits and Losses
A. Preprogram 1070 km	Efficiency +(+) Equity (-)	Addition of new capacities +	(More intra-structural) (+)	(Weight of time) +++	Promotion of urbanization and addition of disadvantages ( )	(Case Nagoya - compared with Kyoto) -	Suita
B. Stage I 1935 km	Efficiency + (Fukushima and Niigata: +(+)) Equity (-)	(Less than for A.) (+)	(As for A.) (+)	(Less weight than in A.) ++	Depending on the segment: ( ) or void	(Better pre-cautions ?) ( )	(Smaller localities) -
C. Stage II 1502 km	Efficiency ++ Equity + (Inter-non-capital-centre-traffic)	Hokuriku and Kyushu: +(+) Hokkaido: (+)	(As for A.) (+)	(Less weight but full span) ++	(-) or void	Void or (+)? (character of the areas and distance from main centres)	( )
D. Basic plan 7000 km	Efficiency + Equity ++ (remark as for C.)	(+)	Less of other effects, and so: +	(Still less weight, but all-pervasive) ++	(-) or void depending on other, accompanying investments	(-), void or even (+), depending on place in centres hierarchy	-
E. Further extensions	Efficiency: (+) Equity: + Less important for regions than D. If infrastructure present	(+) or void (less than for D.)	(As above) +	(Less effective, esp. if other infrastructure present) +	void	Almost none	(-)

Footnotes for Table 7.10

Shinkansen stages

	Line	Length	Total length
A:	Preprogram:		
	Tokaido and Sanyo:	∿ 1070 km	
B:	Stage I:		
	Tohoku (Morioka):	∿ 500 km	
	Joetsu (Niigata):	∿ 300 km	
	Narita (Narita):	∿ 65 km	
		∿ 865 km	∿ 1935 km
C:	Stage II:		
	Tohoku IInd stage (Aomori):	∿ 170 km	
	Hokkaido (Sapporo):	∿ 370 km	
	Hokuriku (Takasaki - Toyama - Tsuruga - Osaka):	∿ 590 km	
	Kyushu I (Nagasaki):	∿ 120 km	
	Kyushu II (Kagoshima):	∿ 270 km	
		1520 km	∿ 3500 km
D.	Basic Plan:		∿ 7000 km
E.	Further extensions?		∿ 9000 km ?

Contributions of Shinkansen extensions to issue increments:

+++ essential (+) or (-) uncertain

++ important

\+ positive

void

\- negative

Appendix 1

7A.1 The Interaction Structure: An Outline for Analysis

This Appendix constitutes an addendum, in order to justify some of what has been said before, and at the same time a blow-up, showing more details in a quasi-rigorous frame, a shorthand of, or an introduction to a more in-depth analysis.

A series of four tables will be shown, serving for the presentation of perceptional interrelations between actors and issues, interaction of actors and finally policy stances of actors with regard to issues (for logical sequencing of tables, see Fig. 7A1.1).

The first table, table aA (Table 7A1.1) shows actors' (rows) interests (entries) in various issue areas (columns). These interests result from direct consequences which arise within each issue area for the attainment of the actor's goals. In the most primitive case the interests linked with individual issues would represent elements (whether additive or multiplicative) of a (multi-) linear goal function appearing at the end of the row. This is not feasible (and, in any case, not attempted) here because of the non-trivial relations among issues.

With instruments and value expression (given for each actor) in terms of goals one can pass over to application by actors of these instruments to issue areas so as to achieve desired changes in goal attainment. Thus, a table akin to interaction table aB. (Table 7A1.2) can be obtained. Table aB shows actors (rows), instruments, of course, coincide with positions of interests they refer to.

In the previous two tables the direct goal contributions and the use of instruments to shape these direct goal contributions were presented. As mentioned above, however, issues are interrelated in a certain cause-and-effect pattern. Actors recognize this and in their real actions take into account also indirect contributions and indirect instrument-use influences. Table b (Table 7A1.3) shows how issues (rows) are interrelated (entries) with other issues (columns), so as to form a portion of a cause-and-affect model explaining behavior of the socio-economic system looked at.

On the basis of table aA, it is possible to determine interest-overlappings among actors. This can be shown in table cA which is not given here because of too much complexity (17x17), containing actors (rows), their interests (entries) and other actors (columns) expressing some interests. Of course, such a table should be based not immediately on table aA, but rather on an expansion of the latter into a series generated through cause-and-effect links from table b (Table 7A1.3). (For various paths of interaction tables' determination, see Figure 7A1.1). Here only very rough approximations have been taken as inferred from information obtained during the field study.

The table cB, in which actors (rows) would be shown in their operation of instruments (entries), affecting in turn other actors (columns), can be interpreted and constructed in two ways. Firstly, primitively, that the actors try to shape their outcomes in terms of goal measures by influencing with instruments the state of their interests and thus they also "incidentally" influence other actors. In reality, however, actors do not only account for direct and indirect contributions to the attainment of their goal, but also such contributions to values of other actors and therefore their presumed behavior in terms of instruments. This is how the interactive societal process of <u>debate, policy formation</u> and finally the taking of ultimate <u>decision</u> is geared through perception generation, exchange of information and incremental moves. This passage from interaction among actors (table cB) to real actions is illustrated by table d (Table 7A1.4). The simplest, although inapplicable, interpretation would be that, if table cB may represent various policy options, then for each combination of individual options a table akin to d would be generated: actors (rows) their policies (entries), issues(columns). In the present case a straightforward estimation was made of what could be expected from the present state of affairs and business-as-usual assumption. The categories of policies were exemplified, to be operationalized for the given previous tables.

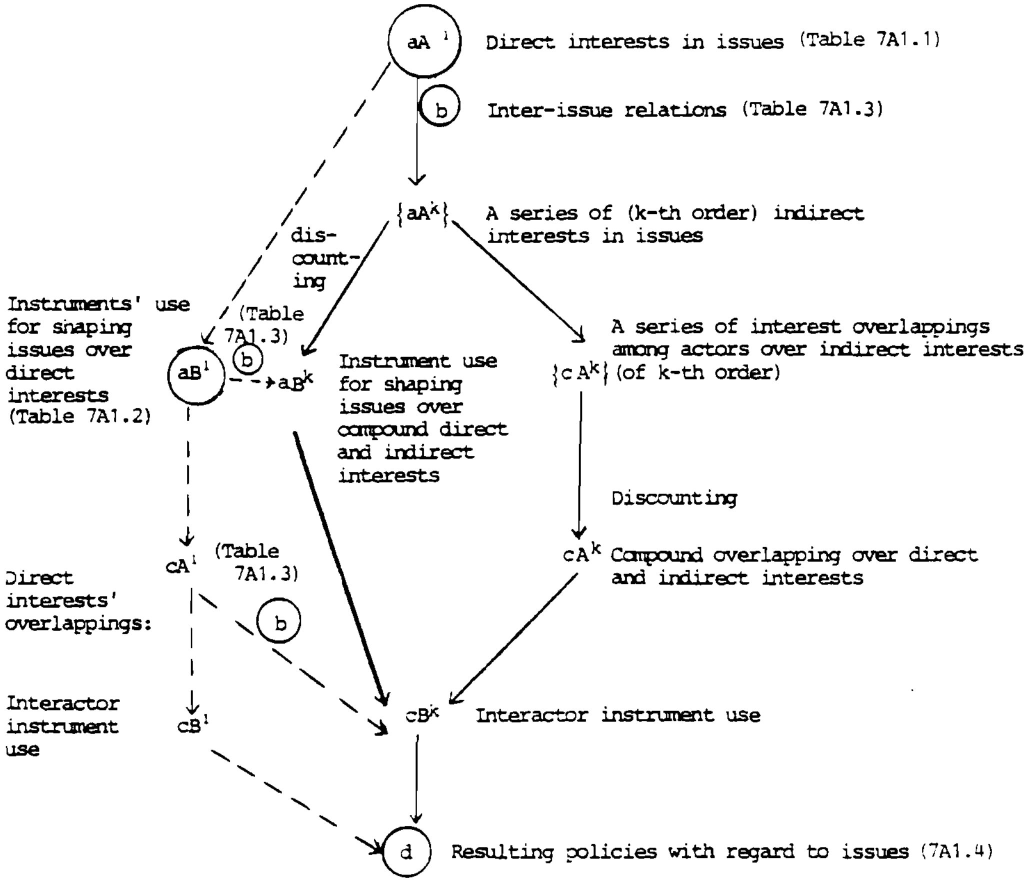


Figure 7A.1.1. Sequence of analysis of societal decision process, its results and their potential consequences carried out through establishment and operations on the interaciton tables. Interactions omitted:

⟶ : main line of analysis

- - -› : short-cut approximate analysis based on only direct interests, illustrated in the Appendix

○ : tables exemplified in the Appendix

x^1 : first order (direct interaction) table

$\{x^k\}$: a series of k-th order (indirect) interaction tables

x^k : a summary (compound) table accounting for k-th order interaction

Table 7A1.1. Interaction Table aA

Issues / Actors		National vs. Regional growth (Efficiency vs. Equity)	Industrial Location	Social Overhead Capital Distribution	Interregional Accessibility	Urbanization & Urban Sprawl	Regional Stability	Local Separation of Benefits & Losses	Goals of actors $\sum$
Government: PM & his Cabinet		Preservation of growth	Satisfaction of big industry	Satisfaction of regions	"Images of archipelago"	General alleviation	Void	Void	Stable growth
MoF		Efficiency	Economies	Productive infrastructure	Inductive and for freight	Void	Economic capacity	Compensation & tax flows	Financial balance
EPA		Broad efficiency; regional potentials	Future economies	Indirectly productive infrastructure	General improvement with constraints	Future diseconomies	Economic resilience	Void	Secure growth
NLA		Balance	Non-over-concentration	Volume: + Spread: +	+ +	-	Growth of carrying capacities	Balancing & Compensation	Balanced growth
MHA		Equity	(Relocation)	(Equal distribution)	Void	(-)	Economic capacity	Balance	Autonomy
MITI		Broad efficiency; regional potentials	Restrained (discounted) economies	Productive & inducing infrastructure	Productive	Possible diseconomies	Preservation of capacities	Void	Industrial long-term growth
MoC		Void	(Economies)	+	+	(-)	Void	Compensation	Growth of sector
MoT		Void	(Economies)	+	+	(-)	Void	Compensation	Growth of sector
Central Public Corporation		Mostly efficiency	(Economies)	+	+	(-) or void	Capacities	Compensations	Projects and profit
Big Business		Efficiency	Concentration	Productive infrastructure	+	Possible diseconomies	Capacities	Compensations	Profit and growth
Small & Medium Local Business		Balance	Local concentration	Productive & servicing infrastructure	(+), void or (-)	(-) or void	+	+ or (-)	Profit and growth
Prefectures Municipal	Capital area	Broad efficiency	Relocation; Restructuring	Servicing infrastructure	(+)	- -	+	(-)	Stability
	Core areas	Balance	Restructuration	Servicing & productive infrastructure	(+) or void	- -	+	(-)	Stability & growth
	Peripheral	Equity	(Relocation)	Productive & servicing infrastructure	(+) or void	(-)	+	(-)	Growth
Citizens	core & central areas	Balance	Restructuring	Servicing infrastructure	+	- -	(+)	-	Human life
	peripheral	Equity	Restructuring	Productive & servicing infrastructure	+	(-)	(+)	-	Human life and a rich life
$\sum$ Comprehensive trends in issues		Balance through utilization of potentials	Programming of potentials and restructuring	Dispersion & balance of infrastructures	Growth, with reservations	Controlled urban development	Strengthening of absorption and manoeuvre capacities of local economies	Compensations? (Not participation?)	Interests

Table 7A1.2. Interaction Table aB

Actors \ Issues		National vs. Regional growth (Efficiency vs. Equity)	Industrial Location	Social Overhead Capital Distribution	Interregional Accessibility	Urbanizational & Urban Sprawl	Regional Stability	Local Separation of benefits and losses
Government: PM & his Cabinet			General policy initiatives, formulations and consensus process control; administrative proposals					
MoF		Budgeting; Taxes	Taxes	Budgeting; Taxes		Taxes	Budgeting, Taxes	Taxes
EPA		Plans	Coordination		Hearings			Void
NLA		(Plans)	Land use control acts	(Plans & coordination)		Land use control acts	(Plans)	Land use control Acts
MHA				Budgeting		(Procedures)	Budgeting	Procedures
MITI		Policies in dealings with industries	Standards; Authorizations			Standards; Authorizations;		Standards
MoC		(Policies) Projects	Projects of infrastructures	Project policies (volume, type, distribution)				Compensation; Routing; Location
MoT		(Policies) Projects	Provision of traffic conditions (incl. fares)	Project and fare policies (volume, type, distribution)				Compensation; Fares; Routing; Location
Central Public Corporations								
Big business		Investment policies	Potential activation & employment			Additional Investments	Contracts; Cooperation	Compensation
Small & Medium Local Business		Investments available	Potential activation & employment; Servicing				Contracts; Cooperation	
Pref. & Mun. govs.	Capital area	Policies in dealings with industries; zoning	Authorization for small industries; zoning	(Own investment) Approval		Land use plans; Zoning	Investments; Financial allevlations	Compensations
	Core areas							
	Peripheral areas							
Citizens	core & central areas	Migration; Demands	Migration; Complaints		Migration	Migration; Complaints		Complaints
	Peripheral	Migration; Demands	Migration; Complaints		Commuting; Mobility	Migration; Complaints		Complaints
								EA: Standards; procedures
								Instruments

Table 7A1.3. Interaction Table b

Issues / Issues		National vs Regional growth (Efficiency vs. Equity)		Industrial Location		Social Overhead Capital Distribution		Accessibility	Urbanization	Stability	Local Separation
		Efficiency	Equity	Concentration	Decongestion	Productive	Social				
E vs. E	Efficiency	(+) indirect	-	(+)	(-)	+	(+)	(+)	(-)	(+)	( )
	Equity	-	(+) indirect	(-)	(+)	(+)	+	(+)	(+)	(+/)	(+)
Location	Concentration	(+) declines	-				(+)		- -	-	
	Decongestion	(-) increases	+			+	+	+	(+) Pattern	Pattern	Pattern
SOC	Productive	+	(+)	Pattern	Pattern		(+) indirect	+	Pattern	Pattern	-
	Social	(+)	+	(+)	+	(+) indirect		+	(+) Pattern	(+) Pattern	(+)
Accessibility		Configuration (+)	Configuration (+)	Configuration	Configuration (+)				Configuration (+)	Configuration	Configuration
Urbanization		(+) declines	-	(+) declines	(+) increases					-	
Stability		+	+	(+)	+				(-)		
Local Separation		(-)	(-)		(-)				(-)	- -	

Table 7A1.4. Interaction Table d

Issues / Actors		National vs. Regional growth (Efficiency vs. Equity	Industrial Location	Social Over-head Capital Distribution	Interregional Accessibility	Urbanization & Urban sprawl	Regional Stability	Local separation of benefits & losses
Government & Cabinet		Stability promotion						
MoF		Financial Soundness	Rationality	Restraints				
EPA		Steady growth	Utilization of available economies	Adjustments	Rationalization			
NLA		Balanced development	Resource orientation	Preparation to future development	Adjustments	Control		
MHA								
MITI		Discounted long-term economies	Rationality			Rationality	Combined development	Control
MoC		Actual needs	Rationality	Routine	Adjustments to expansion	Controlled development		
MoT		Actual needs	Rationality	Routine	Adjustments to expansion			
Central Publ. Corporations			Rationality		Rationality			
Big Businesses		Restrained expansion	Rationality			Slow relocation	Care	Care
Small & medium local business			Direct advantages				Cooperation	
Prof. & municipal govs.	Capital	Export of growth					Preparation	Controls
	Core	Restructuration	Restructuration				Preparation	Controls
	Peripheral	Image promotion					Preparation	Controls
Citizens	Core & capital		Outmigration			Outmigration		Suits
	Peripheral		Less migration			Less migration		Suits

Policies & Trends

The outlined course of analysis, if treated rigorously, will involve very detailed modeling considerations (generation of table expansions, discounting, identification of intertable relations, establishment of interactive algorithms of stable policy solution finding, its resolution or assessment of convergence, etc.). As it was not possible within the frame of the field study conducted, only superficial use was made of a procedure which can be proposed as a rational way of analyzing societal processes and their likely outcomes.

Appendix 2

7A.2 Models and Their Use in Analysis of Regional Impacts

7A.2.1 The Models and Studies Considered

The small sample of models and studies assembled here contains items of two types. The first type comprises those which were explicitly aimed at the analysis of transportation development strategies, including Shinkansen, and their influence on regional and national economies. The models belonging to the second type are not directly related to Shinkansen or even to transportation system strategies, but were picked up as one that would have been necessary to complement adequate comprehensive model systems, if such were created.

The list in Table 7A2.1 gives all the studies and models accounted for together with their main characteristics.

7A.2.2 The Place of Impact Models

The role and adequateness of models in their functioning as elements of the decision making systems is assessed on the basis of the simple decision-procedure loop as presented e.g. in [30]. This loop can for present purposes be roughly represented as in the figure below.

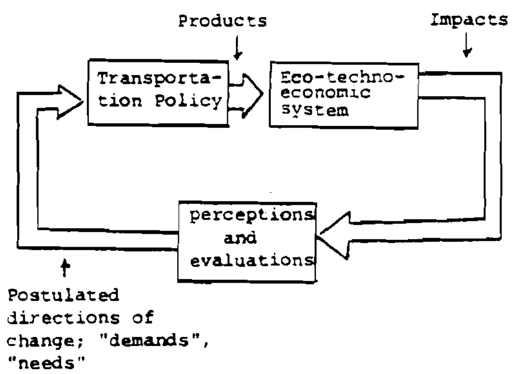


Figure 7A2.1 THE GENERAL DECISION PROCEDURE LOOP

The transportation policy is formed by defining such main choice objects as share of transportation modes, volume of investments and their timing, relative volume of absorbed traffic, prices, and of course locations. Decisions as to these items are made in the inter-institutional decision process, so that the general loop is in reality composed of numerous individual decision makers' loops geared by their particular interests and competence scopes. Such a view has to be complemented for assessment purposes with a more general one in which the loop is deployed along levels of socio-economic organization or physical scope of decision consequences and along time. Closely correlated with the above is the question of economic scope of consequences. One could therefore arrive at the decision process as shaped according to Figure 7A2.2.

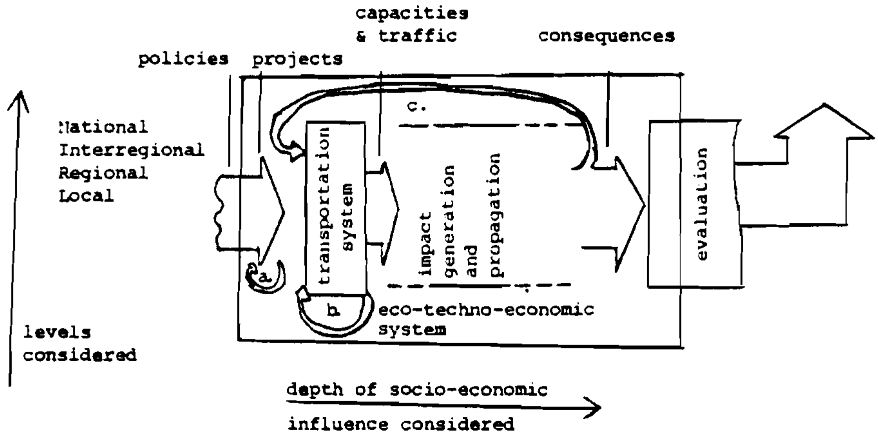


Figure 7A2.2 TWO DIRECTIONS OF DEPLOYMENT OF THE BASIC DECISION LOOP

Some remarks are due on the diagram. First, that all the interventions made on the systems are propagated through it, so that due account should be taken of the projects themselves. Second, that the loop closures exist within the loop depicted here and are either of execution control or of homeostatic character. The first applies, e.g., to control of project execution (loop a.)

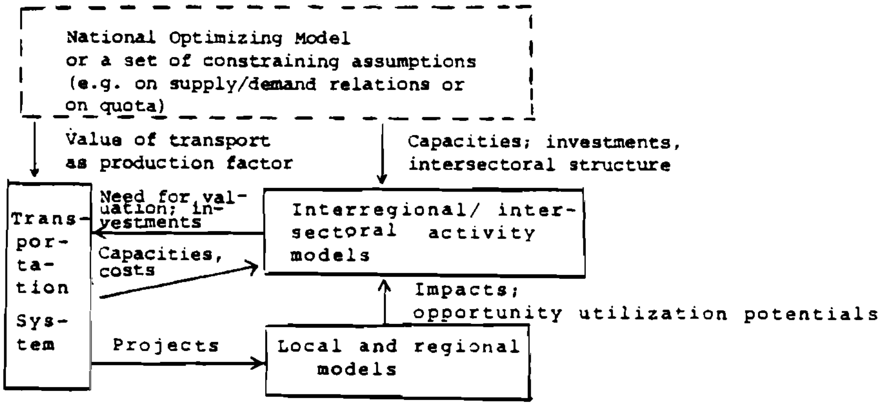
Table 7A2.1. Models and Studies Considered

No.	Model of Study	Economic Scope of Consideration: Modes of Transport	Economic Scope of Consideration: Other Sectors	Time Horizon	Physical level/scope of consideration — Land/Scope of Analysis (X-representation, O-type of value): local	reg.	Inter. reg.	nat.	Assessment Criterion Category
1	Nomura Research Institute: Chuo line study [7]	Shinkansen	local businesses	undef. (med. term)	⊗	x			State of local economy
2	S. Okabe, T. Sasaki: Impact on localities [13] [23]	Shinkansen	local business (mainly trade	undef. (few yrs)	⊗	x	(x)		Gains and losses of trade along the Osaka-Fukuoka Line
3	T. Hasegawa: Inter-city Relations 8B [6]	Shinkansen	Population related to aggregate economic activity indices	very long 100 yrs	⊗	(x)	(x)		City viability seen through population changes
4	T. Oku and S. Kato: Customer-surplus over the lines [24]	Railway (Shinkansen) and highway; allocation to distances and traffic	Aggregate regional and national production indices (from 5)	(up to 10-15 yrs)	(x)	x	(x)	(x)	Passengers' consumer surplus and regional gross product
5	K. Amano: Regional and national economic impact [25]	Railway (Shinkansen) and highway	Interregional/Intersectoral I/O model	up to 10-15 yrs		⊗	x	⊗	National and regional output indices, interregional disparities
6	N. Sakashita: Regional and national economic impact [5]	Transportation (Shinkansen)	Interregional Intersectoral I/O model	up to 10-15 yrs		⊗	(x)	⊗	as above
7	Mitsubishi Research Institute: Local transportation studies	Mix of modes	Passengers	medium term	⊗				Economic efficiency, user's utility and externalities
8	K. Amano: Metropolitan area model	Mix of modes in an aggregate form	Metropolitan economy	up to 10-15 yrs	(x)	⊗			Aggregate economic indices
9	T. Fukuchi and W. Nobukuni: Agglomeration's economy	Aggregate	Macroeconomic model	up to 30 yrs		x	x		Population and capital formation changes
10	Mitsubishi Research Institute: Bay Bridge Impact Study	Transportation infrastructure: Bridges	Interregional macroeconomic model	up to 10-15 yrs	·	(x)	x	⊗	Gross production indices
11	T. Fukuchi: Bay Bridge Model	Transportation infrastructure: Bridges	Interregional macroeconomic model	up to 10-15 yrs		(x)	x	⊗	Gross production indices
12	Mitsubishi Research Institute: Traffic projections	Aggregate + railway	Macroeconomic interregional model	up to 20 years		x	x	x	
13	T. Kawashima et al: BALANO	Aggregate + roads	Macroeconomic interregional model	med. term		⊗	x	⊗	Aggregate economic

or to control of actual transportation systems' performance (loop b), the latter to supply/demand and capital formation relations with economy in its sectoral and regional breakdown (loop c).

It is postulated that for the assessment model system to be adequate it must provide as well for estimation of needs in transportation system, for it is the level of needs that specifies the degree of satisfaction with given transportation policy. The needs, which for the purposes of Shinkansen study would have mainly interregional and local character, can be determined either as sheer demands resulting from interregional I/O structure or as valuations of transportation capacity additions. In the latter case the specification of economically tangible impact would be straightforward. It will require, however, a solution of an optimization-type task on the higher (national) level. A proposal for such a way of proceeding is given in [31], with due account for resource cost nonlinearities, important in the Japanese case. Also, a quasi-hierarchy of public investment objectives which are pertinent in case of transportation is given in [32] as: stabilization (or growth), income distribution and resource allocation. Whichever objectives are aimed at the higher level, however, the interregional module (see Figure 7A2.3a) has to account for needs and effects in the sense mentioned above. Of special importance is to have the clear picture of these sectors and activities for which the projects under consideration have the greatest significance. On the other hadn, the intraregional and local impact models should show and, if possible, evaluate, the externalities that may arise in connection with the projects and which cannot be dealt with in a more aggregate model. These models would also account for local absorption and impact utilization potentials in most affected domains, therefore showing the need for and significance of given transportation additions to individual locations. The structure obtained through mapping of models from the sample into the general framework is shown in Figure 7A2.3.b.

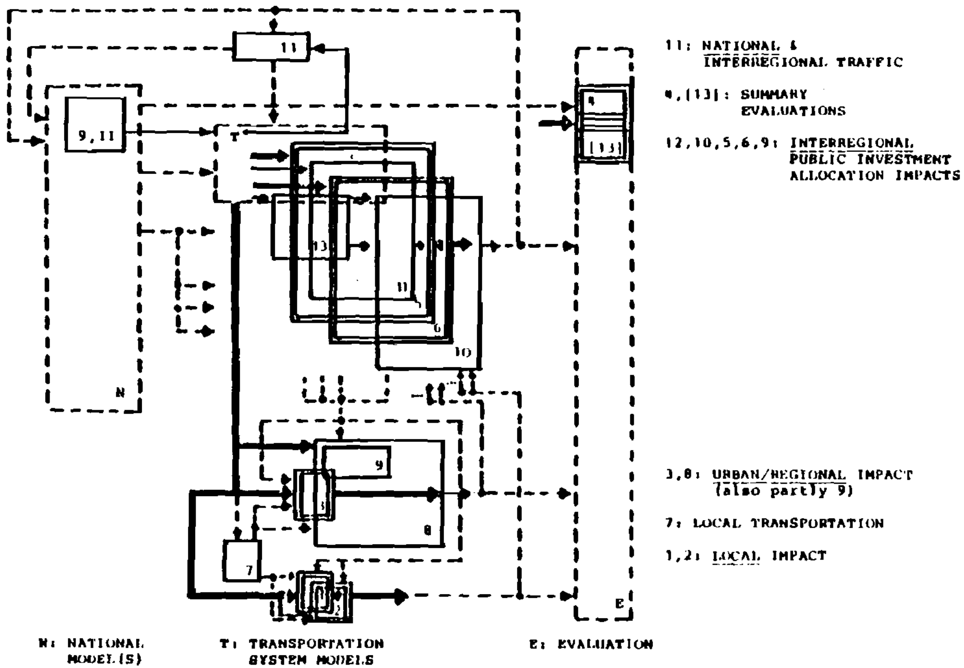
Figure 7A2.3a CATEGORIES OF MODELS AND THEIR INTERRELATIONS



7A.2.3. Types of Problems and Awaited Results

Through provision of assessment data, if not directly through evaluation, the impact models should help in answering what kind of project, where and when should be constructed and what volume it should have. In case of regional considerations, much more than for intra-transportational or even national economic ones, the answers to the above questions depend largely upon the answer to the question: what for? This means establishment of balance conditions (based on the long-term pattern of interrelations) or of a coordination procedure between the national efficiency, regional growth and environmental improvement objectives. As all of these have to be made explicit, however, the impact models should provide the assessment basis for the whole spectrum of values:

Figure 7A2.3.b MAPPING OF CONSIDERED MODELS AND STUDIES INTO THE GENERAL STRUCTURE



* Influence /significance of the construction project	o labor/employment o services o local suppliers o material and land requirements o compensations; land acquiring	local
	o propagation of activation o persistence of consequences	regional & inter-regional
* Influence/significance of the transportation facility	o user (passenger)/impactee differentials o compensations	local
	o station zone activation o passenger in- and outflow potential for individual locations and consequences for tertiary sector (trade, higher services, culture, tourism, higher functions) o resulting contribution to urbanization and concentration	regional & inter-regional
	o resulting national growth differences	national

All of the above should be differentiated for subsequent Shinkansen program additions coupled with alternative highway and/or air transportation options. For local considerations: station siting and possible local transportation restructuration options should be accounted for.

To obtain the necessary information extensive use could be made of I/O models on all levels, both for propagation of potential impact (final demand + change in transportation conditions) and for projecting the transportation demand. It would be very important to relate physical requirements and changes induced by introduction of the Shinkansen to monetary flows (investment volumes, operating cost, incomes, wages, compensations etc.). Over longer time horizons structural types of models could be applied, e.g., SD.

Out of the spectrum of efficiency/effectiveness measures proposed in [30] one can pick up these which can be applied to regional socio-economic contribution of Shinkansen:

* Monetary cost/benefit differentials for developer (broadly defined) and taxing authority for various segments of the network;
* Consumer surplus or other user-oriented measures as opposed to additional (externality) losses surrogate estimated e.g. through compensation costs;
* Sales and sales' induced production growth compared to investment volume;
* GRP/GNP type indices compared to investment volume.

There are a number of intermediate measures, addressing some of the issues in regional economic planning mentioned in the chapter, like contribution of the Shinkansen investment to SOC levels and distribution or (caused by the program) increase of accessibility and mobility, but they can by no means be regarded as final measures applicable to socio-economic changes. For a rough sketch of value areas represented by the above measures and actor representatives of these areas see Figure 7A2.4a. In Figure 7A2.4b the models accounting for related areas are shown.

Another important question is the opposition of regional and national growth rates induced by Shinkansen (if any such influence can be identified at all). For any study involving such assessment two principles should be kept to:

- that both net growth rates and their interregional disparity should be accounted for;
- that the measures be based upon populations affected rather than upon mere enumeration of inhomogeneous regions.

7A.2.4. Some Studies and Answers Provided

The following studies and their results will be considered here (numbers refer to Table 7A2.1):

6. N. Sakashita [5]: SPAMETRI
5. K. Amano [25]: Trade Pattern Coefficient Model
3. T. Hasegawa et al. [6]: Systems Dynamics...
2. S. Okabe [23]: Impact on localities, and T. Sanuki [13]: Role of Shinkansen
1. Nomura Research Institute [7]: Impact on Chuo Line

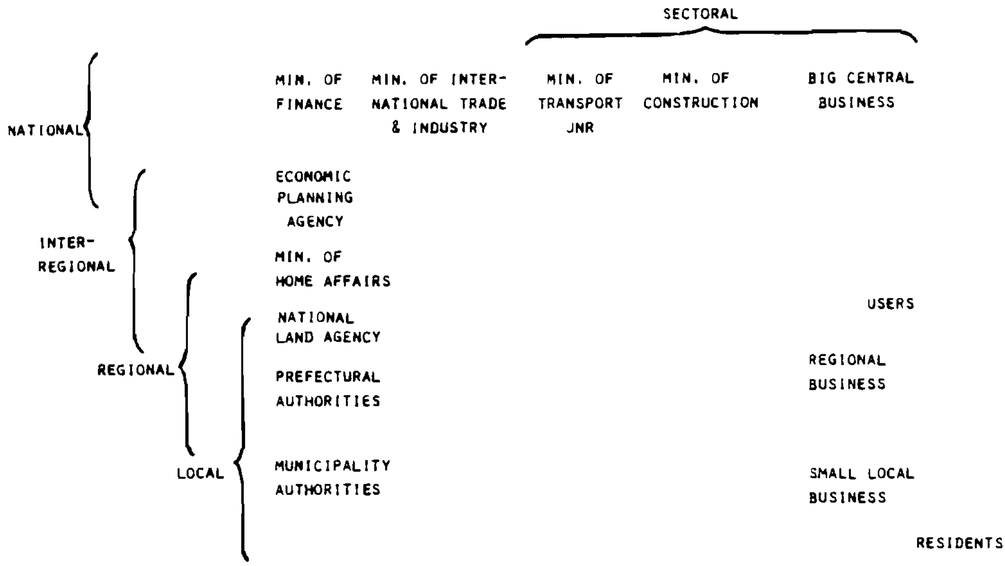


Figure 7A2.4.a. VALUE AREAS AND THEIR REPRESENTATIVES

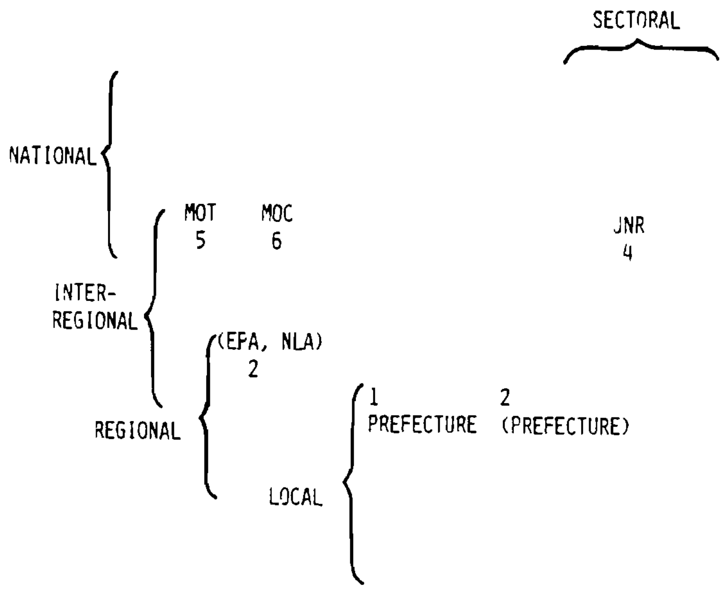


Figure 7A2.4.b. STUDIES: REPRESENTATION OF ACTORS AND VALUE AREAS

These studies, and subsequent presentation of their results in terms of corresponding efficiency measures are ordered from more general, "higher level" ones to more specific, local considerations. Such ordering was caused by the formal, modelling character of the general studies as opposed to non-formal studies of the local impact, and also by greater ease of operations on efficiency measures related to the general studies.

Two first items are the studies based upon models involving interregional I/O relations and the ways in which these are shaped by various public investment patterns, with special emphasis on transportation investments. In SPAMETRI some additional influence of transportation investments is accounted for through incorporation of mobility (accessibility) as a factor in the aggregate production functions. Results of these studies pertaine to regional and national economic (outputs, induced investments) and social (population, incomes) indices.

The third item considered might constitute a link between the higher level studies and the local studies (if not for the entirely different time horizon of these studies and the viewpoint taken), as it tries to assess the interrelations between two centers on the (Shinkansen) line. The methodology used is that of System Dynamics and the main object of analysis are various population groups and their changes resulting from changes in activity structure produced by increase in accessibility.

The local impact studies show what the actual (2) or potential (1) consequences of the Shinkansen introduction to local economic and social activities and functions can be. Because of the character of the super-express train lines (only passenger traffic) mainly the teriary industries and higher-level social functions are looked at.

In commenting on results of the studies three types of problems will be accounted for:

* Representation of various efficiency measures or of various actors viz. actor groups;
* Consistency with the potential model system structure as resulting from previous considerations on decision-making procedure and its deployment;

* (last but not least) significance of results for estimation of Shinkansen's contribution to regional development.

Additions to National Output

This particular measure is not of the main interest here, but should be cited if only to create a background against which some other measures may acquire additional significance.

Table 7A2.2 Some Results on Additions to National Output

No. in Table A2.1 Study: Reference	5 [25]	6 [5]	5 [25]	6	5[25]	5[25]
Analyzed time point	1966	1968	1970	1985	1987	1987
Other features, comments	Tokaido Line	Σ : Summary until 1968		Three transportation & other investment options: rail + other trsp. vs. hwy. vs. non-trnsp.	Shinkansen nt'wk v. hwy. network development S'ksn I stage + hwy II Stage	S'ksn II stage + hwy I Stage
Additional volume	425	272 Σ :1608	225	240(vs.hwy) 5101*,-813*	200 2800	3000
Overall output volume/ratio	70,005 0.59%	38,775 Σ : 235,917 9,70% 0,68%	97,308 -0.23%	127,605 -0.64%**		
Investment volume/ratio		Σ : 1502 107.06%			Σ :60 Σ :2420 333% 115.70%	Σ :2480 120.97%
Error of simulation/ ratio		1843 Σ : 1643 14.76% 97.87% σ:1185 $\frac{1}{n}\Sigma\|\ \|$:803				

Unit: 10^9 Reference: *no comparative investment
**same investment of other kind

"Ratios" indicate the ratios of additions volume to given volumes.

Above (Table 7A2.2) studies do evidently differ in definitions of output, but it is relative additions that matter the most. The need for standardization, however, is felt strongly as far as run characteristics (option specifications) are concerned, especially with regard to reference runs. There is some modest evidence of decline in significance of existing lines (see especially Study 6 for 1985!) and of somewhat higher efficiency than for highways. Both of these have, however, to be analyzed with reference to interregional traffic and growth rates projections and with reference to locally optimal transportation mode configurations. This means: studies in regional and interregional influence of transportation sector vs. the rest of the economy, and local negative impact mitigation and opportunity catchment analyses.

Regional Growth Disparities

The same two models were used in determination of interregional disparity indices. It is postulated that special attention be paid to both definition of indices and their comparison, so that appropriate trade-offs with regard to national growth indices can be explicitly specified. Here (Table 7A2.3), for the sake of illustration, the Hoover type index was shown for a series of cases, as introduced to the present problem area in [5]. Great disparity of index values can again be partly attributed to model differences, but they rather depend more on differences in option specifications. Most of the values were reconstructed from data available.

There is an important difference in contributions to H_A and H_A/V for the Tokaido Line as calculated with 5 and 6. This is certainly to some extent due to the "central growth distribution" mechanism existing in 6, which may tend to equalize growth as opposed to "internal growth determination" of 5. It is also possible that this phenomenon results from the role played by the accessibility factor in production functions of 6.

The signs of "collapse" of 5 for 1970 (especially if the lowering of volume additions ratio from about 0.60% to a mere 0.23% is added to the picture) are presumably connected with a premature saturation of the Tokaido Line's influence. (Such

Table 7A2.3 The Hoover Index and Its Changes As a Measure on Interregional Equity

Study: No. in Table A2.1 / Reference	5[25]	6[5]	5[25]	6	5[25]	5[25]
Analyzed time point	1966	1968	1970	1985	1987	1987
Comments	xxx:Shinkansen xxxx:no. Shinkansen ±xxx:difference xxx:incremental			xxx:rail xxx:hwy xxx:ref ±xxx:diff.1 ±xxx:diff.2	Cases same as in Table A2.2	
H_A: per area Hoover index	0.3557 0.3524 +0.0033 0.5589	0.3318 0.3374 -0.0056	0.3807 0.3744 +0.0063 2.8921	0.3569 0.3517 0.3608 ±0.0052 -0.0039	0.5747	0.3726
H_P: per population Hoover index	0.0864 0.0831 +0.0033 0.4031		0.1075 0.1022 +0.0053 2.7555	0.0588 0.0595 0.0579 -0.0007 +0.0016	0.3930	0.2320
H_A/V: H_A divided by output volume	0.0508 0.0506 +0.0002 0.0782*	0.0892 0.0914 -0.0022	0.0391 0.0386 +0.0005 0.2788*	0.0046 0.0047 0.0045 -0.0001 +0.0001	0.0021	0.0012

$$H_A = \frac{1}{2}\sum_{1}^{9}\left|\frac{V_i}{\Sigma v_i} - \frac{A_i}{\Sigma a_i}\right| \quad ; \quad H_P = \frac{1}{2}\sum_{1}^{9}\left|\frac{V_i}{\Sigma v_i} - \frac{P_i}{\Sigma p_i}\right| ,$$

$$\text{incremental} = \frac{1}{2}\sum_{1}^{9}\left|\frac{\Delta V_i}{\Sigma \Delta v_i} - \frac{X_i}{\Sigma X_i}\right| \quad ; \quad {}^{*}\frac{\Delta H_A}{\Sigma \Delta v_i} \quad ;$$

X: v_i - output, a_i - area, p_i - population of region

results point out the necessity of complementing the studies with analyses of urbanization and migration trends and resulting traffic changes). A different situation is created by step - wise development complemented by other modes of transportation shown in the last three columns. This type of development significantly decreases the index values. Comparison of the two last columns of Table 7A2.3 (more Shinkansen vs. more highway) and also of corresponding conclusions from Table 7A2.2 with the results of analysis performed in [24] (consumer surplus maximization and cost minimization yielding Shinkansen as the leading mode for longer--several hundred kms--and more traffic intensive lines, as opposed to expressway, highway and ordinary railway) indicates that the analyses do not account for more detailed regional and subregional phenomena which may have an important impact on the ultimate efficiency of investment strategies.

Regional Population Changes

One of the most essential indicators of processes taking place on the regional level are population changes, so that it is no wonder they were looked at both in 5 and 6. The results presented in [25] (Figure 7A2.5) show how the Shinkansen construction adds to concentration in PCB area (and in Kyushu as a dependant continuation?) with exception of the capital region itself. This, however, simply means amplification of the main features of existing trends (see e.g. [16]). The study conducted with model 6 for the period until 1985 shows similar phenomenon (Table 7A2.4.a and b) with the difference consisting in the addition of urban Tohoku as a part of megalopolis. Population changes in the Tokai region are also worth a closer look. In most of the predictions, and according to actual data as well, this region has the greatest population gains. This growth is mainly related to increases in the third Tokaido belt center: Nagoya. On the other hand, there is ample evidence of a drain of higher social functions from Nagoya to Tokyo and to some extent to the Osaka area (and also from Osaka to Tokyo) (Figure 7A2.8). This subregional problem has been modelled in Study 3 via the System Dynamics technique yielding the long-term result (seen already after approximately 40 years simulated for the overall time span of about 100 years) of turning the "sub" city into the labor place and concentrating managerial and trade functions in the "main" city (Figure 7A2.6). In addition, there will be an important growth in labor commuting to the "main" city, reaching about 17% of the employed labor force at the end of the simulation

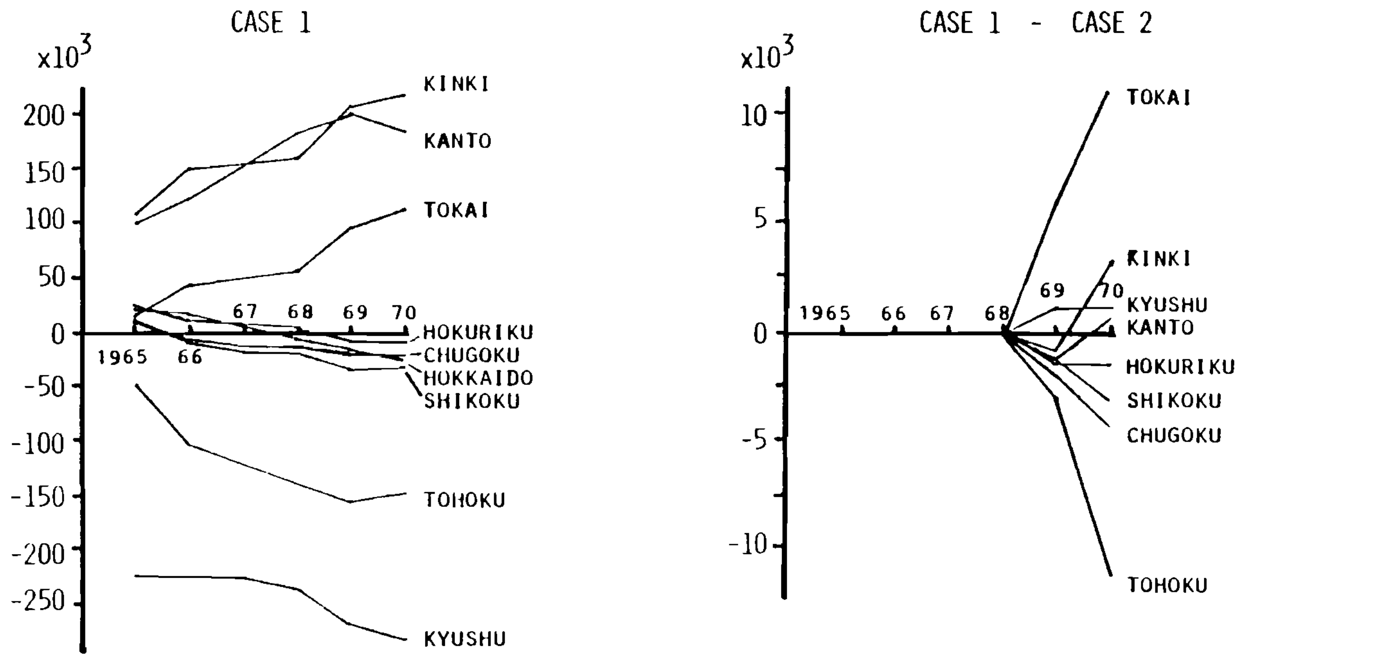


FIGURE 7A2.5. **REGIONAL POPULATION GROWTH : TRADE PATTERN COEFFICIENT MODEL**

CASE 1: WITH SHINKANSEN
CASE 2: WITHOUT SHINKANSEN

Table 7A2.4.a: Population Share Disparity Studies

YEAR/OPTION	1976	1985 HIGHWAYS	1985 RAIL + AIR + SHIP	1985 NON-TRANSPORTATION INVESTMENTS
HOOVER INDEX FOR POPULATION PER AREA	0.2736	0.3068	0.3078	0.3088

$$\frac{1}{2}\sum_{1}^{9}\left|\frac{p_i}{\Sigma p_i}-\frac{a_i}{\Sigma a_i}\right|$$

Table 7A2.4.b: Comparison of Population Shares $\frac{p_i}{\sum p_i}$.

	1976	1985 OPTIONS		
HOKKAIDO	0.0477	0.0488 ÷ 92		
TOHOKU	0.0823	0.0883 ÷ 87	↗	
KANTO	0.3767	0.3527 ÷ 58		↘↘
HOKURIKU	0.0191	0.0226	↗	
TOKAI	0.0341	0.1204 ÷ 11	↗↗↗	
KINKI	0.1681	0.1893 ÷ 1911	↗↗	
CHUGOKU	0.0656	0.0587 ÷ 0.0601		↘
SHIKOKU	0.0360	0.0300		↘
KYUSHU	0.1109	0.0846 ÷ 60		↘↘

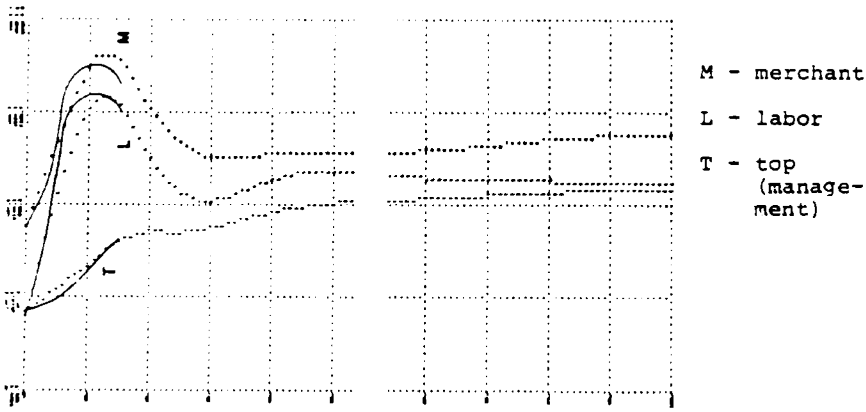


Figure 7A2.6.a POPULATION STRUCTURE OF THE MAIN CITY AT NIGHT, WITHOUT IMPACT

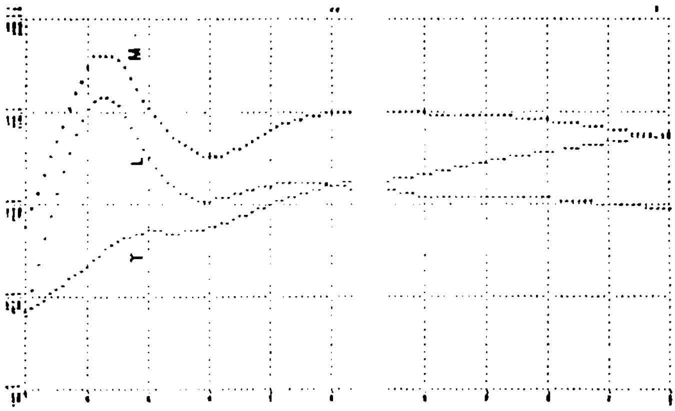
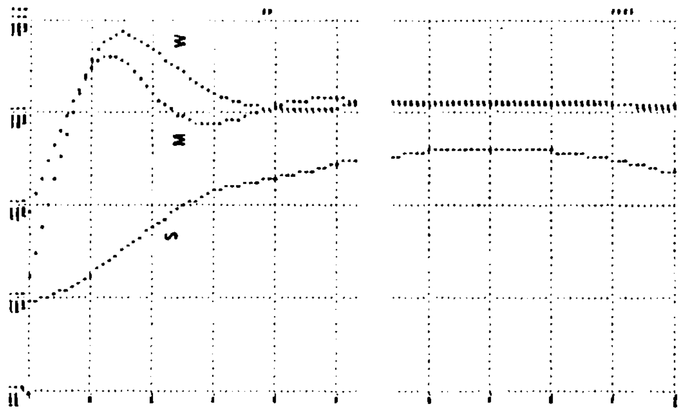


Figure 7A2.6.b POPULATION STRUCTURE OF THE MAIN CITY AT NIGHT, WITH IMPACT

period (Figure 7A2.7) and in trade and managerial commuting to the "sub" city. This result, although very appealing in its clarity, has to be verified in light of actual surveys (e.g. [7], [13] or [23], also see Tables 7A2.5.a and b).



W = main city daytime population

M = main city nighttime population

S = sub-city employment

Figure 7A2.7.a TOTAL POPULATION OF THE MAIN CITY AT NIGHT AND IN THE DAYTIME AND THE NUMBER OF EMPLOYMENT IN THE SUB-CITY, WITH IMPACT

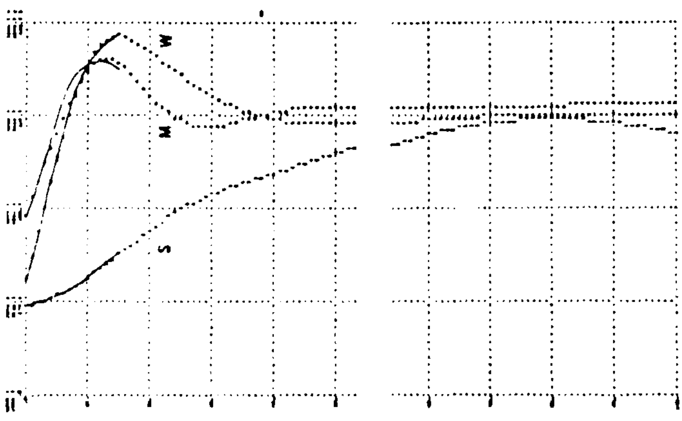
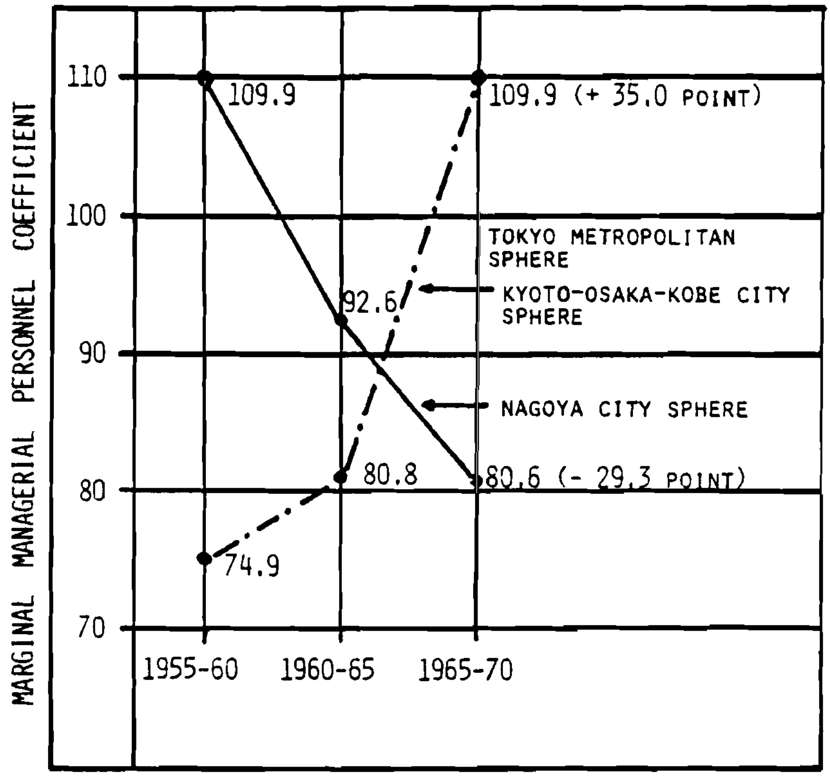


Figure 7A2.7.b TOTAL POPULATION OF THE MAIN CITY AT NIGHT AND IN DAYTIME AND THE NUMBER OF EMPLOYMENT IN THE SUB-CITY, WITHOUT IMPACT

FIGURE 7A2.8

COMPARISON OF GROWTH IN NUCLEUS CONTROLLING FUNCTION

SOURCE: (13)



As follows from considerations in the chapter based upon analyses of recent economic and population shifts (e.g. [16]) there is within the PCB and its extensions a trend of concentration of higher functions and also of relative deconcentration of population and production activities. The Shinkansen does nothing but follow and strengthen these trends. The problem should therefore be reformulated to: can this process be slowed down and if so, what are the relative costs and gains for existing alternatives? Thus,

Table A2.5.a. Anticipated Changes in Place of Purchase for Towns in Hiroshima Prefecture after Sanyo Shinkansen Opening

	TOTAL	PURCHASE FROM TOKYO WILL INCREASE	PURCHASE FROM OSAKA WILL INCREASE	NO CHARGES LIKELY	OTHERS
PREFECTURAL TOTAL	(100.0)	(10.2)	(12.9)	(75.4)	(1.5)
FUKUYAMA	(100.0)	(13.1)	(16.7)	(69.0)	(1.2)
ONOMICHI	(100.0)	(6.7)	(3.7)	(89.6)	(0)
MIHARA	(100.0)	(4.3)	(10.6)	(80.8)	(4.3)
KURE	(100.0)	(11.4)	(16.3)	(70.2)	(3.2)
HIROSHIMA	(100.0)	(14.9)	(20.3)	(63.5)	(1.4)

Table 7A2.5.b. Changes in Sales on the Sanyo Line after its Opening: 1972 - 1974

	GROWTH RATES 1972/74 IN %	
	RETAIL	WHOLESALE
NATIONAL AVERAGE	84.4	96.6
TOKYO	67.2	85.3
OSAKA	64.1	92.5
KOBE	81.2	85.8
AVERAGE	70.8	87.9
REST OF SANYO LINE AVERAGE	89.5	105.26
σ	14.68	48.59

one should take into account the fact that besides the relative drain of "wealth and brains" from the sub-city there will be an accelerated absolute industrial and population growth (Table 7A2.5.b) and subsequently, also a net growth in the two afore-mentioned areas. If the trends persist the sub-city will simply become a part of the "main" city, which is a historically omnipresent phenomenon, of which there may be nothing to be dreaded about provided all the necessary social urban infrastructure--and therefore also transportation and communication--is available.* It is primarily the question of values. On the other hand such an absorption does not necessarily have to take place. Together with growth there would be a (limited) development of own urban functions, also with regard to own hinterland areas.

*It should be realized that if the "town" reaching Utsunomiya, the object of study in 3, were created, then allowing for a modest population density level of 2,500 - 3,000 the population of such town would attain $70-80 \times 10^6$.

If as a result there emerges a sufficient urban potential and at the same time absorption conditions are not sufficient (e.g. as one of the conditions the summary travel time may be too long for everyday mass commuting) then certainly the "sub"-city would maintain its identity, although concentration processes in some areas would anyhow take place. On a somewhat different level this process can be observed for the Osaka-Kyoto-Kobe area as compared to Tokyo. The Kinki core has lost some managerial and cultural functions to Tokyo, but it has been rapidly increasing its "top" population in absolute terms. Analysis of this type, however, cannot be done with the SD model at hand.* Thus, as it was already postulated for interregional studies, such studies should be complemented with urbanization models' analyses.

The numerical results of model 3 are fully applicable to actual or future area of megalopolis but they may not at all be to locations outside it, e.g. down the Sanyo line, where the analysis 2 was focused. There the "sleeper" and "factory" town type arguments do not apply. The acceleration of encroachment of central institutions and businesses is not as big. To the contrary, the competition from the side of central retail trade and other establishments can to a large extent be set off and net benefits be assured for these locations where opportunities of traffic catchment (tourism, local trade) exist and where appropriate planning precautions have been made (see planning guidelines set out in [7], [11]). Studies for peripheral locations have in much higher degree to take into account the interregional economic relations. This connection, however, remains yet to be made. It cannot be assured with the help of an SD model of type 3, meant for long-term, structural studies, and therefore insensitive to rapid short-term changes (evidently occurring often as a result of Shinkansen's introduction into peripheral areas - see [23]).

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* It would have been possible with all that is claimed on SD modelling being true, i.e. that it enables forecasting of structural, qualitative changes, in contradistinction to econometric modelling merely extrapolating existing time series. Actually, there is no provision in this relatively sophisticated model for urban growth and absorption mechanisms.

At the lowest, entirely local level of analysis the direct effect of the New Trunk Lines on land use, habitat and environmental condition are assessed. Some of that is shown in study 1. Only very general statements, however, are forwarded, indicating the need for careful planning with that respect.

Thus, the studies performed for Shinkansen do span the "vertical" level hierarchy. It would not be possible, however, to organize their cooperation in the sense of utilization of outputs as inputs to other ones. There are a number of causes for this. First, there are some formal models on the one hand and traditional analytical studies on the other. Then, they differ with regard to a number of major characteristics, e.g. the time horizon in the crucial model of intercity interaction is by one full order longer than in other studies. Also, the categories which are arrived at are by no means comparable - there is differing depth of socio-economic propagation. This is presumably why so little is done in the area of the overall evaluation through joint consideration of all levels.

The studies provided very valuable material for analysis of future Shinkansen development policies. A basis has been created for establishing an assessment system, if a consolidation work is undertaken. The results obtained until now, however, cannt be seen as constituting actual policy indicators. Clear and standardized policy definition for modelling purposes, consideration of a minimal set of comparable options and explicit evaluation or presentation of standard variables subject to evaluation is necessary for the results to be policy indicative.

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8. THE SHINKANSEN AND NATIONAL DEVELOPMENT ISSUES

8.1 Main Features of the National Economic Development in Japan

8.1.1 The Situation Prior to the Implementation of Shinkansen

8.1.1.1 General National Economic Development

The transformation of the Japanese economy from the late nineteenth century to the present is the subject of many Japanese and non-Japanese studies [4,6,22,24,25,32,33,35,37]. Japan has emerged from a largely feudalistic, low-income, agrarian society to a modern, high-income, industrial economy vigorously and successfully competing with the advanced economies of the world. Sources of Japanese economic development are still undergoing more and more thorough scientific investigation; analytical tools are also engaged in this research [24]. The two main periods of economic development which are considered to have played the most important role in the transformation from an agrarian to a highly industrialized society are the Meiji economic development (1887-1919) and the post-World War II economic development (1953-73). It was at these times that the Old Tokaido Trunk Line and the New Tokaido Trunk Line (Shinkansen) were proposed and completed.

Within the scientific lifetime there exist not only differences of opinion concerning the sources of Japanese economic growth in the Meiji economy [26,30,33,35] but also covering the main aggregated macro-economic data such as GNP and commodity output; opinions vary considerably: Kuznets, Ohkawa, Rosovsky and others had previously estimated a rather high annual growth rate of 4% for the Meji economy. Nakamura [30] reduced the aggregate annual growth rate from 4% to 2.8%, however the most recent [32] estimate of the rates per annum for the Meiji economy as a whole are as follows:

GNP per capita	1.14
GNP per worker	1.68
Commodity output per capita ..	1.93
Commodity output per worker ..	2.77

Detailed discussion on this subject can be found in A.C. Kelly and J.G. Williamson in the monograph "Lessons from Japanese Development" [24].

The authors of the monograph also made a very interesting two sectoral (agriculture and industry) model of the Meiji economy using the production functions form and viewing economic development as a general equilibrium process. The models allowed the examination of several leading development issues by employing counterfactual runs.

Of course, the application of the production functions and the general equilibrium assumption may be considered as an oversimplification; nevertheless the research methods and their results are very interesting and useful when trying to establish the sources of Japanese economic development; if these factors were "unique" to the case of Japan such experience would be atypical of the development process.

It is now doubtful whether the Meiji economy possessed such favorable factors but counterfactual runs give results through sensitivity analysis not by making assumptions and without "miraculous" or "take-off" concepts. The authors, rather than seeking an explanation for the "unusual", undertook a systematic review of a wide range of potential factors accounting for the impressive (but not unusual) early Japanese growth. They state:

> The first factor is an acceleration in the long-run growth rate in Meiji Japan. What explains the Japanese record of growth rate acceleration? The historical explanation focuses almost exclusively on exogenously determined investment "spurts". In contrast, our analysis assigns a notable portion of the Japanese trend rate acceleration to endogenous force.

There was the possibility of accumulating capital (through wage stability, longer working hours, technical change of labor without a labor-surplus problem), demand for industrialization, the capital goods' relative price decline throughout the Meiji period was very favorable for accelerating capital formation rates, there was an impressive rate of growth in agricultural output due to the success of applying new technology to agriculture; this relied significantly on the availability of a disciplined and energetic labor force.

Japan in 1887 can be described as predominantly rural with an urbanization ratio of u = 0.15 and an industrial output share equal to 0.229. In 1915 the Meiji economy gave Japan an urbanization ratio of u = 0.258 and an industrial output share equal to 0.493. Net government railroad investment during 1887-1915 was equal to 703 million yen (at the current price) 17.6% of all net governmental capital formation.

The post-World War II economic development began in 1953/54 when Japan reached the pre-war 1939 peak after 1946 GNP had fallen abruptly to the 1917/18 level.

An indirect statement on the future economical growth as well as on the increase on incomes could also be found in the Tokaido Shinkansen proposal:

> From the future prospects of the national total output as estimated in 1957 by the Economic Planning Borad of the Japanese Government, and from the past transportation showing that, at the most conservative estimate, the JNR will have to carry in 1975 about twice as many passengers and 2.2 times as much freight as it did in 1956.

It is interesting to note again that at that time the first Five Year Road Improvement Program was already on the way. Moreover, the National Expressway Law (Law No. 79 of 1957), the National Development Arterial Expressway Construction Law (Law No. 68 of 1957) and the Japan Highway Public Corporation (Law No. 6 of 1956) were established. (See Map 5.)

The USA consultant, Mr. Wattkins, strongly recommended in 1956 that there should be a rapid growth of highways in Japan.

The period of construction of the Tokaido Shinkansen coincided with the very rapid growth of the Japanese economy as well as an increase in Japanese incomes. The growth rates during 1955-70 are truly impressive. Let us use the Brookings Institution studies of the Japanese economy and the recent monograph by E.F. Denison and W.K. Chung "How Japan's Economy Grew So Fast. The Sources of Post-War Expansion" [6]. Other research will also be used or recommended for more detail [22,26,32,33,35,37]. By 1970 the Gross Domestic Production per person employed in Japan had reached the lowest level observed in most developed countries. The gap between Japan and the United Kingdom was of only moderate size at all price weights (see Table 8.1).

Japan ranks considerably higher in GDP per capita than in GDP per person employed since she had the highest percentage of population employed in 1970: 49.2 percent against 44.9 in the United Kingdom, 43.7 in West Germany, 41.3 in France and 39.9 in the United States.

> Japanese per capita consumption compared much less favorably with the other countries despite the low proportion of Japanese output devoted to national defence. This is because of the very high proportion devoted to gross capital formation. [6]

Since 1967 the Japanese economy has become the third largest economy following the United States and the Soviet Union. Based on international price weights, the per capita GDP of Japan in 1970 was $2,952, more than ten times the amount stated in the Shinkansen proposal. The gap between United States and Japan in national income per person employed in 1970 is presented in Table 8.2.

Passenger car production in Japan increased more than 155-fold between 1955 and 1970, truck production increased 46-fold, and bus production about 9-fold. Since 1967 Japan has ranked as the second largest producer of automobiles in the world, second only to the United States. (See Chapter 5.) By 1967 Japan was the world's largest producer of television sets, radios, cameras and sewing machines. Table 8.3 shows the national income in constant prices by sector and industrial branch, 1952-71.

Table 8.4 shows employment by sector, industrial branch and class of worker, 1952-71. The growth rates from 1953 to 1971 and in the subperiods 1953-61 and 1961-71 are presented in Table 8.5. What were the main sources of this very fast growth? According to the Denison and Chung studies the main sources were the employment factor, the capital formation factor, increased knowledge, economies of scale and income elasticities. It is interesting to note that the main sources were the same in nature as those of

Table 8.1 INTERNATIONAL COMPARISONS OF GROSS DOMESTIC PRODUCT AND CONSUMPTION, VARIOUS MEASURES, 1970

Percentages of US values

MEASURE	PRICE WEIGHTS	USA	JAPAN	FRANCE	FRG	UK	ITALY
GDP per person employed	US	100.0	55.2	79.1	73.3	60.4	61.6
	Other country	100.0	44.3	65.6	61.5	51.2	49.2
	Ideal index	100.0	49.5	72.1	67.2	55.6	55.1
	International	100.0	49.9	72.6	68.2	53.7	52.8
GDP per capita	US	100.0	68.1	81.8	80.3	67.9	53.5
	Other country	100.0	54.6	67.8	67.3	57.5	42.7
	Ideal index	100.0	61.0	74.5	73.6	62.5	47.8
	International	100.0	61.5	75.0	74.7	60.3	45.8
Consumption per capita	US	100.0	56.4	76.7	67.5	70.0	55.0
	Other country	100.0	39.9	60.5	56.0	57.9	42.0
	Ideal index	100.0	47.4	68.1	61.5	63.6	48.1
	International	100.0	48.3	67.9	61.2	62.2	46.0
Total GDP	US	100.0	34.4	20.3	23.9	18.6	14.2
	Other country	100.0	27.6	16.8	20.0	15.7	11.4
	Ideal index	100.0	30.8	18.5	21.9	17.1	12.7
	International	100.0	31.1	18.6	22.2	16.5	12.2

Sources: Derived from GDP per capita, consumption per capita, and population data in Irving B. Kravis and others, "A System of International Comparisons of Gross Product and Purchasing Power", United Nations International Comparison Project: Phase One (Johns Hopkins University Press for the World Bank, 1975), pp. 6, 171-78, and from employment figures in Organization for Economic Cooperation and Development, "Labour Force Statistics, 1961-1972" (Paris: OECD, 1974), Tables 1 and 2 for individual countries.

Sources: E.F. Denison and W.K. Chung [6], p. 5.

Table 8.2 DERIVATION OF ESTIMATES OF CONTRIBUTIONS TO GAP BETWEEN US AND JAPAN IN NATIONAL INCOME PER PERSON EMPLOYED, 1970

DETERMINANT	INDEX: JAPAN AS % OF US (1)	US WEIGHT (2)	CONTRIBUTION TO GAP (3)	PSEUDO GROWTH RATE (4)	WEIGHT × PSEUDO GROWTH RATE (5)	CONTRIBUTION TO GAP (6)
1. National income per person employed	54.8	-	45.2	-	-	45.2
2. Dwellings	31.7	0.0425	2.9	-	-	2.9
3. International assets	-7.4	0.0056	0.6	-	-	0.6
4. All other determinants	-	-	41.7	-	2.913	41.7
5. Hours of work	107.0	0.7962	-	-0.338	-0.269	-3.9
6. Age-sex composition	96.0	0.7962	-	0.204	0.162	2.3
7. Education	95.6	0.7962	-	0.225	0.179	2.6
8. Nonresidential structures and equipment	59.0	0.0937	-	2.673	0.250	3.6
9. Inventories	56.0	0.0304	-	2.942	0.089	1.3
10. Land	59.2	0.0316	-	2.656	0.084	1.2
11. Overallocation to agriculture	92.0	-	-	0.418	0.418	6.0
12. Overallocation to nonagricultural self-employment	95.5	-	-	0.230	0.230	3.3
13. Use of shift work	99.7	-	-	0.015	0.015	0.2
14. Economies of scale	95.2	-	-	0.246	0.246	3.5
15. Labor disputes	100.1	-	-	-0.005	-0.005	-0.1
16. Irregularity in pressure of demand	106.2	-	-	-0.003	-0.003	-4.3
17. Irregularity in agricultural output	100.0	-	-	0.000	0.000	0.0
18. Lag in the application of knowledge, general efficiency, and errors and omissions	69.8	-	-	1.814	1.814	26.0

Sources: E.F. Denison and W.K. Chung [6], p. 250.

Table 8.3 NATIONAL INCOME IN CONSTANT PRICES, BY SECTOR AND INDUSTRIAL BRANCH, 1952-71

Billions of 1965 Yen

CALENDAR YEAR	TOTAL NATIONAL INCOME		NATIONAL INCOME ORIGINATING IN						
			GENERAL GOVERNMENT, HOUSEHOLDS, INSTITUTIONS, & FOREIGN GOVERNMENTS				NONRESIDENTIAL BUSINESS		
	Japanese deflation procedures (1)	US deflation procedures (2)	Japanese deflation procedures (3)	US deflation procedures (4)	Services of dwellings (5)	International assets (6)	Total (7)	Agriculture (8)	Nonagricultural industries (9)
1952	8.907	9,446	1,594	2,133	636	-1	6,678	1,400	5,278
1953	9,667	10,170	1,638	2,141	672	-7	7,364	1,497	5,867
1954	10,372	10,855	1,680	2,163	720	-12	7,984	1,714	6,270
1955	11,210	11,705	1,713	2,208	742	-12	8,767	2,150	6,617
1956	11,838	12,313	1,718	2,193	760	-11	9,371	1,962	7,409
1957	13,083	13,533	1,720	2,170	801	-14	10,576	2,026	8,550
1958	13,780	14,106	1,764	2,120	879	-13	11,150	2,116	9,034
1959	14,912	15,233	1,825	2,146	982	-13	12,118	2,327	9,791
1960	16,989	17,305	1,879	2,195	1,023	-12	14,099	2,242	11,857
1961	18,770	19,007	2,037	2,274	1,125	-16	15,624	2,210	13,414
1962	20,418	20,617	2,913	2,392	1,163	-33	17,095	2,208	14,887
1963	22,234	22,370	2,377	2,513	1,192	-41	18,706	2,060	16,646
1964	24,340	24,434	2,549	2,643	1,235	-68	20,624	2,102	18,522
1965	25,613	25,613	2,734	2,734	1,300	-68	21,647	2,115	19,532
1966	28,009	27,900	2,908	2,799	1,367	-65	23,799	2,185	21,614
1967	31,798	31,607	3,050	2,859	1,451	-63	27,360	2,455	24,905
1968	36,141	35,840	3,217	2,916	1,575	-89	31,438	2,502	28,936
1969	40,030	39,596	3,409	2,975	1,674	-98	35,045	2,375	32,670
1970	44,424	43,848	3,605	3,029	1,774	-72	39,117	2,216	36,901
1971	46,907	46,193	3,798	3,084	1,926	-21	41,204	1,987	39,217

Sources: E.F. Denison and W.K. Chung [6], p. 19.

Table 8.4 EMPLOYMENT BY SECTOR, INDUSTRIAL BRANCH, AND CLASS OF WORKER, 1952-71

Thousands

CALENDAR YEAR	Total employment (1)	General government, households, institutions, & foreign governments (2)	NONRESIDENTIAL BUSINESS: Total (3)	NONRESIDENTIAL BUSINESS: Agriculture (4)	NONAGRICULTURAL INDUSTRIES: Total (5)	NONAGRICULTURAL INDUSTRIES: Wage & salary workers (6)	NONAGRICULTURAL INDUSTRIES: Self-employed & family workers (7)	Addendum: nonagricultural wage & salary workers (8)
1952	37,199	3,033	34,166	13,394	20,772	12,739	8,033	15,772
1953	39,376	3,068	36,308	14,035	22,273	13,411	8,862	16,479
1954	39,862	3,120	36,742	13,695	23,047	13,798	9,249	16,918
1955	41,047	3,196	37,851	14,046	23,805	14,392	9,413	17,588
1956	41,715	3,180	38,535	13,615	24,920	15,553	9,367	18,733
1957	42,778	3,152	39,626	13,160	26,466	16,925	9,541	20,077
1958	43,000	3,078	39,922	12,709	27,213	18,059	9,154	21,137
1959	43,273	3,112	40,161	12,072	28,089	18,947	9,142	22,059
1960	44,345	3,175	41,170	11,959	29,211	20,053	9,158	23,228
1961	44,640	3,266	41,374	11,630	29,744	20,848	8,896	24,114
1962	45,381	3,407	41,974	11,337	30,637	22,035	8,602	25,442
1963	45,824	3,547	42,277	10,720	31,557	22,808	8,749	26,355
1964	46,517	3,695	42,822	10,312	32,510	23,669	8,841	27,364
1965	47,453	3,795	43,658	9,900	33,758	24,883	8,875	28,678
1966	48,528	3,889	44,639	9,544	35,095	26,101	8,994	29,990
1967	49,545	3,966	45,579	9,290	36,289	26,889	9,400	30,855
1968	50,365	4,041	46,324	9,077	37,247	27,639	9,608	31,680
1969	50,757	4,118	46,639	8,787	37,852	28,104	9,748	32,222
1970	51,289	4,183	47,106	8,242	38,864	29,121	9,743	33,304
1971	51,421	4,253	47,168	7,509	39,659	29,998	9,661	34,251

Sources: E.F. Denison and W.K. Chung [6], p. 23.

Table 8.5 SELECTED GROWTH RATES, 1953-71

Percent per year

ITEM	TOTAL NATIONAL INCOME			EMPLOYMENT			NATIONAL INCOME PER PERSON EMPLOYED		
	1953-71	1953-61	1961-71	1953-71	1953-61	1961-71	1953-71	1953-61	1961-71
JAPANESE DEFLATION PROCEDURES									
Whole economy	9.17	8.65	9.59	1.49	1.58	1.42	7.56	6.96	8.05
US DEFLATION PROCEDURES									
Whole economy	8.77	8.13	9.29	1.49	1.58	1.42	7.17	6.45	7.75
Nonresidential business	10.04	9.86	10.18	1.46	1.65	1.32	8.45	8.08	8.75
Agriculture	1.59	4.99	-1.06	-3.42	-2.32	-4.28	5.18	7.49	3.37
Nonagricultural industries	11.13	10.89	11.32	3.26	3.68	2.92	7.63	6.95	8.17
Wage and salary workers	-	-	-	4.57	5.67	3.71	-	-	-
Self-employed and unpaid family workers	-	-	-	0.48	0.05	0.83	-	-	-

Sources: E.F. Denison and W.K. Chung [6], p. 24.

the Meiji economy found by Kelly and Williamson. Unfortunately the Denison and Chung study does not produce an analytical model; therefore counterfactual runs are impossible for a more thorough analysis of the Japanese economy during 1955-70 (of course, the effort needed for modeling would be much greater). The full sources of the growth of the Japanese economy are found in Table 8.6.

Table 8.7 shows the sources of growth with standardized form and with a comparison to other countries.

8.1.1.2 Transport Related Development

In 1957 the proposal for the Tokaido Shinkansen line stated:

> The average individual's income in Japan is today so small that automobiles are not so popular as in many western countries.

Table 8.8 shows a comparison of Japan and the USA with respect to the number of vehicles owned and the national income.

The possible effects of other carriers on the Tokaido Line are as follows:

> The executive secretaries of the Council of Ministers relating to traffic studies the possible influence of the prospective superhighway on the Tokaido Trunk Line.
>
> An analysis was made of the present status of transportation by dividing the areas relative to the Tokaido Trunk Line into small economic blocks. On the basis of the analysis an estimate was made of such amounts of traffic as would possibly be divered from rail to highway transport. According to such an estimate, the superhighway, in the event of its being realized, will take care of about 10% and 5% respectively of the passenger and freight traffic volume of the Tokaido Trunk Line . . . The Japanese National Railways Trunk Line Survey Committee, an advisory organ for the Ministry of Transportation, has also made an estimate of the possible flow of passenger and freight traffic to the projected superhighway and the recommendations of this organ contain much the same results of findings.

Table 8.6 SOURCES OF GROWTH OF ACTUAL NATIONAL INCOME, NONRESIDENTIAL BUSINESS AND WHOLE ECONOMY, 1953-71

Growth rates and contributions to growth rates in percentage points

ITEM	NONRESIDENTIAL BUSINESS			WHOLE ECONOMY		
	1953-71 (1)	1953-61 (2)	1961-71 (3)	1953-71 (4)	1953-61 (5)	1961-71 (6)
NATIONAL INCOME	10.04	9.86	10.18	8.77	8.13	9.29
TOTAL FACTOR INPUT	4.18	3.88	4.43	3.95	3.53	4.35
Labor	1.99	2.30	1.75	1.85	1.91	1.78
Employment	1.14	1.30	0.99	1.14	1.14	1.09
Hours	0.27	0.48	0.14	0.21	0.38	0.11
average hours	0.02	0.45	-0.31	0.01	0.35	-0.27
efficiency offset	0.21	-0.09	0.44	0.18	-0.06	0.38
intergroup shift offset	0.04	0.12	0.01	0.02	0.09	0.00
Age-sex composition	0.17	0.09	0.22	0.14	0.07	0.19
Education	0.41	0.43	0.40	0.34	0.33	0.35
Unallocated	-	-	-	0.02	-0.01	0.04
Capital	2.19	1.58	2.68	2.10	1.62	2.57
Inventories	0.89	0.75	1.00	0.73	0.57	0.86
Nonresidential structures & equipment	1.30	0.83	1.68	1.07	0.64	1.44
Dwellings	-	-	-	0.30	0.42	0.27
International assets	-	-	-	0.00	-0.01	0.00
Land	0.00	0.00	0.00	0.00	0.00	0.00
OUTPUT PER UNIT OF INPUT	5.56	5.98	5.75	4.82	4.60	4.94
Advances in knowledge and n.e.c.	2.39	1.84	2.83	1.97	1.42	2.43
Improved resource allocation	1.15	1.40	0.95	0.95	1.08	0.82
Contraction of agricultural inputs	0.78	0.87	0.72	0.64	0.67	0.62
Contraction of nonagricultural self-employment	0.36	0.53	0.22	0.30	0.41	0.19
Reduction in international trade barriers	0.01	0.00	0.01	0.01	0.00	0.01
Economies of scale	2.36	2.47	2.28	1.94	1.90	1.96
Measured in US prices	1.29	1.25	1.33	1.06	0.96	1.14
Income elasticities	1.07	1.22	0.95	0.88	0.94	0.82
Irregular factors	-0.04	0.27	-0.31	-0.04	0.20	-0.27
Effect of weather on farming	0.06	0.19	-0.04	0.05	0.14	-0.04
Labor disputes	0.00	0.00	0.00	0.00	0.00	0.00
Intensity of demand	-0.10	0.08	-0.27	-0.09	0.06	-0.23

Sources: E.F. Denison and W.K. Chung [6], p. 38.

Table 8.7 SOURCES OF GROWTH OF STANDARDIZED GROWTH RATE OF NATIONAL INCOME, WHOLE ECONOMY, BY COUNTRY, VARIOUS PERIODS, 1948-71

Percentage points

ITEM	JAPAN 1953-71	USA 1948-69	CANADA 1950-67	BELGIUM 1950-62	DENMARK 1950-62	FRANCE 1950-62	FRG 1950-62	ITALY 1950-62	NETHER-LANDS 1950-62	NORWAY 1950-62	UK 1950-62
STANDARDIZED GROWTH RATE	8.81	4.00	4.95	3.03	3.63	4.70	6.27	5.60	4.07	3.43	2.38
TOTAL FACTOR INPUT	3.95	2.09	3.02	1.17	1.55	1.24	2.78	1.66	1.91	1.04	1.11
Labor	1.85	1.30	1.85	0.76	0.59	0.45	1.37	0.96	0.87	0.15	0.60
Employment	1.14	1.17	1.82	0.40	0.70	0.08	1.49	0.42	0.78	0.13	0.50
Hours of work	0.21	-0.21	-0.20	-0.15	-0.18	-0.02	-0.27	0.05	-0.16	-0.15	-0.15
Age-sex composition	0.14	-0.10	-0.13	0.08	-0.07	0.10	0.04	0.09	0.01	-0.07	-0.04
Education	0.34	0.41	0.36	0.43	0.14	0.29	0.11	0.40	0.24	0.24	0.29
Unallocated	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital	2.10	0.79	1.14	0.41	0.96	0.79	1.41	0.70	1.04	0.89	0.51
Inventories	0.73	0.12	0.10	0.06	0.15	0.19	0.33	0.12	0.22	0.13	0.09
Nonresidential structures & equipment	1.07	0.36	0.87	0.39	0.66	0.56	1.02	0.54	0.66	0.79	0.43
Dwellings	0.30	0.28	0.30	0.02	0.13	0.02	0.14	0.07	0.06	0.04	0.04
International assets	0.00	0.03	-0.12	-0.06	0.02	0.02	-0.08	-0.03	0.10	-0.07	-0.05
Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OUTPUT PER UNIT OF INPUT, STANDARDIZED	4.86	1.91	1.96	1.86	2.08	3.46	3.49	3.94	2.16	2.39	1.27
Advances in knowledge and n.e.c.	1.97	1.19	0.66	0.84	0.75	1.51	0.87	1.30	0.75	0.90	0.79
Improved resource allocation	0.95	0.30	0.64	0.51	0.68	0.95	1.01	1.42	0.63	0.92	0.12
Contraction of agricultural inputs	0.64	0.23	0.54	0.20	0.41	0.65	0.77	1.04	0.21	0.54	0.06
Contraction of non-agricultural self-employment	0.30	0.07	0.10	0.15	0.18	0.23	0.14	0.22	0.26	0.23	0.04
Reduction of international trade barriers	0.01	0.00	0.00	0.16	0.09	0.07	0.10	0.16	0.16	0.15	0.02
Economies of sale	1.94	0.42	0.66	0.51	0.65	1.00	1.61	1.22	0.78	0.57	0.36
Measured in US prices	1.06	0.42	0.63	0.40	0.42	0.51	0.70	0.62	0.55	0.45	0.27
Income elasticities	0.88	-	0.03	0.11	0.23	0.49	0.91	0.60	0.23	0.12	0.09

Sources: E.F. Denison and W.K. Chung [6], p. 43.

Table 8.8 Comparison of Japanese and USA vehicle fleets and national incomes

(1957)

	PASSENGER CARS (1000)	TRUCK (1000)	BUS (1000)	TOTAL (1000)	POPULATION	NATIONAL INCOME PER CAPITA
USA (per 1,000 population)	51,631 (318)	10,105 (62)	149 (0.9)	61,885 (381)	162,409	$ 1,952 ¥702,720
JAPAN (per 1,000 population)	136 (1.5)	711 (8)	35 (0.4)	881 (10)	88,000	$ 212 ¥ 76,320

8.1.2 The Situation After the Shinkansen was Built

For almost ten years after the opening of the Tokaido Shinkansen line the Japanese economy enjoyed the rapid growth which had started ten years before Shinkansen. In 1969 the Economic Planning Agency estimated that GNP in 1985 (expressed in 1965 prices) would be ¥130 to ¥150 trillion or four to five times the 1965 GNP of ¥30 trillion, which means that EPA and the national government had considered that the rapid growth ratio of the Japanese economy would remain until at least 1985. This assumption was confirmed in 1972 by the government.

The cumulative total of fixed capital formation for the 20 years between 1966 and 1985 was expected to reach between ¥450 and ¥550 trillion, about seven to nine times that of the total cumulative fixed capital formation for the ten year period 1956-65 (¥63 trillion). During the same period cumulative private investment in plants and equipment was expected to reach ¥210 to ¥260 trillion; cumulative private housing investment ¥110 to ¥120 trillion; and cumulative government fixed investment ¥130 to ¥170 trillion. Classified by functions, cumulative construction investment was expected to amount to ¥270 to ¥330 trillion and cumulative investment in plants and equipment ¥180 to ¥220 trillion.

It is anticipated that a total of more than 1.5 trillion US dollars will be invested in Japan during the twenty years after the opening of the Tokaido Shinkansen line and this would provide sufficient potential for the rapid extension of Shinkansen lines; the more so since government investment was assumed to be as high as approximately 0.5 trillion US dollars.

In 1973 the EPA presented a more detailed profile of the Japanese economy in FY 1977 (Table 8.9) as well as three testing predictions of Japanese economy up to 1990 using long-term econometric models. For a profile of the Japanese economy from 1970-74 a medium-term macro-model-1973 was used. [8]

The proposed investments by sector for 1973-77 are shown in Table 8.10.

Table 8.11 shows a breakdown of gross national expenditure for FY 1960 one year after the construction of the Tokaido Shinkansen line started, for FY 1970 when the law for the construction of the nation-wide network of Shinkansen was adopted and proposed in 1973 for 1977.

8.1.3 The Present Situation

The present (1977) Japanese economy differs radically from that of 1958 or the first decade of the Tokaido Shinkansen (1964-73). The present state of the Japanese economy is still very much influenced by the economic recession which started in many industrialized countries in 1973.

In an analysis by the Nomura Research Institute [44] the situation is described as follows:

> Because of the weak autonomous recovery power of private sector final demand, the Japanese economy is still being supported mainly by the exogenous public sector and export demands. The consequent uneasiness has resulted in an extremely slow rate of growth of the economy, with a quarterly average real rate of increase of GNP in annual terms of less than 4% for fiscal 1976, as compared with the current potential rate of 5-6%. Thus it is difficult to shrink the deflationary gap, resulting in undesirable disequilibriums, both internally with respect to labor and product markets and externally with respect to the trade balance. The continued existence of this large deflationary gap has cooled business attitudes in the private sector, causing a loss of automatic recovery

Table 8.9 PROFILE OF THE JAPANESE ECONOMY IN FY 1977

	FY 1970		FY 1977			FY 1961-70
	Actual figures	Per-centages	Projected figures	Percentage of total	Average annual rate of increase (FY 1973-77)	Average annual rate of increase
GIVEN CONDITIONS AND POLICIES		%		%	%	%
Labor force	51,700,000		54,100,000		0.8	1.3
Government fixed capital formation (1965 prices)	¥5 tril.		(cumulative amount of investment between FY 1973 & 1977, ¥90 tril)		15.5	13
Government transfers to households (Current prices)	¥3 tril.	(% of national income 5.3%)	Y12 tril.	(% of national income 8.8%)	22.0	18
Private pollution control investment (1965 prices)	¥0.2 tril.		¥2 tril.		34.1	
PROFILE OF ECONOMY	(tril.yen)	%	(tril.yen)	%	%	%
Gross national product (cur.pr.)	73	-	184	-	14	16
Gross national product (1965 pr.)	58	-	105	-	about 9	11
Gross national product (cur.pr.)	73	100	183	100	14	16
Personal consumption expenditures	38	51	95	52	14	15
Government fixed capital formation	6	9	23	13	18	18
Private plant & equipment investment	15	20	28	15	11	17
Private housing investment	5	7	17	9	20	22
Exports of goods & services & factor income received from abroad	9	12	21	11	14	17
(less) Imports of goods & services & factor income paid abroad	8	11	19	1½	17	16

Source: Basic Economic and Social Plan 1973-77, EPA, February 1973.

Table 8.10 INVESTMENT BY SECTOR

(Figures in billion yen at FY 1972 prices)

SECTOR	FY 1973-77 INVESTMENT
Environmental Sanitation	7,740
Public Housing	6,080
Health and Welfare	1,820
Schools	4,370
Roads	19,000
Railways	7,850
Ports and Harbors	3,190
Aviation	770
Telecommunication	6,510
Land Conservation	5,830
Agriculture-Forestry-Fishery	5,550
Others	18,290
Adjustment Expenses	3,000
TOTAL	90,000

Source: Basic Economic and Social Plan 1973-77, EPA, February 1973.

Table 8.11 BREAKDOWN OF GROSS NATIONAL EXPENDITURE (trillions of yen, current prices)

ITEM	FY 1960		FY 1970			FY 1972		FY 1977		
	Amount	% of total	Amount	% of total	Average annual rate of increase FY 1961-70	Amount	% of total	Amount	% of total	Average annual rate of increase FY 1973-77
*Gross national expenditure (current pr.)	16.2	-	73.2	-	16.3	94.3	-	183.8	-	14.3
Gross national expenditure (real terms)	20.3	-	57.4	-	11.0	67.0	-	105.3	-	9.4
Gross national expenditure (current pr.)	16.2	100.0	73.2	100.0	16.3	93.9	100.0	182.9	100.0	14.3
Personal consumption expenditure	9.1	55.9	37.6	51.3	15.3	48.5	51.7	95.2	52.1	14.5
Current Government purchases of goods & services	1.4	8.8	6.0	8.2	15.6	8.3	8.8	16.3	8.9	14.7
Government fixed capital formation	1.2	7.5	6.2	8.5	17.6	10.2	10.8	23.1	12.6	17.9
Private plant & equipment formation	3.7	19.6	14.6	19.9	16.6	16.4	17.5	27.7	15.2	11.1
Private housing investment	0.7	4.1	4.8	6.6	22.1	6.6	7.0	16.5	9.0	20.3
Exports of goods & services & factor income received from abroad	1.8	11.1	8.7	11.8	17.0	10.6	11.3	20.8	11.4	14.4
(less) Import of goods & services & factor income paid abroad	1.8	11.0	7.7	10.6	15.8	8.6	9.2	18.7	10.2	16.7

Notes: *In this row the figures for gross national expenditure for fiscal 1972 and fiscal 1977 include Okinawa.
1. The figures in real terms are based on 1965 prices.
2. The figures for fiscal 1972 are based on those of the Government Economic Outlook (as of Jan. 26, 1973) and other calculations along the same lines.

Source: Basic Economic and Social Plan 1973-77, EPA, February 1973.

power. Thus, the economy has entered a vicious cycle in which even if it picks up rapidly for a while as the result of an upsurge in public sector or export demand, it will be difficult to sustain the rapid rate of recovery and the economy will revert to a low growth rate. . . .

Because of the weak recovery power of private sector final demand, the improvement has been led by exports and fiscal expenditures which are largely affected by exogenous or political factors or by temporary surges in final demand such as increased inventory investment due to expectations for a recovery (resulting, in many cases, in a large unintended inventory buildup). . . .

Although a recovery process is underway on the macro level the economy still shows major weaknes on the micro level, i.e., in terms of employment, production, profits, etc. Even at the present time, final demand has shown only an "under-the-surface" recovery: that is, these micro indicators have not reached their respective levels of the previous cyclical peak, with the consequence that expectations by both business and consumers have failed to improve. There is also a wide divergence in the extent of recovery both by industry and by firm.

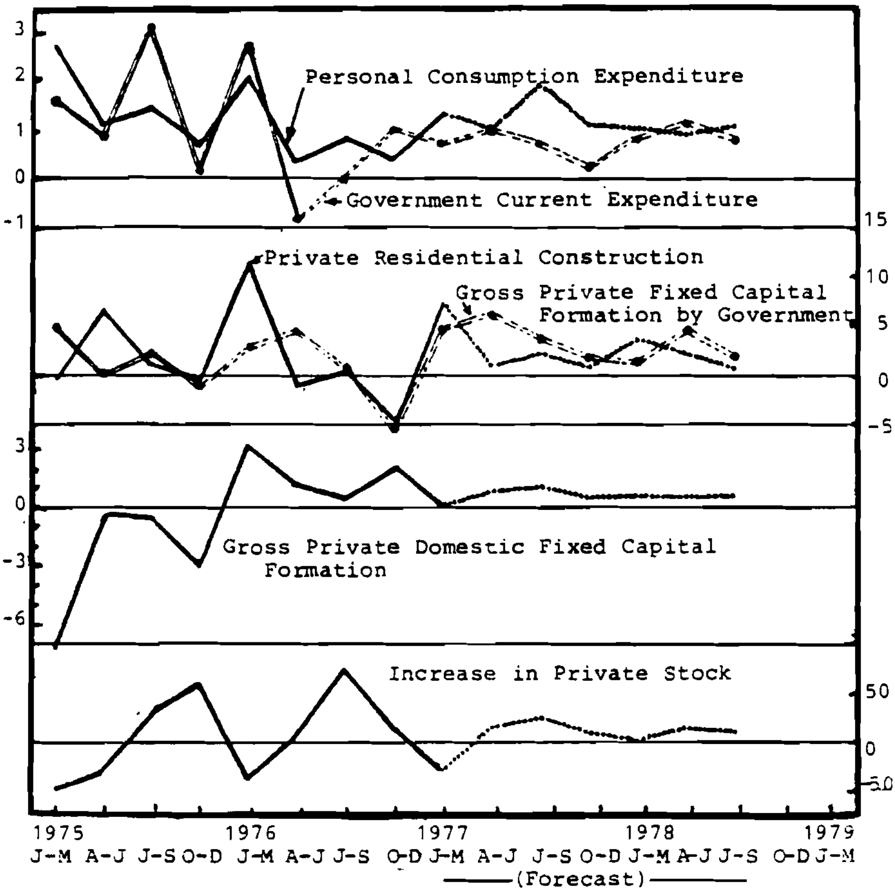
Regarding the employment situation, the number of completely unemployed persons remains at about one million, and the unemployment rate of about 2% is substantially higher than the 1.5% of previous recessions. . . .

The increase in plant and equipment investment spending for fiscal 1976 as a whole from the previous fiscal year will have been, according to the February surveys by the Bank of Japan, the Japan Economic Journal and the Japan Development Bank, about 14% for industry as a whole, but 2-5% for the non-manufacturing industries. In terms of national income statistics, however, the increase in such investment for industry as a whole is expected to have only been about 8% in nominal terms and 3% in real terms.

Figure 8.1 shows the development of important items of gross national expenditure for the years 1975 to 1977 with a forecast for 1978/79.

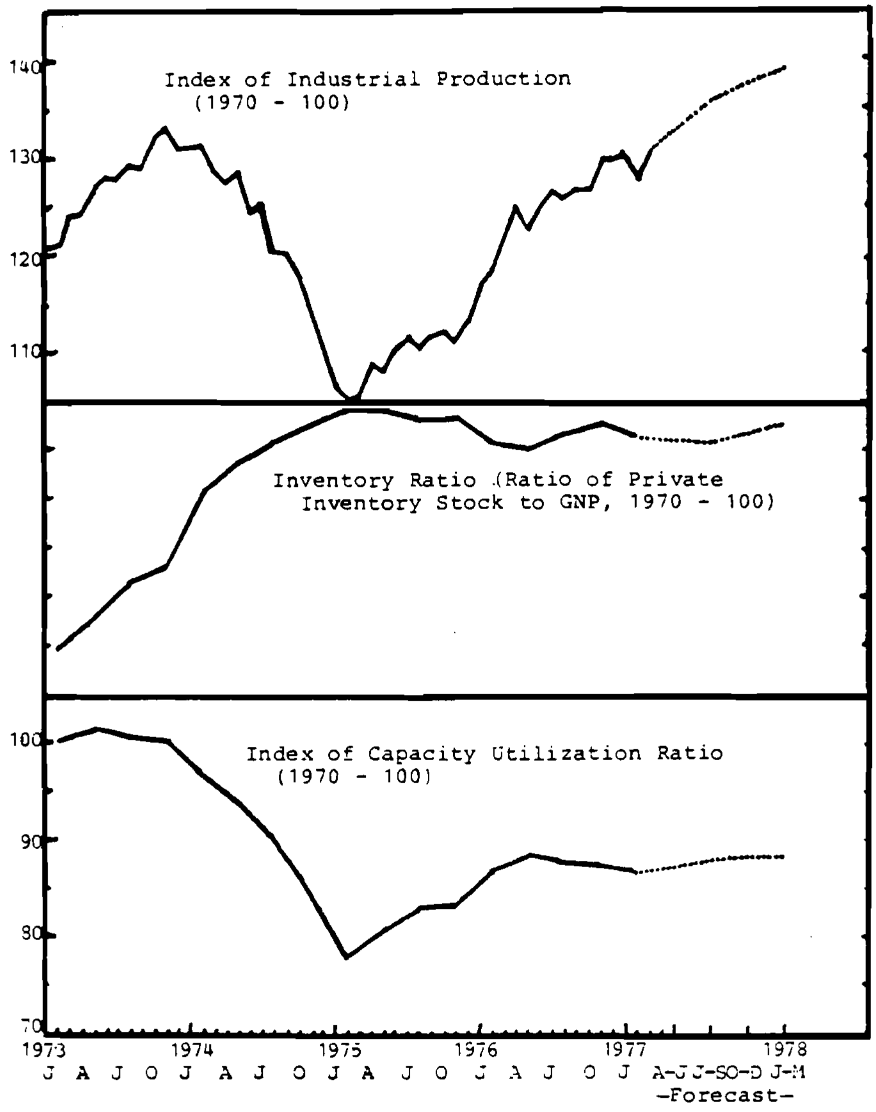
Figure 8.2 shows comparisons in the developments of industrial production, stocks and capacity utilization.

The current state of the economy will probably force the Japanese Government to increase the government sector of investment including the Shinkansen Program, however the realization of



Source: Nomura Research Institute, Quarterly Economic Review, July 1977, p. 3.

Figure 8.1 GROSS NATIONAL EXPENDITURE BY SECTOR (real, increase from the previous quarter)



Source: Nomura Research Institute, Quarterly Economic Review, July 1977, p. 4.

Figure 8.2 INDUSTRIAL PRODUCTION, INVENTORY AND CAPACITY UTILIZATION RATIO the main goals of the Second Comprehensive National Development Plan will be delayed due to the situation in the private sector of the economy.

8.2 Main Actors Involved in National Economic Policy and Planning

Considering the present Shinkansen program as a part and as a result of the national economic policy for Japan and as a subject of long- and medium-range planning, the following questions related to the character of national economic policy arise:

- What is the degree of consciousness of national economic needs? What interests do they reflect?
- What characteristics do national economic plans have? What is their role in society?
- Which economic processes are reflected in the plans and how?
- Who is involved in the planning and decision making process?
- What means for implementation of the plans exist? What do they mean to different types and groups of decision makers?
- How are plans updated to changing internal and external conditions in the national economy?

All the answers to these questions are very much determined by the type and socio-economic structure of the Japanese economy. In several publications [10,14,31] it is described as a "free market economy", oriented towards economic growth and with some expectations from "market mechanisms" (1958-70), as a "welfare society" with emphasis on balanced economic growth and social development (1967-75), or as a "stable society", based on a growth path, which is compatible with limited resource availability (from 1975). In spite of different terms and different growth patterns, the socio-economic type of Japanese economy remained unchanged:

- determined by the private (capitalist) ownership of a major part of the capital goods and the results of their utilization;

- determined by the existence of governmental or municipal sectors in the economy (mainly railways, airlines, local transport, roads, telecommunications, and other parts of the infrastructure, mining, power generation, etc.);
- determined by a 28 year experience in national economic planning combined with redistribution and reallocation of funds by the government.

Table 8.12 shows the share of assets and capital formation for the private sector and for the government.

Under these circumstances "national economic policy" indeed can be related to the national economy as a whole, but the means of active influence of implementation, of decisions regarding funds, distribution and allocation can only be directed to the governmental sector. For the private sector "national economic policy" plays the role of general orientation, supported by taxes and financial incentives. Within this general framework we have to analyze the role of different actors involved in national-economic policy and planning.

Table 8.12 PRIVATE AND GOVERNMENT SECTORS IN THE NATIONAL ECONOMY

	PRIVATE SECTOR	GOVERNMENTAL SECTOR
Assets 1970 (excluding households)	68%	32%
Gross Domestic Fixed Capital Formation 1975 (31% of GNE) = net investment	70%	30%

Source: Statistical Handbook of Japan 1977, pp. 106,108.

8.2.1 The National Government and the Japanese Planning System

8.2.1.1 National Economic Plans

National economic policy is formulated and published by the Diet (parliament) and the Government of Japan by means of the national economic plans. Since the end of World War II the Japanese government has presented nine economic plans, which have been officially adopted. However, the national planning bureau was already in existence before World War II [39]. The list of plans and their main features is given in Table 8.13. These plans are related to four stages of economic post-war development in Japan:

First stage until 1957: recovery from the damage of World War II, achievement of self-supporting economy;

Second stage from 1958 to 1966: plans for greater economic growth;

Third stage from 1967 to 1975: plans for balanced economic growth and social development, environmental protection;

Fourth stage from 1976: plans for better standard of living and stable development.

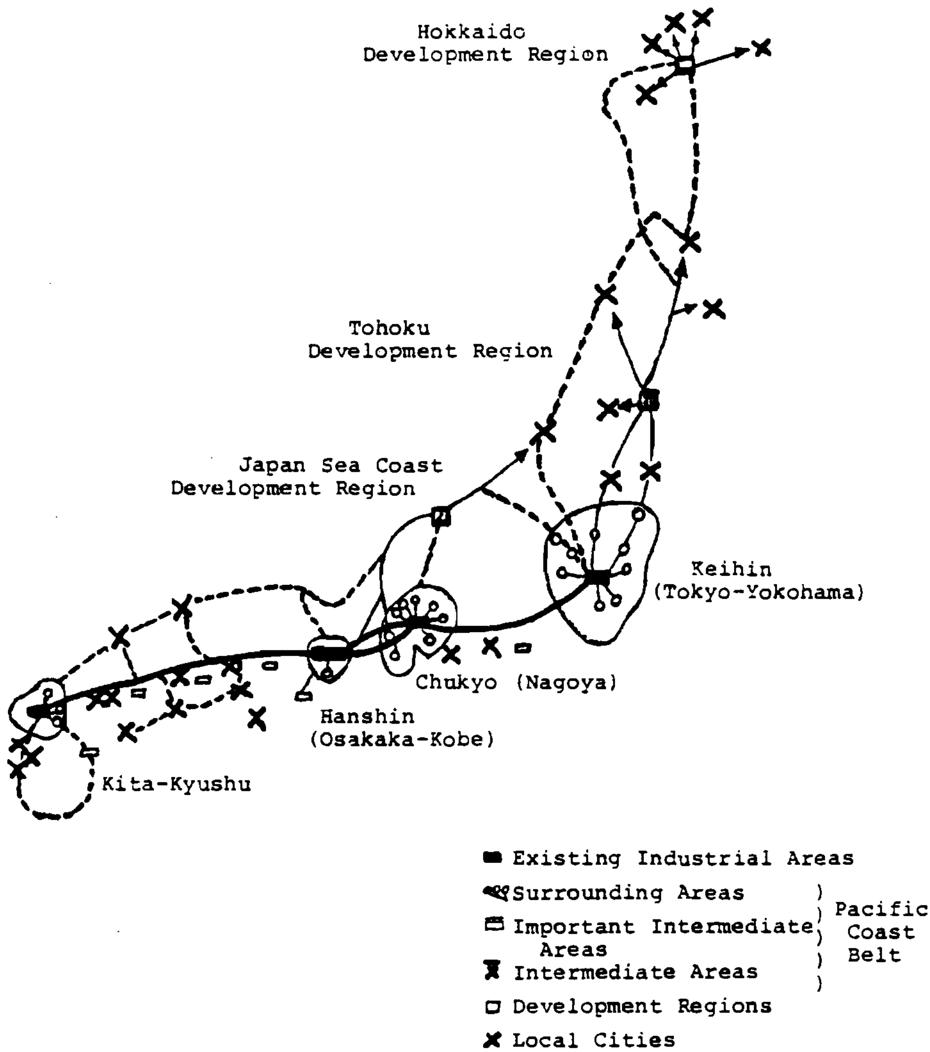
8.2.1.2 Comprehensive National Development Plans

Apart from the above mentioned medium-term plans (most of them are five-year plans), from 1962 comprehensive national development plans for Japan have been employed in order to formulate a longer-range national economic policy. The *first Comprehensive National Development Plan* of 1962 proposed the growth centers development formula as a strategy which intended to "rectify regional inequality".[11] This was a comprehensive response to a concept developed before, the so-called "Pacific Coast Belt Scheme" (see Figure 8.3). Design and construction of twenty-one large-scale and medium-scale industrial growth centers outside the existing metropolitan areas (see Figure 8.4) began just after completion of the Comprehensive National Development Plan and is still ongoing. These new growth centers and the existing metropolises were to be interlinked by the transportation network, which was

Table 8.11 SELECTED FEATURES OF ECONOMIC PLANS IN JAPAN SOURCE: [H]

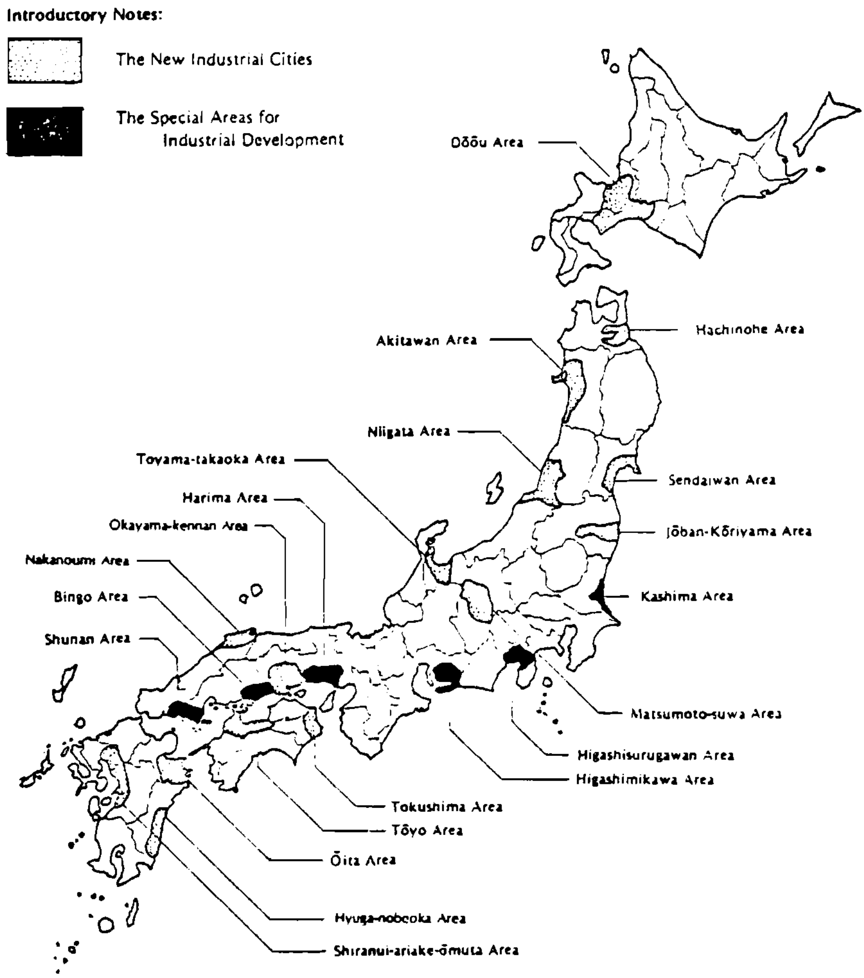
NAME OF PLAN		ECONOMIC REHABILITATION PLAN*	FIVE-YEAR PLAN FOR ECONOMIC SELF-SUPPORT	NEW LONG RANGE ECONOMIC PLAN	DOUBLING NATIONAL INCOME PLAN	MEDIUM TERM ECONOMIC PLAN	ECONOMIC & SOCIAL DEVELOPMENT PLAN	NEW ECONOMIC & SOCIAL DEVELOPMENT PLAN	BASIC ECONOMIC & SOCIAL PLAN	ECONOMIC PLAN FOR THE SECOND HALF OF THE 1970's
Date published		drafted 1949, not officially adopted	December, 1955	December, 1957	December, 1960	January, 1965	March, 1967	April, 1970	February, 1973	May, 1976
Cabinet at the time of plan approval		Katayama	Hatoyama	Kishi	Ikeda	Sato	Sato	Sato	Tanaka	Miki
Plan period (Fiscal years)		1949-53	1956-60	1958-62	1961-70	1964-68	1967-71	1970-75	1973-77	1976-80
Execution period		1949-53	1956-57	1958-60	1961-63	1964-66	1967-69	1970-72	1973-75	1976-
Economic growth rate	Performance prior to the plan	F.1946-48 %	F.1952-55 8.6%	F.1951-57 7.3%	F.1956-60 9.1%	F.1960-64 11.3%	F.1962-66 10.0%	F.1965-69 12.7%	F.1968-72 10.2%	F.1971-75 5.3%
	Projection in the plan - growth rate	F.1949-53 %	F.1956-60 5.0%	F.1958-62 6.5%	F.1961-70 7.2%	F.1964-68 8.1%	F.1967-71 8.2%	F.1970-75 10.6%	F.1973-77 9.4%	F.1976-80 over 6%
	Actual performance during the plan period	F.1949-53 %	F.1956-60 9.1%	F.1958-62 10.1%	F.1961-70 11.2%	F.1964-68 11.4%	F.1967-71 11.2%	F.1970-75 6.0%	F.1973-75 2.9%	F.1976 5.8%
Method for projection		?	Colm method (Labour x productivity)	Desirable balance chosen from 3 cases with different growth rates	Growth rate previously decided	Econometric model	Econometric model	Econometric model	Econometric model	Econometric model
Aims		Rehabilitation of national economy, Reconstruction	Self-support of the economy, Full employment	Maximization of growth, Improvement of national living, Full employment	Maximization of growth, Improvement of national living, Full employment	Rectifying imbalances	Balanced & steady economic development	Construction of admirable society through balanced economic growth	Promotion of national welfare, Promotion of international cooperation	Realization of a richer national life & stable development of our country's economy
Major policy objectives		Regain the 1930-34 standard of living by the end of 1953, energy & raw material - use, price & investment - control, US aid, foreign capital inflow	Modernization of production facilities, Promotion of international trade, Reduction of dependence on import, Discouraging consumption	Improvement of infrastructure, Heavy-industrialization, Promotion of exports, Encouraging savings	Improvement of social overhead capital, Improvement of industrial structure, Rectifying the dual structure of the economy and improvement of social stability	Modernization of low productivity sectors, Effient use of labour force, Qualitative improvement of national living	Stabilization of prices, Improvement of economic efficiency, Promotion of social development	Improving economic efficiency from an international viewpoint, Securing price stability, Promotion of social development, Maintaining adequate economic growth & cultivating development foundations	Creating comfortable environment, Securing a stable & comfortable life, Stabilization of prices Promoting international cooperation	Securing stable prices & full employment, Ensuring a stable life & creating a good living environment, Cooperation with & contribution for the development of the world economy, Ensuring economic security & fostering of grounds for long term development

* Another plan was drafted for 1948-52.



Source: [11]

Figure 8.3 THE PACIFIC COAST BELT SCHEME (1960)



Source: "The Outline of the National Land Agency", May 1976, p. 31.

Figure 8.4 THE NEW INDUSTRIAL CITIES AND THE SPECIAL AREAS FOR INDUSTRIAL DEVELOPMENT expected to play an important role for mutual economic influence and balanced development. The government was the leading force for implementation of the development formula. Major means of implementation were:

- government investment for infrastructure;
- tax reduction for enterprises located in the growth centers; and
- development financing.

The (second) *New Comprehensive National Development Plan* of 1969 proposed the network development formula in order to attain the following targets during the period 1969-85:

- efficient utilization of all land;
- regional development to suit particular local conditions (such as natural, cultural, historical, stage of development);
- development and conservation of safe and pleasant environmental conditions;
- control of interactions between the development of human society and nature as a dynamic system.

The network development formula is therefore composed of three phases:

(a) formation of the national network following an intermeshed polygrid pattern and based on
  - formation of a national data communication network;
  - formation of an intensive airway network (Figure 8.5);
  - the extension of the already existing super express railways (Shinkansen) (Figure 8.6);
  - construction of about 7,600 km expressways (Figure 8.7);

  providing a high degree of mobility of information, people and commodities.

(b) planning and implementation of the key development projects, consisting of:

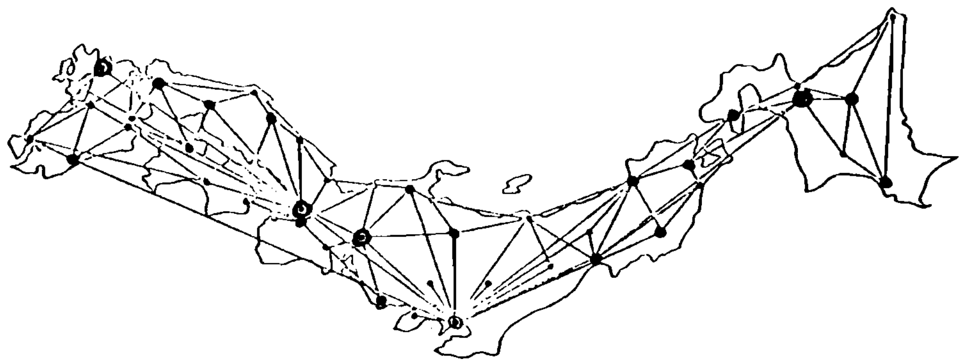


Figure 8.5 <u>AIRWAY NETWORK (1975)</u>

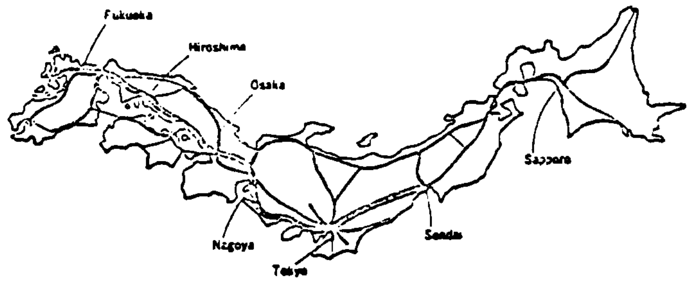


Figure 8.6 NEW TRUNK LINES RAILWAYS

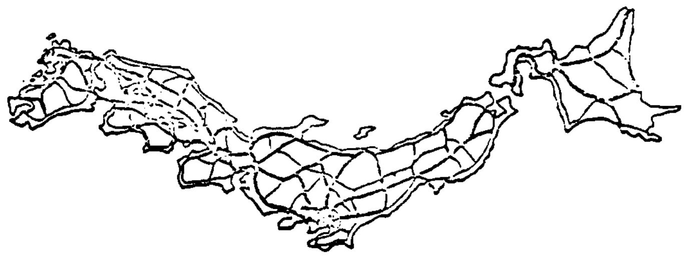


Figure 8.7 EXPRESS WAYS

- an industrial development program (in the agricultural sector, fisheries, manufacturing, distribution and recreation), with the private sector playing a leading role;
- environmental conservation programs.

(c) consolidation of broad living zones increasing the scale of units of demand, and development of the social facilities, with the strategic task of construction of subnetworks in the zones and development of center-cities in the zones.

The *Third Comprehensive National Development Plan* covers the period from 1976 to 1990.

A survey of the main features of the three Comprehensive National Development Plans of Japan is given in Table 8.14. In Figure 8.8 the medium-term and long-term plans for national economic development of Japan are placed in a time-scale. This figure represents one of the main features of the Japanese planning system with overlapping plans as a kind of "permanent planning". This guarantees:

(a) a time span of plans, which is long enough for e.g., investment decisions, and

(b) a high degree of flexibility, allowing adjustment in the plan tasks to changing internal and external conditions, in particular to deviations in the actual rate and structure of growth from the plan.

8.2.1.3 Special-Purpose Plans and Programs

Along with the medium- and long-term national economic plans and programs other plans have been applied to special fields of economic activity, mainly for infrastructure. The following should be mentioned:

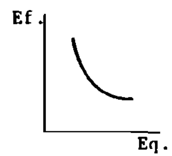
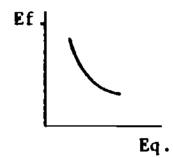
- "The National Land Use Plan";
- "The Five-Year Road Improvement Plan" (at present the eighth five-year program in operation);

Table 8.14 COMPREHENSIVE NATIONAL DEVELOPMENT PLANS

A Note on: The Methods of Planning for Comprehensive Regional Development in Japan to conceptualize the comprehensive development plans from the following viewpoint: The economy grows much rapidly when the society favors the more efficient activities irrelevant to its past. Economic growth necessarily widens inequality between the efficient fractions and the rest of the society, and between its modern part and traditional ones. It is why the dual structure is in common with the countries named as "developing" in terms of modernity.

Name of Plan	State of the World Concerned	Governmental Actions	Techniques of Planning
The 1st Plan 1961 (1961-1970)	• Inequality between urban and rural regions began to be revealed, particularly in terms of income differential	Public aids for rural central cities providing industrial facilities	Birth of concept of comprehensive development
The 2nd Plan 1969 (1966-1985)	• Remodeling infrastructure, which had been used in the last hundred years, supported in the economic capabilities • Expected inequality between productive activities and infrastructure • Stress on the inequality of man-made environments	Big Projects and their organization • Networks of transportation and communication • Productive facilities • Environmental protection	• Regional econometric model • Individualistic solution: national, local, personal for itself
The 3rd Plan 1974 (19 76-1985)	• Hitting the ceiling of resources • Facing the unbalance between human activities and space • People's action against the productive functions • People's requirement of direct participation • Stress on the differentials of natural environments	• Control of human activities • Human settlements with natural, cultural and traditional amenity in the rural areas • Participation procedures	• Rigid allocation culicula of population-and-human activities through state-provinces-cities-town and villages • Polls • Historical research of the human settlement in the archipelago

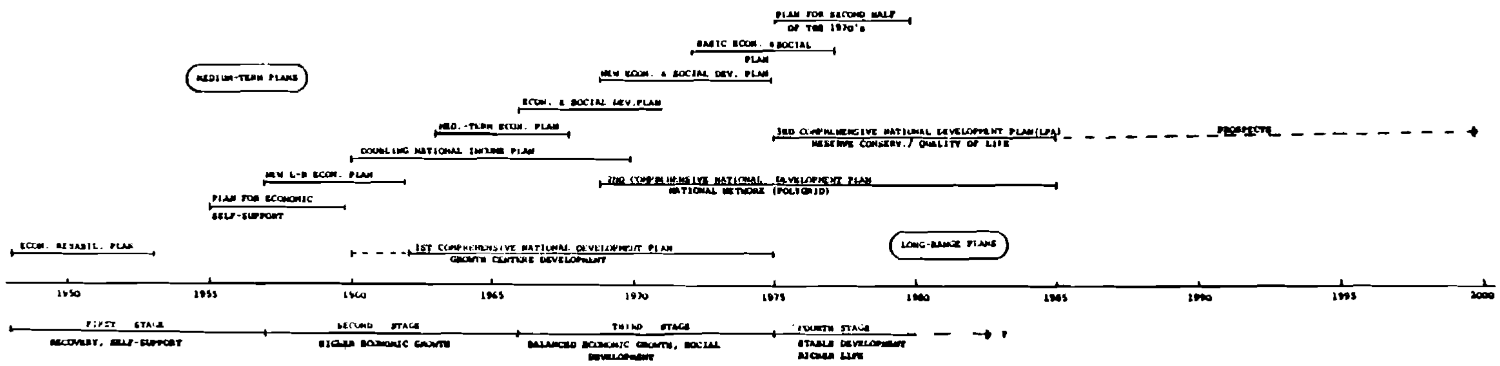
Table 8.14 continued

Instruments	Characteristic of the Plan	People's Interest	Behavioral Determinant	Efficiency and Equity	Economic Plan's GNP Growth Rate
• To improve income differentials • Growth poles (1962)	• Final products • Problem solving	Economic Development	Growing flow oriented		• 7% • Doubling the National Income
• To enlarge productive capacity by organizing of kinds of increasing returns to scale • Big projects	• Final products • Plan oriented	Quality of life based on the economic growth	Growing flow oriented		• Around 10% • Economic and Social Development
• To stabilize demand • Human settlements redistributed • Land use plan • The year 2000 project	• Try and error for planning as process of implementing the 2nd Plan of making the 3rd Plan • Restriction	Quality of life based on cultural, traditional aspects of human life	• Diversity • Transitory confusion from flow to stock (from rise to change)		• Less than 6% • Stability

Source: [14]

Hisayoshi Haruta
Economic Planning Agency

29 October 1976



Sources: [10,11,14,31,39]

Figure 8.8 NATIONAL ECONOMIC DEVELOPMENT PLANS OF JAPAN

- "The Five-Year Port Improvement Plan";
- "The Five-Year Sewerage Improvement Plan"; and
- other public investment programs.

These special plans and programs are being coordinated with the comprehensive national development plan by the National Land Agency, inaugurated in 1974.

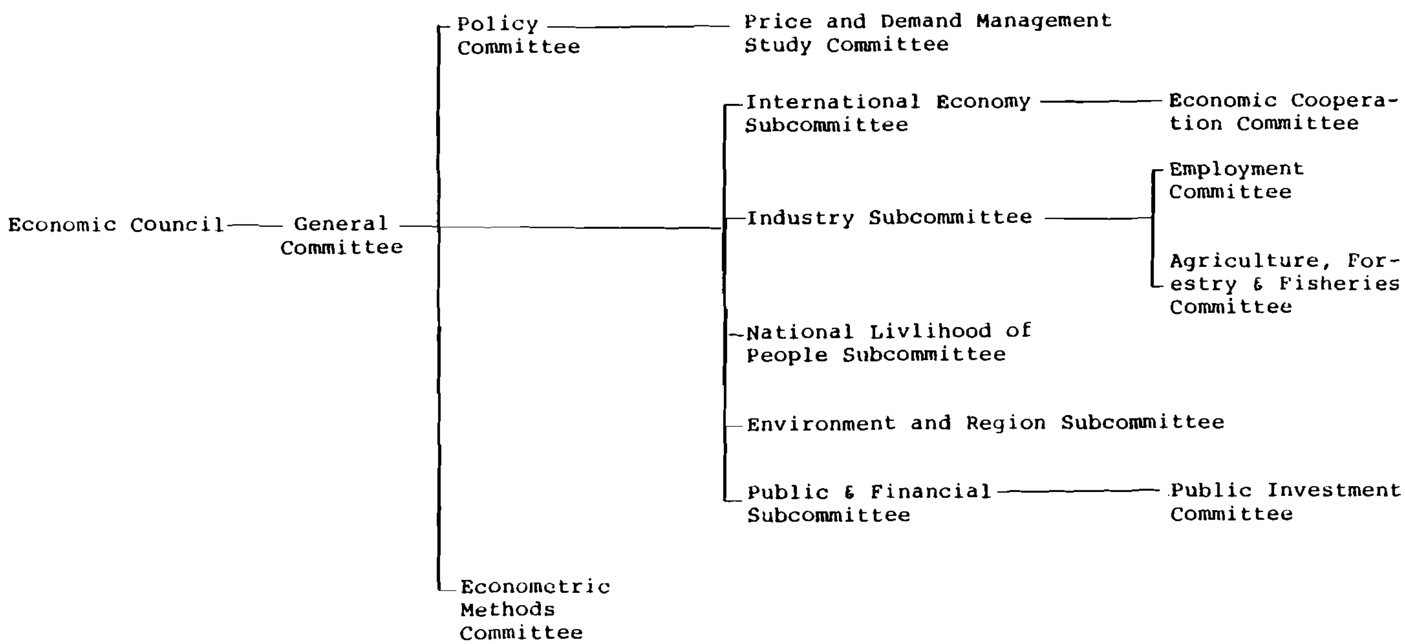
8.2.1.4 Governmental Organizations in National Planning Processes

Due to the character of the Japanese society as a parliamentary democracy, there are several public institutions which are involved in the planning process. In the case of the five-year national economic plans the responsibility is split within the planning process as follows:

1. *The general purpose* and *general objectives* of the plan are given by the Prime Minister to the Economic Council.
2. The plan is *drafted* by the Economic Council, an advisory body to the Prime Minister, composed of experienced people (see Chart 8.1).
3. The draft plan is *coordinated* by the Economic Council and in particular by the Economic Planning Agency (EPA), which is one of the Prime Minister's units for decision preparation (see Chart 8.2); in the process of plan formulation it goes through various channels:
   - with the political party currently in power;
   - among government organizations;
   - with the private sector;
   - with local governments,

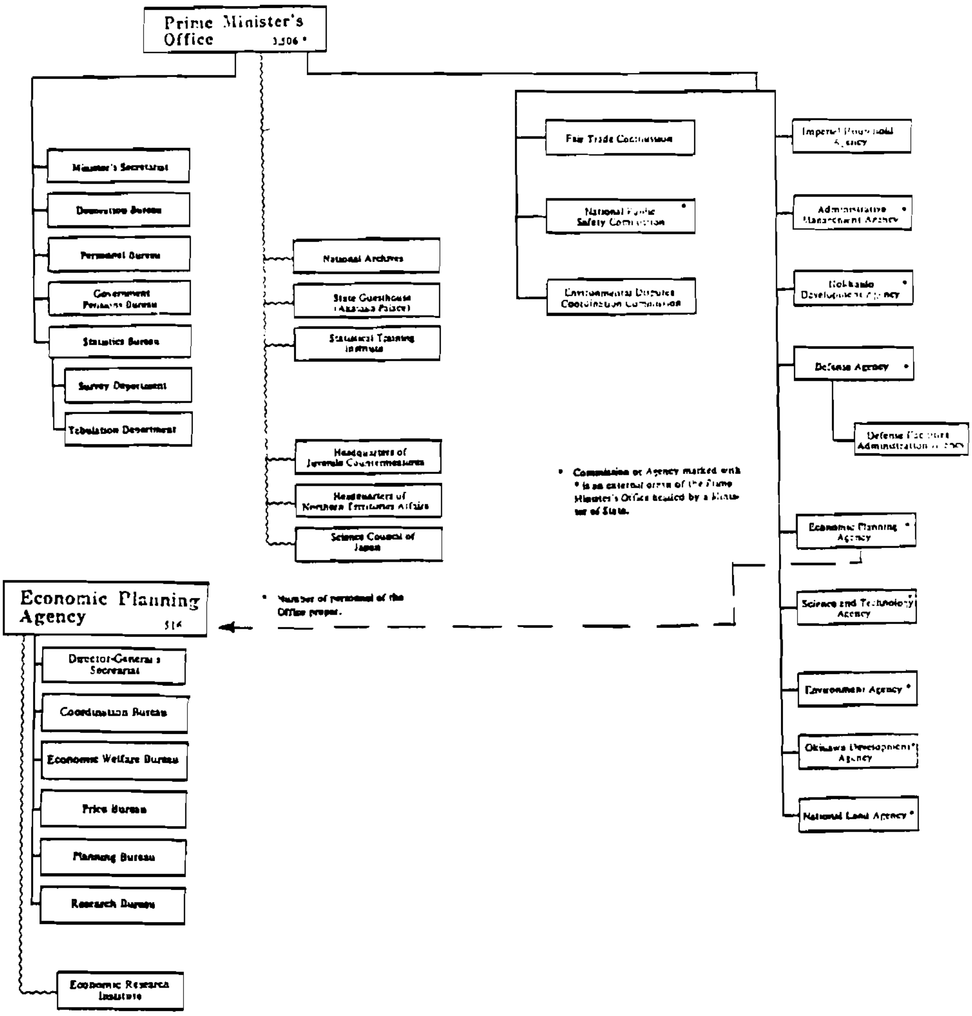
   aiming at *consensus*, which is the key word for understanding the Japanese decision making system (see 8.3.5).
4. The draft plan is *adopted* by the government as the government plan.
5. The plan is *implemented* by means of
   - annual plans and budgets, submitted by the EPA to the cabinet;

Chart 8.1 ORGANIZATIONAL CHART OF THE ECONOMIC COUNCIL*



* As of early 1950's.

Chart 8.2 ECONOMIC PLANNING AGENCY - POSITION AND STRUCTURE



Source: Organization of the Government of Japan [ ], p. 4,5, and 9.
Prime Minister's Office, January 1975

- ministerial plans, programs and budgets;
- prefectural plans and budgets, although local governments do not participate in the planning process (!);
- orienting the private sectors.

8.2.1.5 The Social Function of National Economic Planning in Japan

The opportunities and limitations of national economic planning in Japan are determined by the character of the socio-economic system and can only be understood within this framework. From Japanese sources the social function of national economic planning and of respective plans is characterized as follows:

> The first task is to show the general direction of government economic policy from the longer term viewpoint so as to give the basis for specific policies to be taken by each ministry and to guarantee consistency among them. For example, the improvement of social overhead capital has been stated in almost all plans. There are five-year programs for each project such as road construction, railroad construction, sewage construction, housing, etc. If these programs are made independently, based on the demand in each field, many problems will arise such as misallocation of resources, overheating or down-swing in business trends, imbalance between costs and benefit to the nation, etc. The government economic plan therefore gives a consistent basis for these programs.
>
> This first task also has a political purpose: the plan is used as a manifestation of the philosophy of the current cabinet or of the prime minister. The second analysis of long-term problems of the economy and the formulation of the strategy to overcome these problems. The prediction of labor shortage in the Doubling National Income Plan or the environmental problem in Basic Economic and Social Plan are past examples. This task is now thought to be very important in the current plan because of the realization that an unpredicted stage of development has now been reached. Japan will not be able to imitate its predecessors; it must have foresight regarding its problems and formulate measures to overcome them. After experiencing the oil crisis Japan realized the need to save for rainy days. Japan has little land and natural resources. Domestic production of food is about 70% of the amount demanded. It produces no oil, no ferrous ores and little coal. Our economic activities depend on other resource-rich countries. This means that the world demand-supply situation or political instability

> have a significant influence on the economy. As these are data for the plan, account must be taken of the world situation and remedies prepared for any problems that arise.
>
> The third task of the plan is to present a guide-post for the private sector, entrepreneurs and consumers, by showing the development process of the Japanese economy. When private enterprises make long-term investment plans, they have to think about the general business trend for the future. Then the plan can show the path and can avoid confusion or bottlenecks. This function of the plan is sometimes called generalized market research. Government is responsible for the realization of planned public expenditure but not for the behavior of the private sector. Government contributes to the realization of the planned target for the private sector partly through this role of preparing guide posts.
>
> For the public, the plan is intended to contribute information about the problems the economy faces, or the costs of a welfare society. This is the educational role of the plan. The fourth role of the plan is the coordination of interests among various social groups. The allocation of public investment is an example of this. The plan with the above characteristics is generally called an indicative plan. [11]

This characterization of plans as being either indicative or predictive, explains why the actual growth of the economy deviated so much from planned growth (See Table 8.15). It also explains why a procedure of frequent revisions to the plans was adopted in Japan. From Japanese sources, altogether five causes of revision were mentioned [11]:

1. The lack of direct control of the private sector and the underestimation of private investment;
2. The misprediction of world economic conditions;
3. The change of cabinet and along with this the change of political philosophy;
4. The lack of supervision and evaluation of plan implementation; and
5. The unexpected down-swing of the economy.

Table 8.15 PLANNED AND ACTUAL GROWTH OF GNP UNDER NATIONAL ECONOMIC PLANS

PLAN	PLANNED GROWTH	ACTUAL GROWTH
Five Year Plan for Economic Self-Support (1955)	5.0	9.1
New Long-Range Economic Plan (1957)	5.0	10.0
Plan for Doubling National Income (1960)	7.2	10.9
Medium-Term Economic Plan (1965)	8.1	10.8
Economic and Social Development Plan (1967)	8.2	9.9
New Economic and Social Development Plan (1970)	10.6	7.5
Basic Economic and Social Plan (1973)	9.4	2.4*
Economic Plan for the Second Half of the 1970s (1976)	6.0	n.a.

* 1973-1976 growth.

Source: Okita [Table 6], Japan Economic Planning Agency, 1976, and OECD, 1977.

Cited from N.J. Glickman "The Management of the Japanese Urban System: Regional Development and Regional Planning in Post-Ware Japan", IIASA, RM-77-47.

8.2.1.6 Transportation Related Plan Targets

All the national economic plans of Japan contained special policy statements and tasks related to transport systems. The main characteristics of each five-year plan since 1956 and the major countermeasures for social capital and transportation are listed in Table 8.16. It also reflects the step-by-step embedding of Shinkansen construction into the national economic policy. The transport related decisions and activities are placed in a time scale in Figure 8.9.

However, if we want to determine the point at which the Shinkansen changed from being a transport sectoral activity to a national economic program, then we need to look at the long-term economic policy documents, the comprehensive national development plans. While the First Comprehensive National Development Plan of 1962 already raised the idea of transport interlinkages between growth centers and metropolitan areas, the Second Comprehensive National Development Plan of 1969 proposed the development of a nation-wide Shinkansen network, which led to the "Law for Nation-Wide Shinkansen Network" of 1970, a 7000 km high-speed railway network construction program. *This was the beginning of the Shinkansen as a national large-scale development program.* (See Chapter 2.)

8.2.2 Public Corporations

The public sector of the Japanese economy consists of five governmental enterprises (Postal service, National Forestry, etc.) with 360,000 employees and 113 public corporations supervised by ministries. Among these public corporations are nine dealing directly with transport-related activites; two of them are:

The Japanese National Railways (JNR), and
The Japanese Railway Construction Corporation (JRCC)

which are responsible for planning and construction of the Shinkansen Lines (see Chapter 4).

Table 8.16 TRANSPORTATION POLICY IN ECONOMIC PLANS OF JAPAN [11.6]

Economic Plan	Major Countermeasures	Major Countermeasures for Social Capital	Major Countermeasures for Transportation	
Five-year Plan for Economic Self-Support F. 1956 - 60	1. Self-support of economy 2. Advancement of employment 3. Stability of economy 4. Coordination of qualitative improvement and quantitative development of economy	1. Arrangement of transportation and communication facilities 2. Arrangement of national land securing facilities 3. Construction of dwellings 4. Intensifying the foundation of agriculture, forestry and fishery	1. Intensification of overseas marine transportation 2. Arrangement of international aerial navigation 3. Arrangement of facilities for increase of domestic transportation demands 4. Arrangement of facilities for attending to school and office in large cities	Road: Execution of the five-year plan advancement of improvement of not-improved sections of national roads and prefectural roads, arrangement and repletion of toll road system Railway: Strengthening of transportation ability of main trunk lines, electrification of main trunk lines, dieselizing of branch lines, arrangement of facilities for attending to school and office within large cities, particularly strengthening of subways, exchange of old facilities and cars Harbour: Arrangement of export and import harbours intending to continuous starting of ships and to reduce freight expenses
New Long-Range Economic Plan F. 1958 - 62	1. Stability of economy and maintenance of high growth rate 2. Promotion of national living level 3. Realization of full employment 4. Planned extension of basic section	1. Intensifying the transportation ability 2. Intensifying the foundation of agriculture, forestry and fishery 3. Security of national land 4. Stability of residential conditions	1. Establishment of comprehensive transportation system for increase of domestic transportation demands and change of structure 2. Arrangement of transportation facilities in mining and industrial zones 3. Moduration of transportation in large cities 4. Arrangement of international airports	Road: Mainly arrange the sections to become bottleneck of productive activity where the transportation amount is large in accordance with transportation demands, and execute concurrently arrangement of interurban roads and construction of highways for motor car Japan National Railways: Main trunk lines are mainly arranged in accordance with increase of transportation demands, and electrification and dieselizing are advanced for modernizing transportation. Harbour: Harbours of foreign trade and handling important raw materials are mainly arranged in order to cope with increase of transportation demands and large-sized ships and special use.
Doubling National Income Plan F. 1961 - 70	Remarkable promotion of national living level and accomplishment of full employment 1. Repletion of social capital 2. High rate of industrial structure 3. Furtherance of trade and international economical cooperation 4. Promotion of human ability and advancement of science and technology 5. Moderation of double structure and securing of social stability	1. Securing minimum limit of necessity of social capital for strengthening industrial foundation (particularly for transportation) 2. Repletion of foundation of living such as dwellings and living environmental facilities, particularly modulation of urban problems 3. Strengthening the national land securing facilities	1. Repletion of arrangement of roads 2. Arrangement of harbour facilities 3. Local major invertment eliminating all-round policy 4. Arrangement of airports and aerial navigation securing facilities 5. Repletion of urban transportation facilities	Road: Repletion of transportation between large cities, arrangement of streets and network of roads connecting large industrial city and its suburb Harbour: Major arrangement of important harbours where the freight amount is extremely large Japan National Railways: Promotion of labor productivity in order to secure economic rationality such as new installation of important trunk lines connecting large-scale industrial zones, making double tracks, and rationalization of internal organization in JNR thoroughly Airport: Construction of airports in important cities

Table 8.16 (continued)

Economic Plan	Major Countermeasures	Major Countermeasures for Social Capital	Major Countermeasures for Transportation	
Medium-Term Economic Plan F. 1964 - 68	1. Arrangement of various conditions that form the foundation for raising the living level such as the expansion of trade, high grade of industrial structure, advancement of science and technology, and promotion of human ability 2. Correction of delayed facts in the economical society produced as a result of high-grade growth, modernization of low-productivity portion, fluidity of labor power and its effective utilization, and qualitative promotion of national life 3. Arrangement of social capital and repletion of social security	1. Repletion of various facilities of foundation of living beginning with dwellings 2. Arrangement of foundation for modernizing the agriculture, forestry and fishery 3. Arrangement of transportation and communication facilities	1. Intensifying comprehensive repletion of transportation system 2. Countermeasures for transportation safety 3. Restoration of past investment deficiency 4. Countermeasures for transportation in large cities	Road: Arrangement of roads to intend modulation of safety of severest transportation congestion and after looking into decidedly the future trend concurrently, arrangement of not-improved trunk line roads, modulation of transportation congestion in large cities, stepwise construction of trunk line motor car roads, modulation of transportation in large cities, and arrangement of roads as living environment, particularly advancement of pavement Railway: Intensifying the transportation in attending to school and office in large cities, laying double track of main trunk lines, countermeasures for safety, electrification, dieselization, and improvement of crossings. Harbour: Arrangement of foreign trade harbours, making efficient of loading and unloading, arrangement of industrial harbours, arrangement of piers specially used for domestic ships and container ships, mechanization of loading and unloading, arrangement of harbour facilities, and harbour arrangement for policy of local development of new industrial cities.
Economic and Social Development Plan F. 1967 - 71	1. Consistency of stability of prices and economical growth 2. Economic efficiency 3. Advancement of social development	1. Comprehensive arrangement of dwellings and living environmental facilities 2. Arrangement of reasonable transportation and communication facilities 3. Arrangement of social capital relating to agriculture	1. Countermeasures for transportation in large cities 2. Countermeasures for transportation safety 3. Modernization of freight transportation 4. Arrangement of international transportation facilities 5. Arrangement of transportation network of trunk lines	Road: Arrangement of roads in large cities and their surroundings, countermeasures for safety, efficient construction of highways for motor car, installation of general national roads, and major arrangement of local roads Railway: Arrangement and unification of performance of railways in attending to school and office within large cities, basic examination of management of JNR, making efficient of construction of new lines, modernization of freight transportation such as the concept of base freight station, making high speed, repletion of trunk line along the Pacific Ocean, and laying double track of main trunk line directly connected to it, and electrification Harbour: Unified, organic arrangement of harbour in the zone of large cities, arrangement of international container base on the sea, major arrangement of base development harbours, and countermeasures for safety Airport: Starting the use of new Tokyo international airport, arrangement of airports of trunk line, making possible the runoff and landing of large-sized aeroplane in the whole day at main local airports, and countermeasures for safety

Table 8.16 (continued)

Economic Plan	Major Countermeasures	Major Countermeasures for Social Capital	Major Countermeasures for Transportation	
New Economic and Social Development Plan F. 1970 - 75	1. Efficiency of economy from the international viewpoint 2. Stabilization of prices 3. Advancement of social development 4. Maintenance of proper economical growth and culture of economic foundation	1. Arrangement of good dwellings and healthful and safe living environments 2. Arrangement of transportation and communication system for fulfulling the leading role in the organization of national land utilization 3. Arrangement of material land securing facilities and development of water resources 4. Arrangement of productive foundation of agricultural, forestry and fishery industries	1. Systematic arrangement of main trunk line transportation network constituting the main axis of national land 2. Transportation countermeasures taking major points on modulation of congestion in attending to school and office in the range of large cities, smoothening of transportation on road, and modernization of circulation of things 3. Countermeasures for transportation safety	Railway: Arrangement of new trunk lines, and of railway network in attending to school and office in large cities Harbour: Arrangement of harbours in the zone of large cities and of base harbours connected to them Airport: Arrangement of base airports and of main airports connected to them
Economic Plan in the First Period in the 70's of Showa F. 1976 - 80	1. Securing price stability and full employment 2. Securing stable life and comfortable environment 3. Cooperation and contribution to worldwide economic development 4. Securing economical safety and culture of long-range development foundation	1. Arrangement of living environmental facilities 2. Intensifying the foundation of national life 3. Arrangement of transportation and communication facilities	1. Strengthening of facilities in the places to become bottleneck against increase of demands 2. Countermeasures for environment and safety 3. Modulation of congestion of transportation in large cities 4. Repletion of transportation network of trunk lines	Road: Concerning highways for motor car, it is aimed at to offer about 3,200 km in the end of F. 1980. Furtherance of countermeasures for noise, arrangement of roads for living, and systematic arrangement of network of city roads Railway: Concerning new trunk lines, it is aimed at to start both lines of Tōhoku and Jōetsu in the planned period. Advancement of countermeasures for noise, repletion of the existing railways and of subway network, and advancement of arrangement of monorails etc. concurrently. Improvement of arrangement of connecting facilities Harbour: Major arrangement of circulation base harbours and of overseas trade harbours, arrangement of facilities necessary for prevention of water quality pollution etc., countermeasures for transportation safety, and advancement of arrangement in remote places and detached islands Airport: Promotion of arrangement of international airports and of domestic airports to cope with flight of jet aeroplane, advancement of countermeasures for noise, and countermeasures for transportation safety. Promotion of arrangement in remote places and detached islands

Table 8.16 (continued)

Economic Plan	Major Countermeasures	Major Countermeasures for Social Capital	Major Countermeasures for Transportation	
Economic and Social Basic Plan F. 1973 - 77	1. Creating rich environment 2. Securing easy and stable life 3. Stability of prices 4. Advancement of international cooperation	1. Arrangement of facilities relating to living directly connected with promotion of national welfare 2. Arrangement of related projects for effective use of national land such as formation of transportation and communication network of trunk lines	1. Countermeasures for safety and environment 2. Establishment of effective transformation system according to district	Road: Concerning highways for motor car, it is aimed at to arrange about 10,000 km up to F. 1985, and about 3,100 km will be used including the highways already installed during the period of this plan. Positive arrangement is made in the roads relating to living in prefectures, and at the same time the arrangement in the general national roads is mostly finished during the period of this plan. Railway: Concerning the new trunk lines, it is aimed at to arrange about 7,000 km up to F. 1985, and during the period of this plan the Tōhoku, Narita, and Jōetsu lines are started in operation amounting to about 1,900 km including those already installed. As for the existing lines, laying double track and electrification are advanced. In large cities such as Tokyo, Osaka, Nagoya etc., the arrangement of subway network is promoted. Harbour: Major arrangement of circulation base harbours is executed. Airport: Arrangement of new Tokyo international airport is advanced, and concerning the Kansai international airport the arrangement is started in the initial period of this plan aiming at early completion. Arrangement of domestic airports to cope with flight of jet aeroplane is also promoted.

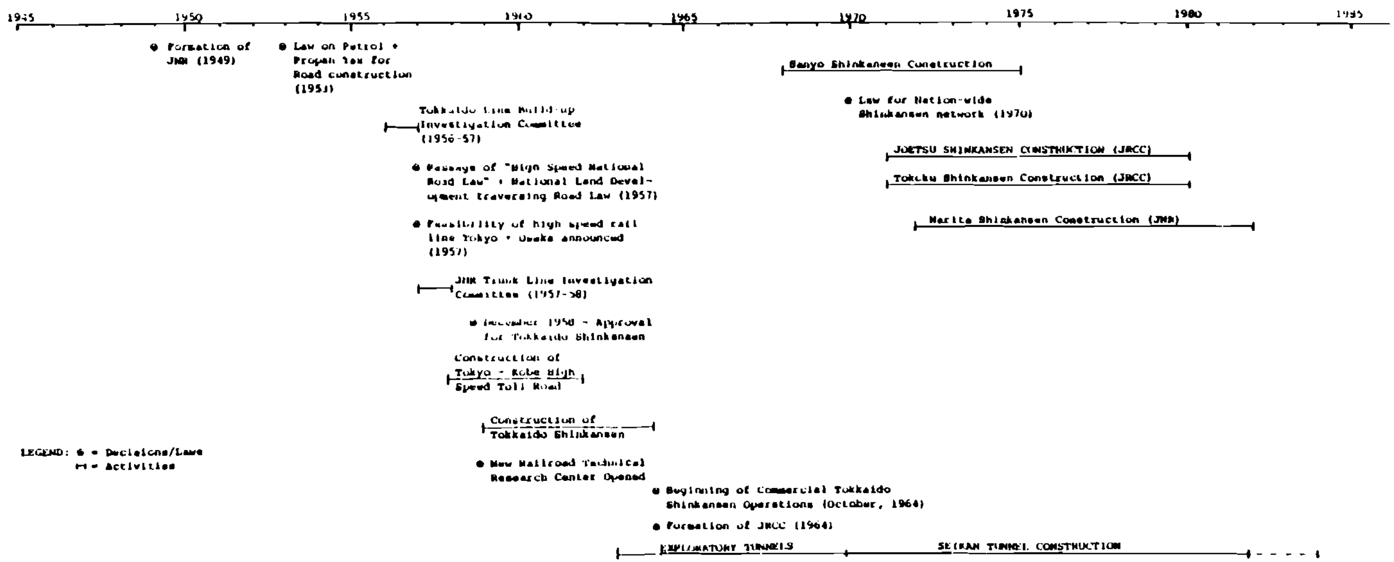


Figure 8.9 DECISIONS AND ACTIVITIES ON TRANSPORT SYSTEM DEVELOPMENT

8.2.3 Private Sectors of the Economy

Similar to many other market-oriented (capitalist) economies the major part of the Japanese economy is in the hands of private companies and entrepreneurs. But, there exists two important differences compared with other countries:

- the very low share of foreign capital (1.4%), and
- the large amount of small establishments.*

The second feature in particular has important consequences for the demand for transportation and mobility.

The business interactions, material supply interlinkages and the sale of final products for the 5.5 million small and medium sized establishments, provide a high degree of transport activity with relatively small quantities to be transported, and also the necessity to establish and to maintain a larger amount of personal contacts connected with business trips. New, fast transport facilities on the one hand cover this demand, and on the other hand stimulate its growth.

In general, industries expected the following after the opening of the Shinkansen:

- quicker/easier exchange of information,
- increased sales, more customers,
- easier liaison with the main office,
- expansion.

At the same time the small industries were afraid that they would not be able to compete with the larger industries in this way.

8.2.4 Local Governments

Japan's territory is subdivided into 47 territorial units governed by a prefecture. (See Chapter 7.) Almost all activities for the implementation of national economic policy actually take

*5,474,000 establishments employ less than 50 people. This is 98% of all establishments (excluding individual ownership in agriculture, forestry and fisheries). [Source: Statistical Handbook of Japan, 1977, p. 102].

place in these territorial units and affect the nature, economy and living standard of the unit. Only a part of these activities are planned and supervised or even implemented by local governments. Their power and influence is in general restricted to the implementation of those projects which are financed through the local budget (about 50% of the total budget of Japan).

Although prefectures are strongly affected by the results of national economic policy, they are not formally included in the national planning process.

> The local governments do not participate in the planning process . . . There is .. no guarantee of consistency between central government policy measures and those of local governments. [11]

Of course, there is a certain coordination during the planning process between governmental agencies, ministries and prefectures.

The attitude of local authorities to Shinkansen is very diverse. In the construction stage their main concerns are:

- delineation of track, location of stations;
- direct and indirect impacts of Shinkansen construction (land price rise, disturbances by construction activities).

After construction, there was some interest in the impact of Shinkansen on the local economy and some concern as people complained about noise and vibration.

In Fukuoka (Hakata) a socio-economic impact study, initiated by the local government, showed that among 1,300 citizens, 81% welcomed Shinkansen, but 19% expressed opposition. Their main complaints were with regard to noise and vibration and the rise in the price of land and other commodities.

Actually, the function and the population of Fukuoka city increased sharply after the opening of the Shinkansen line. The impact on the sales of the different middle and small industries is not significant, particularly because the period of opening overlapped with the economic recession.

8.2.5 Citizens

There are both positive and negative impacts to citizens resulting from Shinkansen construction, depending on the distance from the metropolis. Positive impacts are:

- higher degree of mobility,
- indirect impacts arising from improved regional and national economic conditions.

Negative impacts are:

- noise, vibration,
- increased price of land and other commodities.

Based on these different interests, citizen action groups developed, and in some cases (e.g., Narita Shinkansen) they were able to counteract action for implementation of national economic policy decisions to build new Shinkansen lines.* The influence of these citizen groups during the preparatory phase was very limited.

8.3 Issues

8.3.1 Long-Range Planning and Programming

National economic planning as a new tool for government national policy formation was introduced in Japan in the late 40's when two drafts of economic plans for 1948-52 and 1949-53 had been prepared but not yet approved by the cabinet.

The first national economic plan was accepted by the government in December 1955. It was prepared for 1956/57-1960/61 by the recently established Economic Planning Agency. This plan assumed that GNP would grow at least 5% per year and suggested the rapid growth of the second sector of the economy, especially of heavy and chemical industries as well as of export. This plan was used simply as an economic forecasting tool (the so-called pre-econometric or naive econometric forecasting method used by H. Kolme in his work "The American Economy 1960" published in 1952.

*For detailed analysis of citizen action groups arising from environmental impacts of Shinkansen, see Chapter 6.

The real economic growth of Japan was much higher than that predicted in the plan. The new Prime Minister, Kishi, asked for the preparation of the new five-year economic plan for 1958-62. The main goals of the new plan were "to reach continuous fast (maximum) rate growth of national economy, to increase income per capita and full employment". The plan was approved by the cabinet in December 1957. For the elaboration of the second plan a more advanced methodology was used. Three alternatives were considered: 5,7, and 9% as an annual GNP growth rate and an intersectorial balance for them was made. The 7% growth rate was chosen as being the best; however, due to imbalance of payments it was proposed that 6 1/2% should be used. The second plan became the basic economic document within the Japanese governmental apparatus when the Tokaido Shinkansen proposal reached them and was also used for the preparation of the demand projection for the Tokaido Shinkansen project. The real economic growth of Japan however was much higher than predicted.

The next Prime Minister, Ikeda, asked for a new economic plan which would double the national income. As a response to this first long-range plan for 1961-70 was formed by the EPA. An assumption of 7.2% annual gtowth rate was just a simple arithmetic operation; however, many sectoral calculations were made and five subgoals were proposed:

- to increase capital investment;
- to increase the industrialization ratio;
- to increase international trade;
- to stimulate research and development; and
- to improve economical structure and social stability.

This plan was well received by the private sector of the economy. The plan was approved in December 1960, and already in 1961 private capital investment had been increased by almost 40%. As far as 1970 is concerned it reached more than three times this level.

In 1963 work on the medium-term plan had been re-established with extensive use (for the first time in Japan) of national econometric models. In January 1965 the new Sato cabinet approved the economic plan for 1964/65-1968/69. Since that time four medium-term plans were prepared and approved by the cabinet. Table 8.13 shows the main features of these plans. The Appendix shows the econometric models used for the medium-term plan. The new comprehensive national development, worked out by the government in 1969, succeeded the ten-year development plan of 1960. This plan was prepared in accordance with the Comprehensive National Land Development Act of 1950. The purpose of this plan was to establish the basic direction of national development on the basis of a long-range and comprehensive viewpoint. Table 8.14 shows the key elements of these plans. Figure 8.8 shows the chronology of the national economic development plan of Japan.

Long-range planning and programming in Japan should have been considered as a complex socio-political process. An anatomy of choice has been described by H. Haruta from the Economy Planning Agency [14]:

> . . . The planning authority in the free and competitive market-place is an atomic economic agent, and so the plan is merely a trivial bit of the whole will of the society . . .
>
> . . . . When we publicize the plan so that we may exert some influence on the market-place and it is our obvious aim to do so, the announcement will naturally influence the actual state of the world and will change it by piecemeal. Therefore, the actual state of the world and the intended traverse of the plan itself will never be identified unless we announce a modified version of the plan, taking into consideration the effects of the announcement. . . .
>
> Suppose E: plus without the relevant minus as an example of emotional attitude, and L: plus with the relevant minus as that of logical requirement. If we agree with E with the emotional majority, we can easily make a plan without conflicts; individual welfare temporarily goes up, in the meantime the society is headed for a catastrophe. On the other hand, if we insist on the law of L, we lose the approval of the majority and, as a result, social decision making becomes inefficient; under these circumstances, people age without performing anything, and facilities, without being maintained, decay.
>
> Now, planning enters into its political process. Our struggle for a compromise C starts between ex ante duty (efficiency in politics) and ex post responsibility (reality).

Where, $C = \left|(w_1 \cdot E + w_2 \cdot L)/(w_1 + w_2)\right|$

w_1: emotional power of the majority

w_2: rational power of the scientists (planners)

Emotion	Necessity	Efficiency in Politics	Process	Implementation in planning
1.00	0	100	Go	0
0	1.00	0	Stop	1.00
$w_1/(w_1 + w_2)$	$w_2/(w_1 + w_2)$	$w_1/(w_1 + w_2)$		$w_2/(w_1 + w_2)$

	ex ante chaos	ex post chaos
E	0	100
L	1.00	0
C	$w_2/(w_1 + w_2)$	$w_1/(w_1 + w_2)$

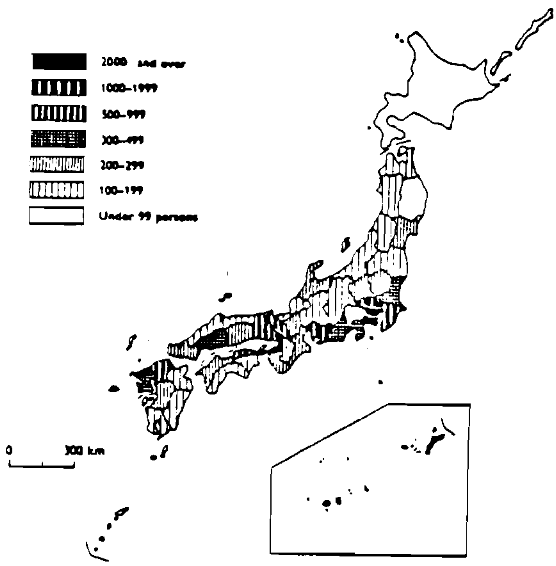
People concerned are exhausted through this process. No one can distinguish between truth and falsehood. At that moment the plan is born as a delicate balance between truth and falsehood.

Comprehensive planning is defined as a competitive political process in which science and politics approach an equilibrium on the basis of necessity and emotion. [14]

8.3.2 Habitations Pattern

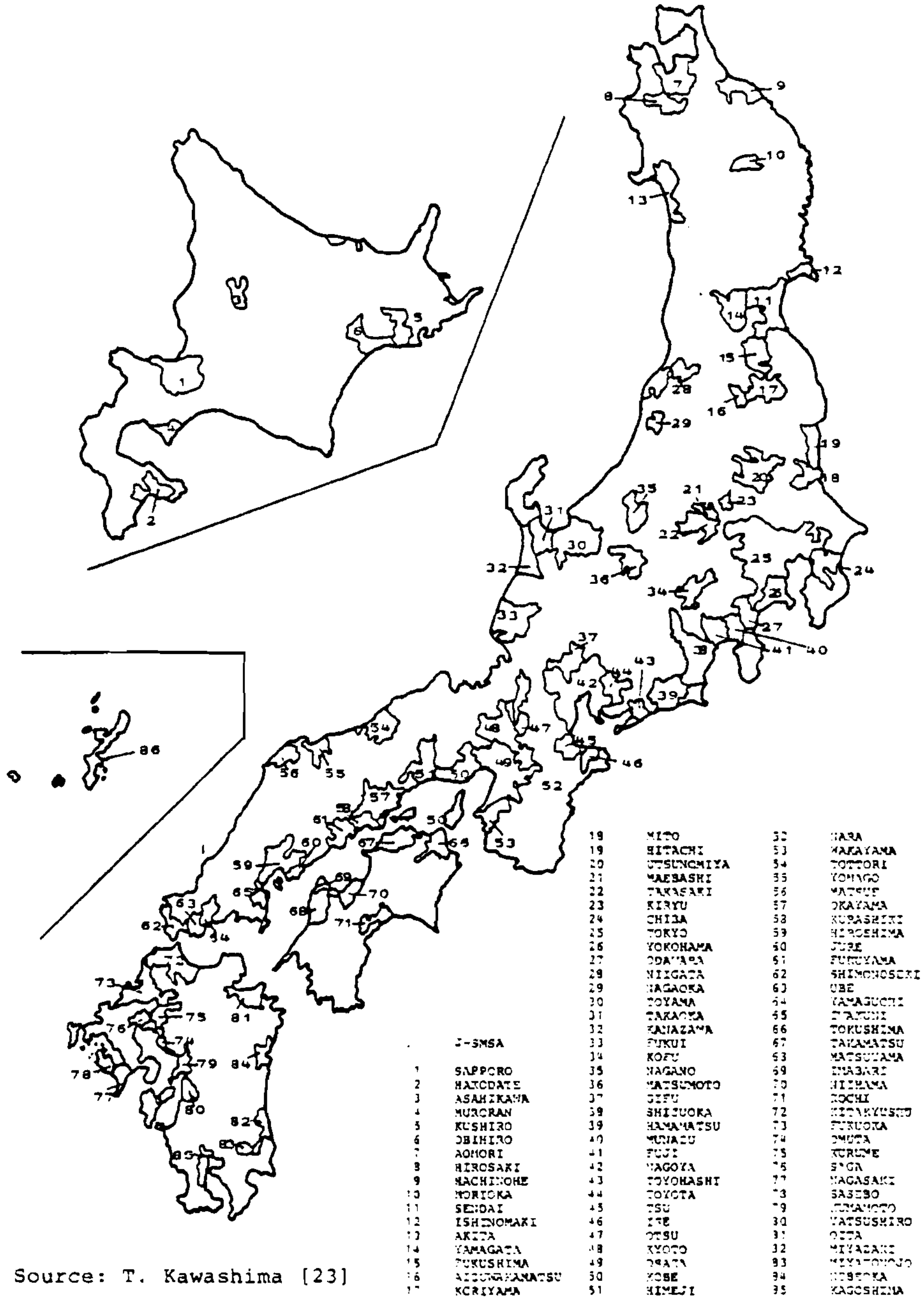
Today, Japan ranks sixth in the world in terms of population as well as of population density. Nevertheless, her habitation pattern is unique in the world. Moreover, the spatial population structure of Japan and its self-dynamics is extremely important from a scientific as well as a practical point of view not only for Japan but for scientists and planners all over the world. The population density in Japan varies greatly from region to region, from over 2,000 per sq. km to less than 99 (see Figure 8.10).

An excellent tool for the analysis of pattern and its dynamics in Japan is the J-SMSA, the Japanese version of the US Standard Metropolitan Statistical Area made by T. Kawashima (see Figure 8.11). [23]



Source: Statistical Handbook of Japan, 1977

Figure 8.10 POPULATION DENSITY (1976)



Source: T. Kawashima [23]

Figure 8.11 THE JAPANESE STANDARD METROPOLITAN STATISTICAL AREAS

Kawashima divided Japan into five regions:

A - Hokkaido (S-JSMA);

B - Honshu I: Tokaido-Sanyo Megalopolis;

C - Honshu II: Non-Tokaido-Sanyo Magalopolis;

D - Shikoku (6 J-SMSAs); and

E - Kyushu (14 J-SMSAs).

It is the opinion of many urban scientists that a new type of human settlement has emerged recently in Japan, that the Honshu Megalopolis already exists.[7] Megalopolis is understood to mean a new human settlement unit of between 50-100 million people. The megalopolis concept is still only a scientific one; it is not yet a statistical, administrative or planning unit. However, this concept helps us to understand the habitation pattern of modern Japan and helps to analyze the relation between spatial population structure and the Shinkansen.

The Japanese national planners in their 1969 New Comprehensive National Development Plan stated:

> . . .With the advance of information and rapid transportation systems with a higher degree of efficiency we can expect that all of Japan, extending 2000 km from north to south will be integrated into a single unit . . . the new network will be established by connecting the capital Tokyo with Sapporo, Sendai, Nagoya, Osaka, Hiroshima and Fukuoka in a big agglomeration.

In other words they proposed to establish a Fukuoka-Hiroshima-Osaka-Nagoya-Tokyo-Sendai-Sapporo megalopolis. This concept differs from the concept of the first Comprehensive National Development Plan where a modal network of big cities had been proposed.

Kawashima in his work defined all outh Pacific parts of Honshu including Tokyo as the Honshu Megalopolis. Recent computation at IIASA shows that even some norther parts of Pacific Honshu could be included in the Honshu Pacific Megalopolis.

The spatial population analysis also revealed that the Kitakyushu and Fukuoka J-SMSAs could be included in the Honshu Megalopolis. However, it seems that tradition and culture will not allow this as yet and that Kawashima is right to limit the megalopolis to the Honshu.

The Honshu Pacific Megalopolis is the fastest growing human settlement unit in Japan between 1960 and 1975. (See Table 8.17.)

From the point of view of the megalopolis the Tokaido Shinkansen should be considered as a rapid transit (urban high-speed railway) as well as its first extension to Okayam in 1972. The Shinkansen which is operating now could be considered as more than 90% megalopolis rapid transit and less than 10% intermetropolis transport.

The Shinkansen Tokuku Line will serve as an extension of megalopolis regional transit to the Sendai and then as outside transportation.

From the megalopolis dynamics follows that by the early 80's Sendai will be a part of the Honshu Pacific Megalopolis (see Figure 8.12). However, it is impossible that the Honshu Pacific Megalopolis will reach the Sapporo Metropolis by 1985. Nevertheless as the IICNDP proposed, the opening of the Saikan Tunnel in the 1980s could be an important factor in the human settlement of Hokkaido, which possesses a "high degree of nature" in Japan. (See Figure 8.13.)

Table 8.17 THE POPULATION OF FIVE JAPANESE REGIONS

J-SMSAs	1960	1965	1970	1975
Honshu Pacific Megalopolis	37,974,573	43,362,010	49,335,050	54,502,445
Honshu II (without megalopolis)	11,316,397	11,591,113	122,331,521	13,124,459
Hokkaido	1,989,939	225,695	2,593,990	2,919,403
Kyushu	6,802,591	6,884,312	7,145,347	7,665,110
Shikoku	2,173,273	2,192,247	2,301,764	2,478,877

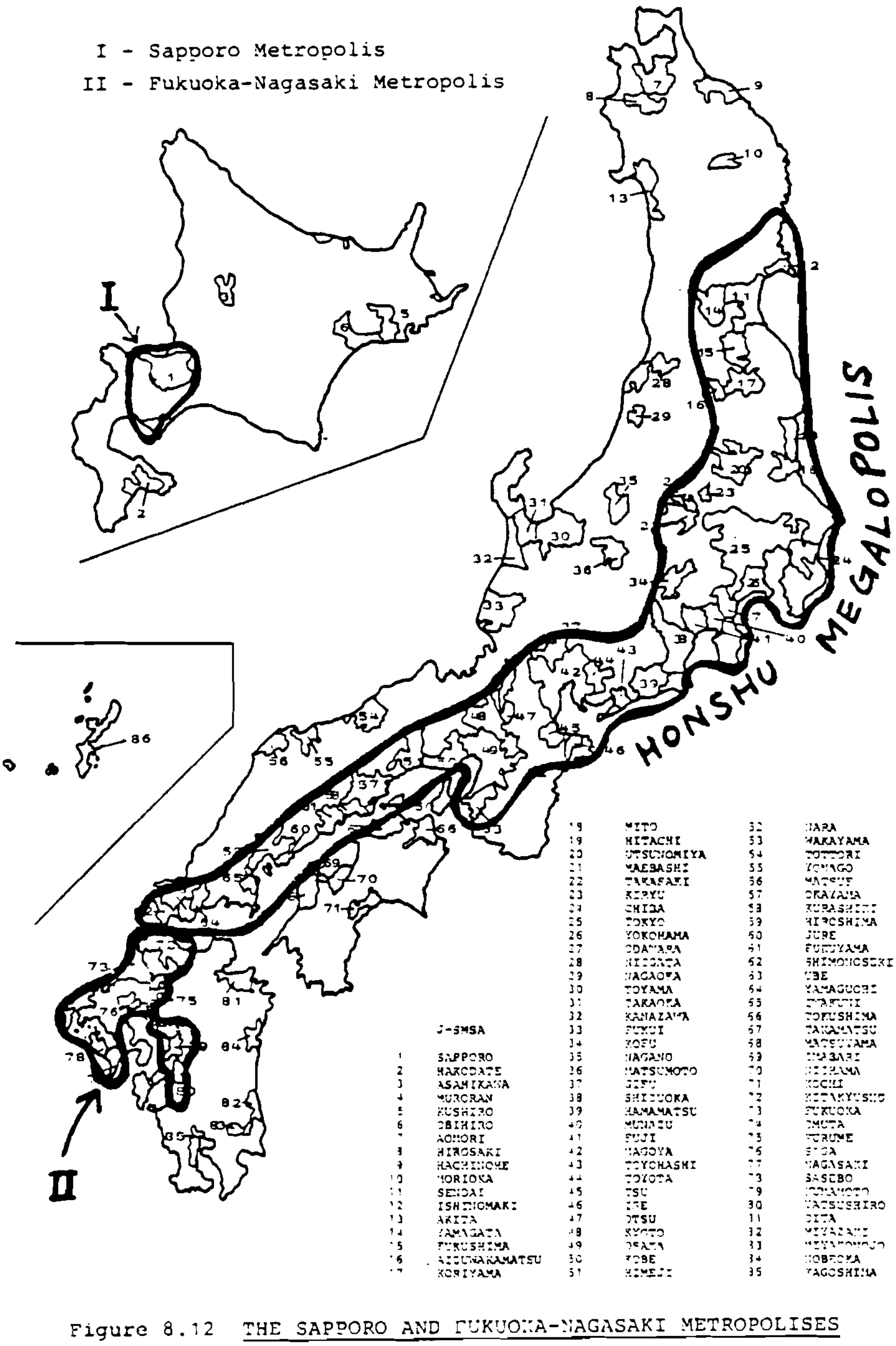
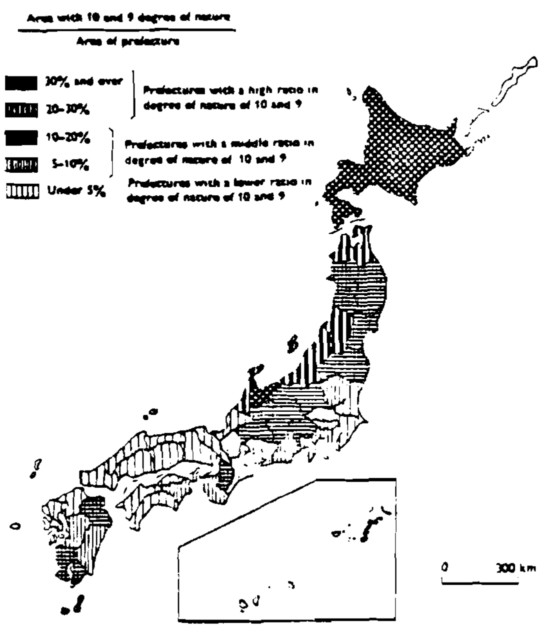


Figure 8.12 THE SAPPORO AND FUKUOKA-NAGASAKI METROPOLISES



Source: Statistical Handbook of Japan, 1977.

Figure 8.13 VEGETATION NATURALNESS RATINGS - RATIOS OF NATURAL FOREST AND GRASSLAND WITH HIGH DEGREE (10 and 9) OF NATURE (FY 1973)

The behavior of the Honshu Pacific Megalopolis is crucial for the future of Japan. H. Haruta thinks that a Megalopolis can exist only if the growth ratio of the Japanese economy is not less than 4%; if it is less than this, the megalopolis will collapse. [14]

The formation of the megalopolis is still in the early stage, and nobody knows about its behavior as yet. There are some pre-megalopolises in the FRG and the USA; however, they differ very much from the Japanese one. Will the Honshu Megalopolis continue to grow, as well as no-megalopolis J-SMSAS, or some of them?

First of all Japan's general habitation pattern should reach a steady state condition during this generation (25-30 years) due to limited human resources and the Honshu Megalopolis could reach a range of 80-90 M (now (1975) 61 M); however how this will change the megalopolis is an open question, but it is almost certain that the Fukuoka-Nagasaki Metropolis will be a part of the future Japanese Megalopolis.

The habitation pattern of Japan will be strongly influenced by the new transport relations and, in particular, by the new generation of Shinkansen. Will Japan be a human habitation and transportation prototype for the future? [28]

8.3.3 Investments

One of the most important factors which makes any particular program a large-scale national program is (among other factors such as the impacts on national economic growth, the national habitation pattern, the living conditions, conservation and/or utilization of natural resources, export power of the national economy, etc.) the amount and share of investment needed compared with the total national investment expenditure in a given period.

In the case of the Shinkansen, investment is a major indicator which shows that Shinkansen can be considered as a large-scale program since the beginning of the 1970s when the preparation and the construction of the JOETSU Shinkansen, the TOHOKU Shinkansen, the NARITA Shinkansen and the SEIKAN Tunnel began (see Figure 8.14).

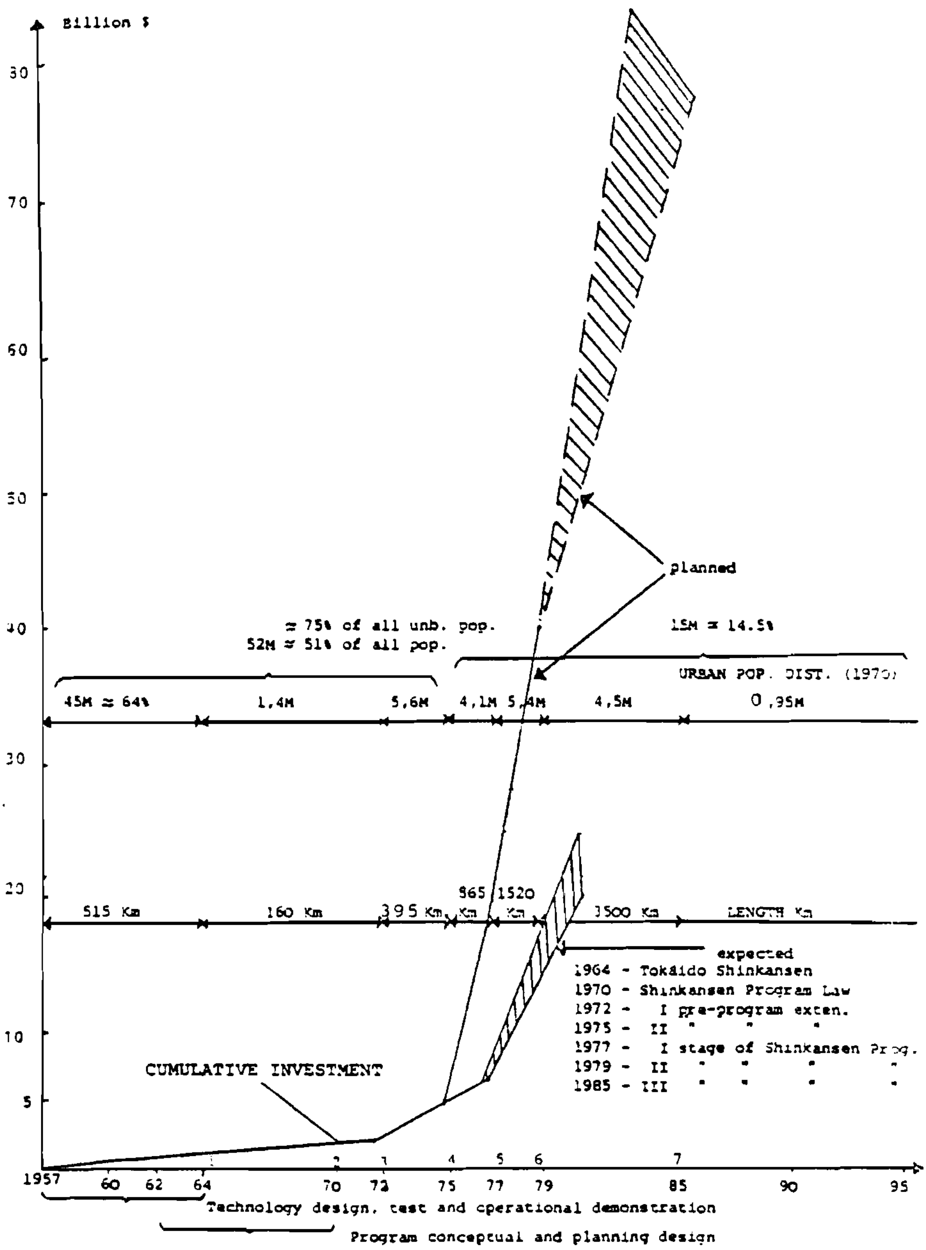


Figure 8.14 SHINKANSEN PROGRAM DEVELOPMENT STAGES

Planned, cumulated investment totalled about 80 billion US \$ to be spent in about 15 years. The target seems to be very ambitious when this is compared with total gross domestic fixed capital formation of about 100 billion US \$ in 1975. Counting an increase of +5%/a from 1976 to 1985 the calculated gross domestic fixed capital formation will amount to about 3.10^{12} US \$ (250 ¥/US \$).* This means that the total planned Shinkansen investment for 15 years will claim about 2-3% (2.6%) of the total national investment. The conclusions drawn from this rough calculation are:

1. The Shinkansen program lies within the range of feasibility from the point of view of investment.

2. The implementation of this huge investment program requires an extraordinary fund raising scheme through a temporary and/or final redistribution of national income of Japan.

8.3.4 Industry Transition

Industry has been the main driving force in the development of Japan since Meiji times. Ikeda's famous Doubling National Income Plan was undoubtedly the product not only of the governmental apparatus but also of Japan's business community. Before being appointed to the office of Prime Minister, Ikeda was appointed three times Minister of Finance and twice Minister of Industry and International Trade (MITI).

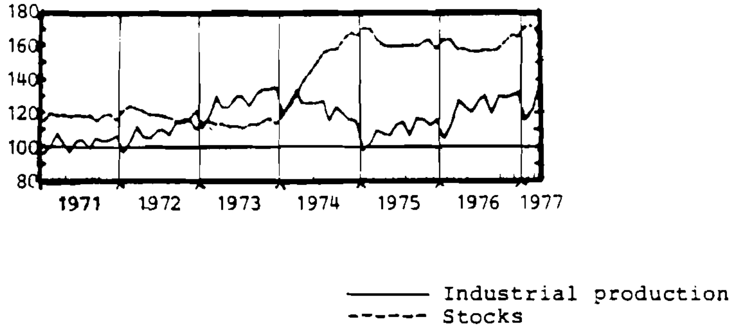
The Second Comprehensive National Development Plan was prepared under the supervision of Prime Minister Sato. It was a long-range plan involving huge construction projects. Prior to his appointment as Prime Minister, Sato was Minister of Construction as well as Minister of Finance and Chairman of the Hokkaido Development Agency. The construction sector of Japanese industry enjoyed the fastest growth between 1960-70 in all sectors of the

* 1971	112	1976	189	1981	241	
	127		198		253	
	142		208		266	
+12%/a	160	+5%/a	219	+5%/a	279	
	180		230		293	
	721		1044		1332	3097 · 10^9 US \$

economy. It is obvious that this plan opened new prospects to the Japanese construction industry and, of course, was supported by them.

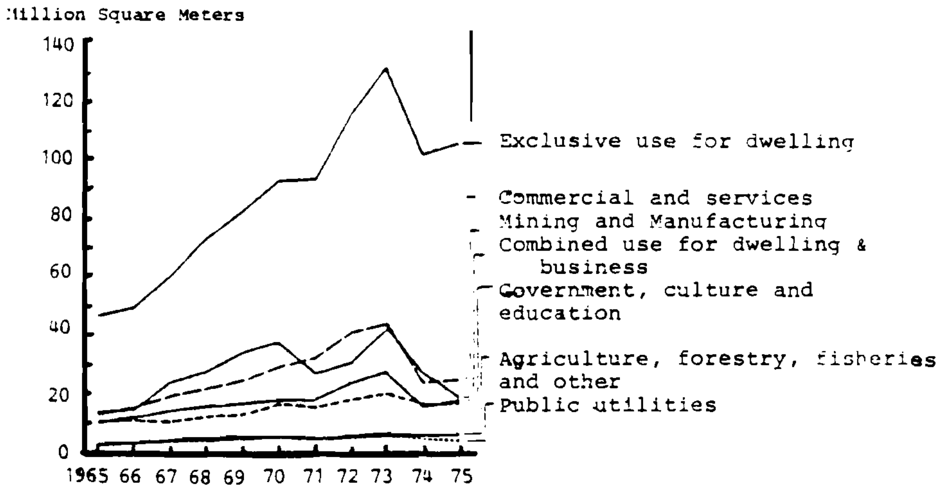
Prime Minister Tanaka was responsible for the Grand Strategy for 1985; he based it on the Second Comprehensive National Development Plan. Tanaka was twice Minister of Finance and Minister of Industry and of International Trade before becoming Prime Minister. The business community of Japan appears to have reached a consensus on the need for such a program. This program, described sometimes as the largest peace-time project in human history, needed one trillion $ in public and private funds [4]. The Shinkansen Network project was included in this program (~8% of the program cost). Subsidies to the manufacturing industries to stimulate the industrial redistribution of Japan were expected to be somewhere in the region of $10 billion. In order to redistribute Japan's population, seventy new towns should have been built each of 200,000 people at a cost of $1.8 billion (12.6% of the program cost). The main actors of this huge program were big construction, manufacturing, wholesale and retail trade corporations. Therefore, in reality, the Tanaka Program was not only designed to reshape that habitat pattern of the Japanese archipelago but also to reshape the Japanese economy. This program called for a sharp increase in taxation (corporate tax included) which decreased the competitive power of Japanese products in the international market. Therefore, the private sector of the economy could support this program only in favorable conditions of the world economy. The world economy has been changing since 1971 and the Japanese economy (both private and governmental sectors) responded immediately to the 1971 and 1973 new world economy environment (see Figures 8.1, 8.16, and 8.17).

Since the autumn of 1973 there has been a new situation in the international resources market and this has forced the Japanese government to revise its medium-term national economy plans as well as its long-range plans and programs. Nevertheless, the need for Japan's grand strategy arose again. In August 1977, the Nomura Research Institute stated:



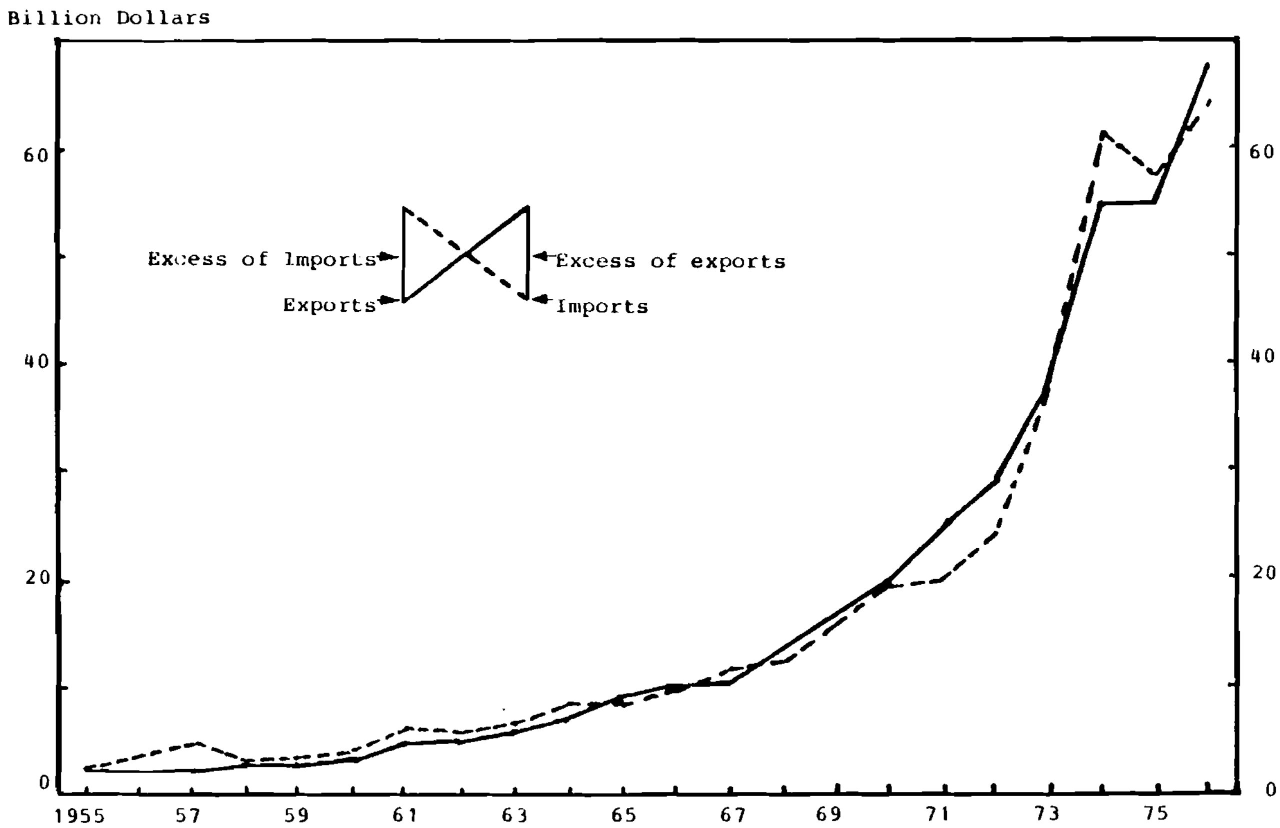
Source: Statistical Handbook of Japan 1977

Figure 8.15 INDEXES OF INDUSTRIAL PRODUCTION AND STOCKS (1970 av. = 100)



Source: Statistical Handbook of Japan, 1977

Figure 8.16 FLOOR AREAS OF BUILDING CONSTRUCTION BY USE



Source: Statistical Handbook of Japan, 1977

Figure 8.17 TREND OF FOREIGN TRADE

There are four reasons why we believe Japan should have clear grand designs. First of all, although Japan had few cleancut grand national designs or comprehensive strategies in the past, its development was smooth because the international environment was relatively favorable to the country. However, a transitory disarray expected from the structural change of the international order and from the slowdown of the world economic growth over a long period will make it very difficult for Japan to effectively cope with the international environment.

Second, although it may not be aware clearly, Japan had what may be called the national goals in a sense. These goals were to catch up with Western countries or to place priority on the economic problems and make utmost efforts for economic development and growth or to follow the model of the advanced democratic industrial nations in the West. Since Japan has achieved these goals in a way, there arises the need to have the new national goals and new designs.

Third, Japan's growing international influence has also increased an international interest in her grand designs, and now there is a fear that any ambiguity about the grand designs may create unnecessary frictions and distrust among nations.

Fourth, Japan pursued material gain and self-centered national interests in the past. However, today's world of growing international interdependence and increasing complication demands Japan to behave by realizing its international responsibility and to pursue national interests through international cooperation. In other words, Japan has arrived at a point where it should assert itself and achieve goals by recognizing her international responsibility.

It is, of course, impossible for anybody to propose an exact target time or to make detailed definitions of new projects; however, it is possible to take a long-term view of Japan's industrial structure and the prospect of Japan's science and technology for the next 30 years [15].

Japan's future economic potential is a key factor in implementing the new overall strategy and again her industry should be a dominant driving force. However, new orientation for industry has been proposed and it is expected that industry should respond quickly to:

1. New energy strategy and nuclear energy development.
2. New research and development strategy and an industrial structure switch into innovation intensive technology, capable of producing new R&D intensive export products.
3. New policies for making Japanese industry international through overseas investment and business activities.

There have been proposals for industrial policy planning and the reshuffling of functions within the Ministry of International Trade and Industry (see Figure 8.18). The industrial relocation plan remains however though with much less momentum. There were even proposals from the Nomura Research Institute in 1977 [44] that "the increase in the government R&D investment should be financed mainly with the transfer from public works expenditure". It was stated that R&D investment has a great effect on creating demands and stimulating economic activities in the long-run and that R&D investment should be treated on the same footing as public investment in budget allocation. The strong position of the Japanese construction sector of industry should, however, not be foregotten (see Table 8.18) and the fact there the per capita use of cement in Japan has risen beyond that of developed countries. In addition, employment in the construction sector is still growing (see Table 8.19).

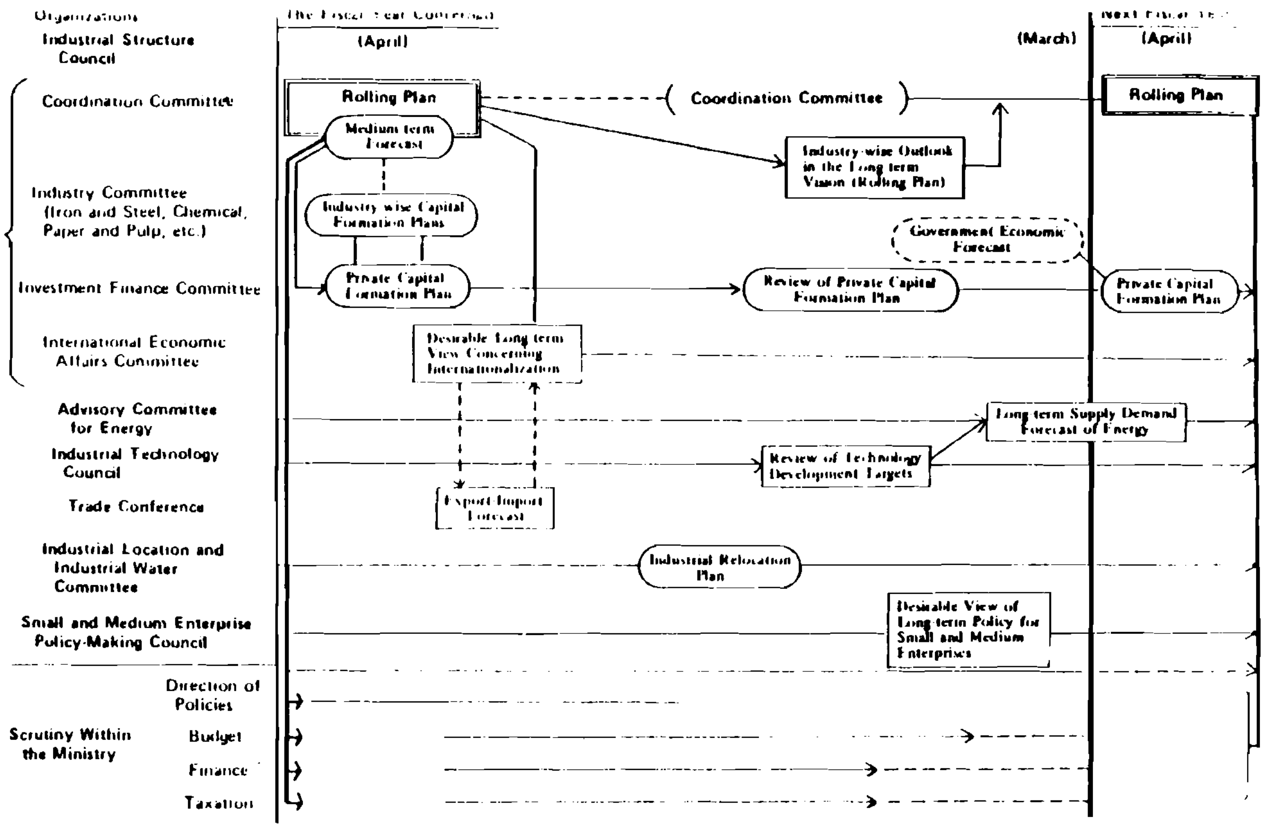
We can expect, therefore, that large-scale construction projects are still vital to the Japanese economy; however, they no longer offer such huge prospects as before.

8.3.5 National Consensus

When asking for motivations and procedures of decision making under conditions of diverging and sometimes conflicting interests, one very often obtains the answer:

> The problem was discussed and intended action was coordinated among all interested social and political groups until *consensus* was reached.

In a paper on "Economic Planning in Japan" [11] the following is stated:



Note: This chart indicates interrelations between committees in forming policies.

Source: MITI

Figure 8.18

Table 8.18 INTERNATIONAL COMPARATIVE BREAKDOWN OF OUTPUT VALUE BY PRINCIPAL INDUSTRY

(Based on Input-Output Tables) (Unit: %)

	SHARE OF OUTPUT VALUE		
	Japan	USA	FRG
1 Agriculture, forestry & fisheries	4.4	4.5	4.6
2 Coal & coal products	0.5	0.2	1.5
3 Iron & nonferrous metal ores	0.1	0.3	0
4 Crude oil, natural gas & pretroleum products	1.5	2.7	1.6
5 Other mining & quarrying, ceramics & non-metallic mineral products	2.1	1.3	2.1
6 Foodstuffs	5.5	6.0	7.7
7 Tobacco	0.5	0.5	0.9
8 Textiles and textile products	2.7	1.7	2.6
9 Wearing apparel, leather & leather products	1.2	1.8	2.2
10 Wood milling, wooden product manufacturing, furniture & fixtures	2.1	1.4	2.1
11 Pulp, paper & paper articles	1.6	1.6	1.2
12 Printing & publishing	1.1	1.4	1.2
13 Chemicals	3.8	3.2	4.9
14 Iron & steel	7.0	2.3	4.2
15 Nonferrous metals	1.2	1.5	1.1
16 Fabricated metal products	2.3	2.4	4.3
17 General machinery & transport equipment	9.9	10.0	8.8
18 Electrical machinery	4.7	3.3	3.4
19 Precision machinery	0.7	0.7	0.7
20 Miscellaneous industrial products	1.8	2.1	1.0
21 Construction	10.1	6.9	8.9
22 Electric power, gas & water utilities	1.6	2.5	2.2
23 Wholesale & retail	8.8	10.6	9.1
24 Banking & insurance	3.0	3.1	1.9
25 Real-estate & real-estate rents	3.7	7.1	2.7
26 Transportation & communication (excluding broadcasting)	4.6	4.5	4.2
27 Public administration	1.4	5.1	4.7
28 Community services & government scientific & research institutes	3.5	3.0	3.1
29 Business & personal services	8.7	8.2	7.1
30 TOTAL	100.0	100.0	100.0
Primary Industries (1-5)	8.6	9.0	9.8
Secondary Industries (6-20)	46.0	39.9	46.3
Tertiary Industries (21-29)	45.4	51.1	43.9

Source: MITI

Table 8.19 EMPLOYED PERSONS BY INDUSTRY

(1000 persons)

YEAR	TOTAL	AGRI-CULTURE AND FORESTRY	FISH-ERIES	MIN-ING	CON-STRUCTION	MANUFAC-TURING	WHOLESALE & RETAIL TRADE, FINANCE, INSURANCE & REAL ESTATE	TRANSPORT & COMMUNI-CATION	ELEC-TRICITY, GAS, WATER & STEAM	SER-VICES	GOVERN-MENT
		(Both sexes)						(Both sexes)			
1960 av.	44,360	12,730	670	430	2,530	9,460	8,990	2,390		5,740	1,420
1965	47,300	10,460	670	290	3,280	11,500	10,080	2,940		6,490	1,580
1970	50,940	8,420	440	200	3,940	13,770	11,440	3,240	280	7,510	1,610
1975	52,230	6,180	430	160	4,790	13,460	12,960	3,320	320	8,550	1,960
1976	52,710	6,010	420	180	4,920	13,450	13,230	3,410	330	8,910	1,750

Source: Statistical Handbook of Japan, 1977.

> In order for the plan to be effective, there must be a *consensus* on the plan not only among the cabinet members but also among government organizations and among various social groups. This consensus is reached in the process of plan formulation through various channels of *coordination* with various social groups.

This procedure sometimes takes a very long time and it is very difficult, and in some cases impossible, to determine a single person who is responsible for a complex and expensive decision.

This causes extremely difficult conditions for decision analysis, and for a foreigner it is almost impossible to fully understand the whole predecision mechanism. Bearing this limitation in mind, one can only try to give reasons for the important role consensus plays in Japanese management and decision-making processes:

1. There is a high degree of national feeling and awareness of national needs among the managerial staff in governmental institutions and in companies.
2. The share of foreign capital in the Japanese economy is very low, i.e., the risk of disturbance by "outside" interests.
3. Japanese tradition, culture and education promotes tolerant personal behavior.
4. For government officers a strict subordination into a strong governmental hierarchy is requested.
5. Decisions within the governmental system are highly centralized.
6. A single, top-level government official is usually not exposed to difficult, risky or costly decisions. In the case of failure a subordinate can take over the responsibility.
7. There exists a personal basis for achieving consensus between government institutions and companies. Top-level civil servants, with a deep understanding of

governmental policy, usually move for the last third of their professional life to leading positions in companies.

Of course, in this consensus-aiming, predecision process, only people and groups who have political and/or economic power are included.

8.4 Interrelations

The Shinkansen program interacts very strongly with the national economy as a whole and with all main national economy actors. However, interrelation between issues and actors differs. Table 8.20 shows the interrelation between issues and different stages of the Shinkansen program. At present it is probably impossible to assess the third stage of the Shinkansen program from the point of view of investment benefits, industry transition and national consensus. Table 8.21 shows interrelations between the issues, it is important to stress that all issues are interrelated and some of them even have very strong links. Table 8.22 shows the actors probable interest grades in particular issues. Table 8.23 shows how the different actors supported or opposed the stages of the Shinkansen program.

8.5 Conclusions

(1) National Economic Policy formulation in Japan is done by means of *national economic plans.*

(2) The *Shinkansen Network* project was *initiated* by the second Comprehensive National Development Plan. In this sense the introduction of long-range national development planning played a crucial role for the Shinkansen Network Project. This project could be considered as a product of the governmental long-range planning activities.

(3) *Five-year plans* overlapping each other, on average by two years, have been implemented in Japan since 1948. Currently the ninth five-year national economic plan is in operation in Japan. Five-year plans contain governmental activities also in the transport sector and provide the basis for annual budgeting. The

Table 8.20 THE INTERRELATIONS BETWEEN ISSUES AND THE STAGES OF THE SHINKANSEN PROGRAM

ISSUES / SHINKANSEN PROGRAM	LONG-RANGE PLANNING & PROGRAMMING 8.3.1	HABITAT 8.3.2	INVESTMENTS 8.3.3	INDUSTRY TRANSITION 8.3.4	NATIONAL CONSENSUS 8.3.5
PREPROGRAM	No relation	Support megalopolis	Moderate. Very profitable	Support peaceful belt. Industrial. Locales	Almost full support
I STAGE	Product of long-range planning	Extension of megalo-polis to Sendai. First major mode (Niigata)	Moderate economic justification	Minor effect	Partial support. Social conflict
II STAGE	"	Should change habitat pattern	Socially justifiable	Some support. Industry allocations	Partial support & social conflict
III STAGE	"	New habitat pattern	Very big, effects unknown	?	?

Table 8.21 INTERRELATIONS AMONG ISSUES FOR THE SHINKANSEN PROGRAM

(The issues are numbered as in Table 8.20)

ISSUES \ ISSUES	1	2	3	4	5
1		necessary	necessary	useful but not necessary	useful
2	no relation		important factor	important factor	no relation
3	public investment necessary	necessary		important factor	sensitive factor
4	support of industry necessary	necessary	necessary		no direct relation
5	national consensus necessary	necessary	important	important	

Table 8.22 THE INTERESTS OF VARIOUS ACTORS IN THE KEY ISSUES RELATED TO THE SHINKANSEN PROGRAM

ACTORS \ ISSUES	LONG-RANGE PLANNING & PROGRAMMING	HABITATION PATTERN	INVESTMENT	INDUSTRY TRANSITION	NATIONAL CONSENSUS
Cabinet	+ +	+ +	+ + +	+ +	+ + +
EPA	+ + +	+ +	+ +	+ +	+ +
NLA	+ + +	+ + +	+ + +	+ + +	+ +
M of T	+ +	+ +	+ + +	+	+
M of C	+ +	+ +	+ + +	+	+
MF	+	+	+ + +	+	+
MITI	+ +	+	+ +	+ + +	+
JNR	+	+ + +	+ +	+ +	+
JRCC	+ +	+	+ + +	+	+
JHC	+ +	+	+ +	+ +	+
Others	+ +	+ +	+	+ +	+
Private Sector	+	+	+ + +	+ + +	+ +
Local Government	+ +	+	+ + +	+ +	+ + +
Citizen	+	+ +	+ + +	+	+ + +

(+++ very strong interest; ++ strong interest; + moderate interest).

Table 8.23 HOW VARIOUS ACTORS SUPPORTED OR OPPOSED VARIOUS STAGES OF THE SHINKANSEN PROGRAM

ACTORS / SHINKANSEN PROGRAM	Cabinet	EPA	NLA	MoT	MoC	MF	MITI	JNR	JRCC	JHC	JDB	Private Sector	Local Government	Citizen I	Citizen II
PREPROGRAM	S	S	X	S	NS	O	?	SS	S	O	X	S	S	S	X
I STAGE	S	SS	SS	SS	NS	?	S	SS	SS	NS	SS	S	SS	SS	O
II STAGE	?	S	S	S	NS	?	S ?	S	SS	NS	SS	NS	SS	SS	O
III STAGE	?	S	S	S	NS	?	S ?	NS	SS	NS	SS	NS	SS	SS	O
FURTHER EXTENSION	O							O			SS				

(SS - strong support; S - support; NS - no support; O - opposition).

five-year planning therefore played and still plays an important role in the *implementation* of the Shinkansen network program.

(4) National economic plans are *indicative plans* playing a certain binding role only for governmental institutions and an orientation role for the private sector. The private sector can only be influenced by indirect means. That is the reason for significant *deviations* of real national economic development from the planned figures.

(5) The actual degree of *integrativeness and comprehensiveness* in governmental planning and programming, and of implementation of national economic policy, was higher in times of rapid economic growth than it is now and in conditions of economic recession, which is caused by changing external and internal economic conditions. But the need for integrativeness and comprehensiveness increases with the growing scale of the program, e.g., the Shinkansen program.

(6) The application of *econometric models* for five-year planning of the national economy helped to guarantee a certain degree of comprehensiveness and consistency of the plan. Input-output analysis supports this. In the econometric model there is only one equation used for the transport as a whole.

(7) In the predecision/preprogram stage as well as during program implementation, the *subjective factor* plays an important role in Japan. Without personal engagement and dedication Shinkansen would never have come into being. On the other hand, the consensus-seeking philosophy and practice of decision-making guarantees a certain degree of anonymity of the decision-maker and makes it difficult to perform post-factum decision analysis.

(8) The actual *influence of local governments and citizen interest groups* on national economic policy formulation is very limited, although interest groups actually have been able to delay the construction of new Shinkansen lines.

(9) The *scale of investment* is a very important indicator in considering a program to be a large-scale national economic program. From this point of view the Shinkansen project became a

large-scale development program since the implementation of the national Shinkansen network began, i.e., the early 1970s. The activities for the preparation, construction and operation of the first Shinkansen line from Tokyo to Hakata can be considered as the preprogram stage.

(10) The elaboration and implementation of the Shinkansen network program is closely interlinked with the future development of *production*, research and development and *settlement*. The feasibility and efficiency of implementation of the 7000 km Shinkansen network depends completely on the implementation of the previous concept, to develop new industrial, scientific and settlement centers away from the present metropolises and also from the ability to change the structure of Japenese industry in accordance with the changing world economic conditions.

(11) The unique habitation pattern of Japan with the first megalopolis-type urban agglomeration in the world produces very favorable conditions for a high-speed ground urban transportation system (Shinkansen first and second generation); however, the realization of the full network concept sharply decreases overall effectiveness as well as the efficiency of the program.

Appendix

The Application of Models in the National Econometric Planning of Japan

Econometric models are used in the national planning of Japan. A medium-term, multisectorial model was used by the government for the preparation of the latest five-year plan and a long-term multisectorial model will be used for assessment of the growth potential of the Japanese economy in the next ten years.*

The Medium-Term Multisectorial Model

Purpose: Conditional forecasting for five years.

*See: Econometric Models for the National Economic Plan for the Second Half of the 1970s, Economic Planning Agency, Government of Japan, Tokyo, August 1977.

Data Base: Semi-annual data for the period from 1960 to 1972 (twenty-six samples) from input-output tables (56 sectors) and national accounts.

Degree of Disaggregation:

economy : seven sectors

industry : ten groups

final demand: nine categories, some of them divided into sub-categories

exports : six geographical areas.

Endogenous Variables: 691 - e.g., final demands, except governmental expenditures, demand for labor by industries, inputs by each sector.

Exogenous Variables: 7090 - e.g., government expenditure, labor available.

Type and Structure of the Model: (See Chart 8A.1) non-linear simultaneous equations.

The Long-Term Multisectorial Model

Purpose: Seeking feasible economic paths in the future.

Data Base: Estimation of initial conditions for 1975 using recent data.

Assumptions for Exogenous Variables: Fifteen kinds, mainly structures of exports and public expenditures, import prices, wage rates, rate of employment, rate of technological progress, production levels in 1990, and elimination ratios of pollution levels and saving ratios of energy.

Degree of Disaggregation:

industry: thirty-four groups.

Endogenous Variables: Export in a certain composition; Supply prices of domestic goods; Prices of exported goods; Cost of capital services in industrial sectors; Level of public expenditure; output.

Exogenous Variables: Consumption; Interest rate; Labor supply; Prices of imported goods; Surplus on trade; Trend of technological progress; Wage rates by industries.

Type and Structure of the Model: (See Chart 8A.2) clockwise approximations and connection of a turnpike simulation model with five sub-blocks and a main block.

Chart 8A.1 SUMMARY CHART OF CAUSAL ORDER

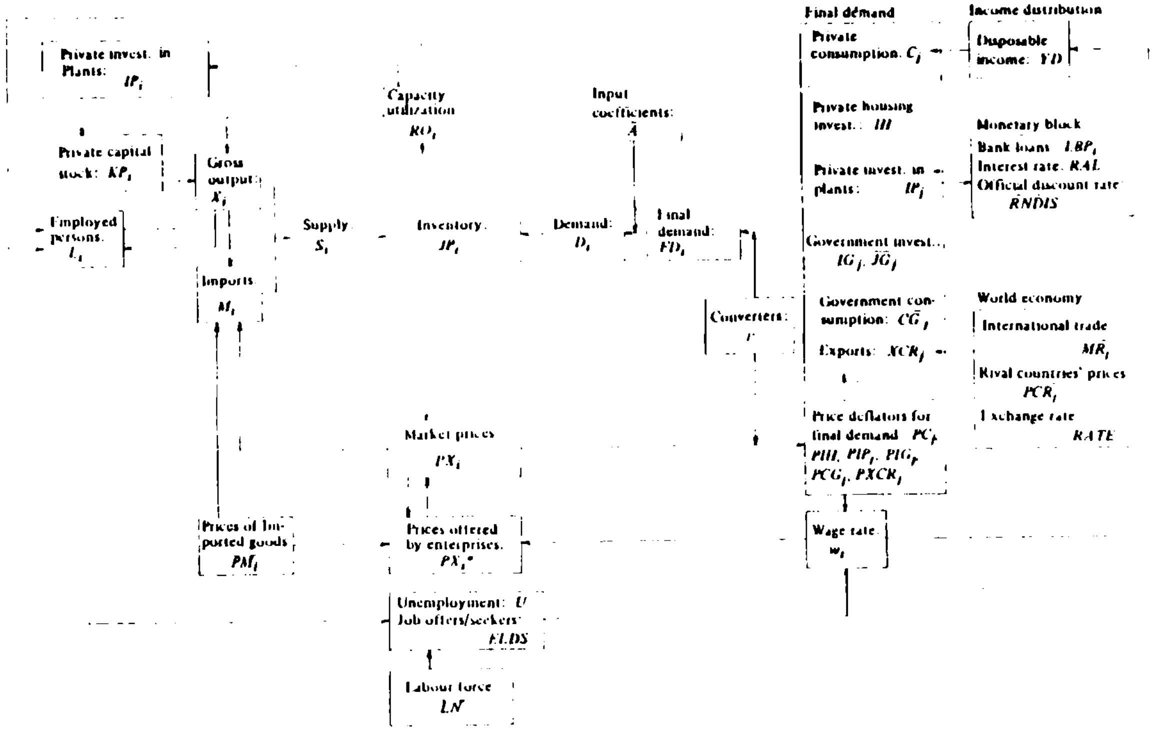


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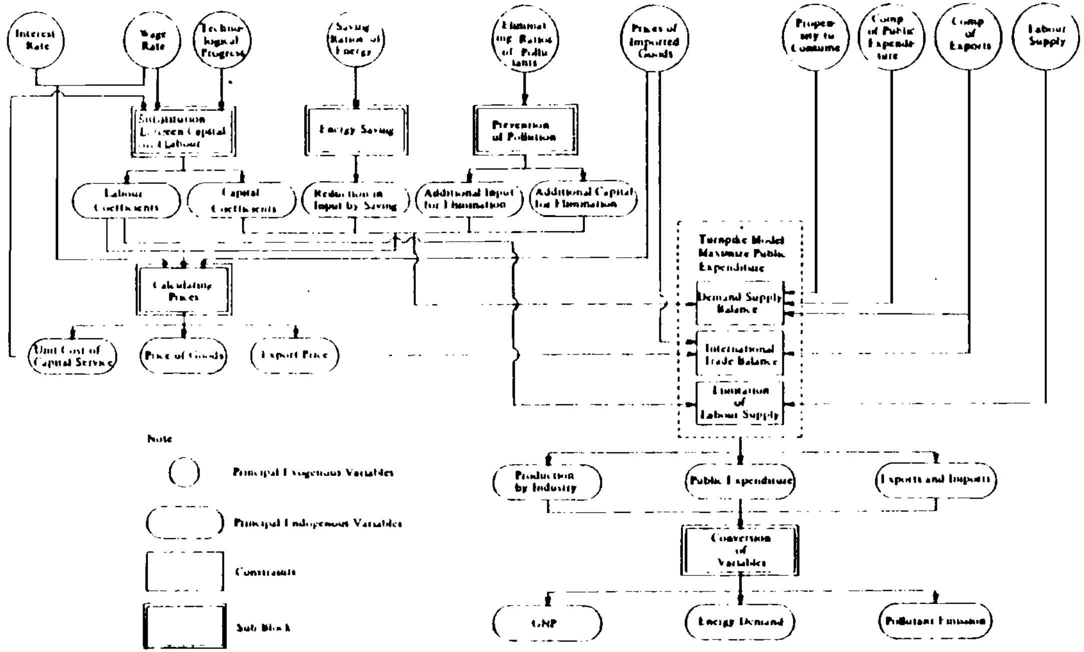
Chart 8A.2 OUTLINE STRUCTURE OF THE MODEL



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PART III

OVERALL ANALYSIS

9. OVERALL EVALUATION OF THE SHINKANSEN PROGRAM

It is extremely difficult to evaluate the large-scale development program before the first stage has been completed, and this will take another three to five years. Moreover the Shinkansen Program was, and still is, the most ambitious and costly transportation program in the world. Detailed analysis of different subsystem issues does give us sufficient information to talk about the advantages and disadvantages of this program. This development program used successful technology from hardware, software and orgware contents and an interaction point of view (Figure 9.1). However, with both positive and negative societal impacts (see Chapters 4 through 8) it cannot be considered successful as yet. Nevertheless, we do not consider this program as a failure. All modern transportation programs have positive as well as negative societal impacts (see Chapter 4.1). The gap between urban and transport technology has become rapidly larger in the past twenty years. Modern societies need both modern urban and transportation systems; however present economic potential does not allow the solution of this problem in the short term and in the correct way.

It seems to us that the most crucial issues in the Shinkansen Program are environmental ones. Economical and regional issues at this moment are not so important because they will play a role in the second and third stages of the development of the program which are still being discussed and which will not be started until the middle of the next decade at the earliest. However, at that time new technology may be available which will in turn force planners to reconsider the Shinkansen Program.

Environmental issues arose after 1972 (see Table 9.1) when the Shinkansen Program was already established. However complaints started almost straight after the opening of the Shinkansen Line. At that time neither environmental nor technology assessment studies existed. The technology of the Shinkansen, which is still the most advanced rail technology, existed before the societal impact assessment of new technology was considered.

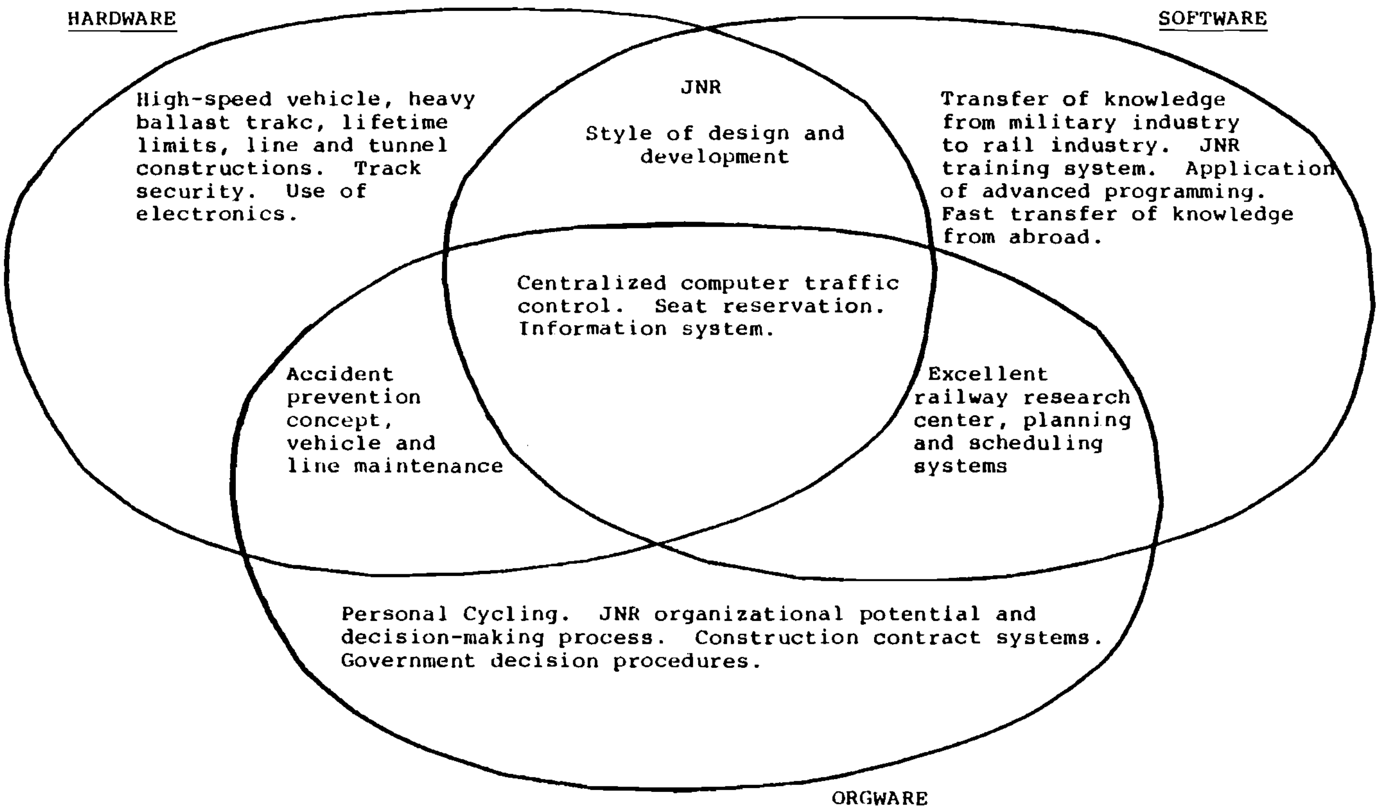

Figure 9.1 THE SHINKANSEN TECHNOLOGY--ISSUES OF EXCELLENCE

Table 9.1 WHEN THE ISSUES AROSE

Issues / Time	Prior to Tokaido Shinkansen <1964	Tokaido Shinkansen built 1964-73 The Shinkansen Program started (1969/70)	Present - 1974 until now I Stage of the Shinkansen Program Implementation
RAILWAY	Speed Safety Reliability	Accessibility Frequency of service Comfort Ergonomics	Profitability Environmental standard Future technology
TRANSPORTATION	Does not exist	Integration of transport systems The automobile/highway growth	Energy Environmental and safety standards Automization & computerization Air system growth Future inter-city transport systems
ENVIRONMENTAL	Does not exist	Does not exist Complaints started	Standard setting (1972) Citizen participation Environmental impact
REGIONAL DEVELOPMENT	Does not exist	National v regional growth Interregional equaity Redistribution of social capital Redistribution of industrial location	Regional stability Interregional accessibility
NATIONAL DEVELOPMENT	Does not exist	Long-range planning Habitat pattern	Industry transitions Investments National consensus

Profitability was also considered crucial as a JNR issue after 1973; this was partly due to a new economic situation, and partly due to the change in structure in the Japanese transportation system. However, the Tokaido Shinkansen Line proved that, at least in highly populated regions, this new railway technology could be highly profitable. Nevertheless, the lack of an initial cost/benefit analysis of the Shinkansen Program as a whole led to an unclear situation in which no one knew who should pay compensation for future deficits of the Shinkansen lines which operated in relatively low populated regions. It seems to us that political aspects of launching the Shinkansen Program had more momentum than economical ones. The establishment of the Shinkansen Program did not contradict national, regional; transportation and railway policies in Japan at that time (Table 9.2). However, after 1973 there was a drastic change in this policy (Table 9.2). The solutions used for the Shinkansen Program in comparison with TVA, BITPC as well as theoretically feasible large-scale development programs are shown in Table 9.3.

The organizational solution of making the Shinkansen Program a part of the JNR had several advantages. However, the JNR's huge deficit (its debts total more the ¥10,000,000 million and ¥1,800 million a day in payment of interest on loans) make conditions unfavorable for the Shinkansen Program. The programming and budgeting system used for the Shinkansen Program allows it to be put forward each year as one of the items of national public works. However, in reality it gives a one-year horizon which is too short in any circumstances for such a program.

Table 9.4 shows a comparison of the Shinkansen Program with others already studied by the IIASA team. Comprehensiveness and integrativeness in the Shinkansen Program are not fulfilled at the moment. However, in the initial stage of the program (1969-73) comprehensiveness was fulfilled through other complementary projects due to the Second Comprehensive National Development Plan. The Third Comprehensive National Development Plan approved by the Cabinet in November 1977 did not give comprehensive support for the Shinkansen Program.

Table 9.2 POLICY CHANGES OVER TIME

Issues / Time	Prior to Tokaido Shinkansen <1964	Tokaido Shinkansen built 1964-73	Present - 1974 until now
RAILWAY	Growth Introduction of new technology	Achieved good competitive position with respect to highway and air transport systems	Achieved profitability New technology research
TRANSPORTATION	Road improvement program Railway development	Independent growth of all transport modes: Road improvement programs. Air transport programs Shinkansen program	Continuation of previous policy and response to new issues
ENVIRONMENTAL	No overall policy	Research and institution building	Research Standard setting Monitoring
REGIONAL	No comprehensive policy	Comprehensive policy building through long-range planning and programming	Reformation of previous policy for less ambitious rescheduling of target dates
NATIONAL	Maximized GNP	Maximized GNP and launched long-term policy for redistribution of social capital	Stabilize moderate growth ratio and response to new world economy and new issues

Table 9.3 LARGE-SCALE DEVELOPMENT PROGRAMS SOLUTIONS

SOLUTIONS \ LSDP	TVA	BITPC	SHINKANSEN	THEORETICALLY FEASIBLE
ORGANIZATIONAL	Establishment of a public corporation	No	Partly Shinkansen Departments in JNR	Public Corporation
NATIONAL PLANNING AND PROGRAMMING	Attempt made	Long-term program five year plans	Long-term planning & five year national plans	Long & five year planning
SUPPORTING SYSTEMS RESEARCH	No	TPC systems of models	Network node concept & econometric modelling	Systems of models
SPECIAL LAW FOR SUPPORT	TVA Act	Partly through five year plan	Shinkansen program Law	Program Law
RESOURCES AND FUND ALLOCATION	Budget allocation & later bonds	Five year plan allocations	One year budgeting & orientation figures in plans. Bonds	Five year program funds
ALTERNATIVE CONSIDERATIONS	No	Local alternatives	Limited	Program & subprogram alternatives
GOVERNMENTAL MEETINGS AND DEBATES	Yes	Yes	Yes	Yes

Table 9.4 CRITERIA FOR LARGE-SCALE DEVELOPMENT PROGRAM

CRITERIA / LSDP	TVA	BITPC	SHINKANSEN	THEORETICALLY FEASIBLE
Comprehensiveness	Yes	Yes	Only at the initial stage (1969-73)	Necessary
Integrativeness	No	Attempt made	No	Necessary
Scale	Large ~5 billion US $	Large ~5 billion US $	Very large ~80 billion US $	Necessary
Specification of time of completion	Unspecified	~30 years	15 years (too ambitious)	Necessary but also realistic

10. LESSONS TO BE LEARNT FROM THE SHINKANSEN PROGRAM CASE

The last eight years in the history of the Shinkansen program have been a unique opportunity for the better understanding of the role and applicability of large-scale development programs in modern society. The Shinkansen technology is world famous and socio-economic achievements in Japan in the last 25 years are unique.

These few summary comments resulting from the retrospective study of the Shinkansen program which are given below can be regarded as generally applicable conclusions pertaining to processes of emergence, organization and influence of large-scale national/regional programs. They may be called "lessons" because of their indicative character with regard to other potential programs.

10.1 Emergence

Large-scale programs occur as a result of a coincidence of some extremal socio-economic conditions. This extremality may either be of a negative (e.g., the Tennessee river valley region lagging behind the rest of the country coupled with a generally felt need for some steps leading from the Great Depression) or a positive character (development opportunities, e.g., resources). The latter applies to Shinkansen which was conceived in the period of rapid growth and concentration, during which, at the same time, capacities were created to make a leap forward and tensions (traffic demand) arose that could best be dealt with by a qualitative change of approach.

10.2 Side-Purposes

(a) In many cases, especially for market oriented economies, large-scale programs constitute an attempt to introduce national planning. This applies both to the formal side (an instrument of national planning) and the contents of planning (forcing the desired development pattern). Thus, a large-scale program is regarded as a feasible solution to the problem of national state intervention in general and very often for specific cases is therefore undertaken. Shinkansen can be viewed as an example of national para- or pre-planning activity with regard to some broader socio-economic strategy questions.

(b) The visible and nationally important features of any large-scale program result in its frequent inclusion as one of the issues debated in the election campaign (F.D. Roosevelt - TVA, K. Tanaka - Shinkansen as an element of remodelling the archipeligo concept). This, however, involves some risk connected with the possibility of a change of cabinet or of switch in priorities. In this case the program may present important additional difficulties in national governing. Promises shoudl not be made too explicitly in view of difficulties in curtailment.

10.3 Organization

(a) Laws: As the conditions of a program's realization may change over time it is often advisable to enforce it with a law so that it cannot in future be easily dismissed on the basis of superficial changes. By enactment of an appropriate law (TVA Act, Shinkansen Law, Five-Yea Plans, having the character of law in the USSR - Bratsk) a buffer is created enabling the program to persist in disadvantageous conditions. It is important to notice that the law enactment is invariant with respect to other organizational solutions.

(b) Inter-Institutional Changes: There is no evidence or need to establish any new institution or special mechanism in order to deal with the large-scale program realization. In particular, less attention may be paid to internal organizational solutions for program realization than to the formation of external interfaces with existing institutions and procedures. Even in the case of the creation of a new institution, the inter- and cross-institutional character of the program management cannot and should not be avoided.

(c) Time-Horizon: It does not seem to be necessary to define any strict time horizon or end point for the program. The large-scale programs are by their very nature long-term ones and the changes in external conditions may easily move the termination time by as much as 5-10 years. A preliminary time horizon of 15 years for nation-wide Shinkansen network construction was proved to be infeasible and in general its specification was not necessary. The program is a sequence of decisions for each of which some more precise time schedule can be given so that an adequate overall flexibility and adaptiveness is preserved. Elicitation of any overall termination time creates unnecessary tensions and increases the risk of negative evaluations not relevant to the problem which the program is aimed at. Termination of a program does not occur in an abrupt way ("finished"), but is a process of decay and dissolution, during which the program functions are absorbed by actually existing routine institutional mechanisms.

10.4 Place of Technology

Although new technologies often constitute an important element of qualitative innovation required for the program to be successful, they by no means work by themselves, but should be regarded against a broader socio-economic context. For the Shinkansen case, while the Tokaido line can be regarded as a full technological success, partly because of the then low environmental consciousness, its performance cannot be extrapolated to new lines. The program itself had triggered a feedback which then impacted its further development and there also had been a value change in this period.

Let us classify the actors as regulators, developers, users and impactees. It may be said that local developers have shown too much demand for the program perceived as a mythical key to welfare (through technology!). Because of the existing precedence and of the local developers' pressure, the regulators maintain their positive stance towards the program. There has been an important change in main (central) developers' attitudes, from entirely positive and doubtful or partly negative (losses for JNR over the peripheral lines), which is also an important corroboration of lessons on the time-horizon problem--see 10.3(c). Users, who presumably maintain their positive attitude, have been faced with fare increases and are more likely to prefer air travel over longer distances. The main change has occurred in the impactee category. This category, strongly negative, is apt to use stronger and stronger instruments in pursuing its goals. Resolution of the above cannot therefore be done simply by enforcement and compensation or by abandonment. It has to involve a broad overview of a situation involving the explication of such paradoxes as the positive attitude of local developers, in many cases where the Shinkansen introduction could lead to negative changes in local economy or an unfavorable attitude from central impactees who are also potential users benefiting from recreational opportunities.

Thus, the technological success can turn into a social failure in the near future if adequate analysis of societal interaction and socio-economic impact for a multi-dimensional technology assessment is not carried out. No extrapolation of past experiences can be made in a situation of changing values.

10.5 Impact Analysis

Therefore there has been an increased interest and investment in impact studies, and also in impact models. While it is incontestably true that, for complex interrelations pertaining to the program form, modeling is the only way to ultimate rationalization of decisions; the present generation of models is only a first step in this direction. All the three large-scale programs analyzed were accompanied by modeling, with Shinkansen being the only one modeled from the very outset, but the existence and studies conducted with the help of models do not yet safeguard against difficulties.

11. CONCLUSIONS

The Shinkansen Program Case Study brought together a select group of systems analysts and scientists concerned with large-scale program organization and management, transportation systems, national and regional developments, environmental problems from East and West with a view to examining current Japanes experience on the subject. The Shinkansen Program Case Study gave us the unique possibility to understand more fully the national, regional and sectorial institutional mechanism in modern Japan. In our view, it has been an extremely stimulating experience.

Any large-scale development program, due to its multi-institutional interactions, is extremely suited for management, organizational, and socio-economic studies, especially in an international setting.

The aim of our study was not only to evaluate a particular large-scale development program, but also to further extend the methodology of large-scale development programs' case studies as well as the methodology of program management itself. During the first IIASA case study on TVA, we were mainly concerned with internal organizational solutions for program realization; during the second case study--Bratsk-Ilimsk--we concentrated mainly on pre-planning and model building processes for program formation and realization. During this last case study we were mostly concerned with interaction processes between different institutions, citizen groups, and technology. Some of us, who took part in all three case studies strongly feel that these cases should be considered as complementary, and perhaps, after some time, it may be possible to generalize our experience. At this moment we urge the reader to consider our three case study reports together.

The lessons to be learnt from the Shinkansen Program case study were presented in the previous Chapter, and should be considered as part of the conclusions.

As new technology was the main driving force of the Shinkansen Program, we have therefore examined the Shinaknsen Technology in more detail. We were very pleased to learn that a systems approach was fully applied within the design of this technology; moreover we could consider it as an example of the most advanced systems integrated organized transportation technology.

At the IIASA Shinkansen Conference we had the opportunity to hear the presentations of many experts from Japan concerning the excellence of transportation hardware that was available in the Shinkansen technology. This "excellence in hardware" included high-speed vehicles, heavy ballast track, line and tunnel equipment, track security facilities, and the use of electronic equipment. There was also excellence in transportation software systems due largely to a transfer of knowledge from the space, aircraft and military industries to the rail industry. Shinkansen technological system excellence includes not only hardware and software elements, but also special orgware arrangements, i.e., the establishment of a special Shinkansen task force, JNR and governmental decision making procedure and so on.

Issues of excellence in each of the hardware, software and orgware areas may exist in isolation in other countries. Without the particular combination of these factors, as we see in the Shinkansen case, other experiences have not shown the success we have seen with the Shinkansen combination of systems. France, for example, has a record of having possessed high-speed vehicles for railway transportation. Other countries as well have possessed some of the excellent hardware or excellent software needed for an advanced railway transportation system of the likes of Shinkansen. Other than Shinkansen we have not found a case of such scale where the combination of all of the necessary systems aspects are present.

What kind of obstacles were encountered in the Shinkansen case? This aspects must be considered in a total S-IOT framework for analysis. The framework for our analysis and thinking is that of advanced technological systems, and in our consideration of the Shinkansen case some obstacles did exist. In the late 1950's there was a concern that the railway hardware was too noisy, and this suggested major problems for implementation of the system in the environment at that time. However, environmental problems remain major obstacles for all modern transportation systems. Detailed discussions and conclusions on this can be found in Chapters 4 and 6 of this report. There were certain organizational limitations as well, i.e., limited decision-making power, and a price system not supportive to the development of a large-scale railway system. As well, there were certain limitations of software and orgware, e.g., lack of intensive noise-reduction research, and a too passive an attitude to standard setting. An understanding of obstacles of this sort helped us in the overall analysis of the system and its development.

We hope that the Shinkansen Program Case Study will be a useful source of information for the scientific community of our NMO's as well as to the program management and transportation theoreticians and practitioners all over the world, since program management as well as an advanced transportation system will play an even more important role in the near future.

Appendix

Institutions and Persons Visited during the Study

Table 1.1

INSTITUTION	REPRESENTATIVES
Economic Planning Agency	Mr. Tetsuo Nagasawa - Senior Planner, Officer in Comprehensive Planning Bureau Mr. Nobuyuki Yasuoka - Staff Member, Comprehensive Planning Bureau
National Land Agency	Mr. Noburo Nishifuji - Senior Planning Officer, Planning and Coordination Bureau Mr. Masaki Takahashi - Staff of International Co-operation, Ministry Secretariat
Environmental Agency	Dr. Michio Hashimoto - Director of Air Preservation Bureau Mr. Yoshiaki Tsuruoka - Senior Research Officer, Planning and Coordination Bureau Mr. Saburo Kato, Senior Office in International Division Mr. Takashi Hurusho - Noise Pollution Division in Air Preservation Bureau
Ministry of Transportation	Mr. Shogo Arai - Deputy Director of Policy Making Division, Secretariat of the Minister Mr. Yoichi Iwahashi - Director of Facilities Division, Railway Supervision Bureau
Ministry of Construction	Mr. Michio Suzuki - Senior Construction Officer in Planning Division of Road Bureau
Japan Industrial Policy Research Institute (JIPRI)	Mr. S. Inaba, Chairman of the Council of JIPRI Mr. Tomuro - Director of JIPRI, Secretary General of Japan-IIASA Committee
Japanese National Railways (JNR)	Main Organizer: M. Nishida, Director, Technical Development Department Dr. M. Takiyama, Vice President, Engineering Mr. H. Yusa, Deputy Director, Information Systems Department Mr. S. Hoshino - Deputy Director, Corporate Planning Department Mr. M. Kamada - Advisor, International Department Mr. S. Yamanouchi - Deputy Director, Train Operation Department Mr. Y. Muto - Deputy Director, Electrical Engineering Department Mr. S. Kubo - Deputy Director, Rolling Stock and and Mechanical Engineering Department Mr. T. Yorino - Deputy Director, Environmental Preservation Department Mr. K. Hayashi - Senior Assistant to Director, Shinkansen Construction Department Mr. N. Tejima - Director, International Department Dr. H. Maruyama - Director, Railway Technical Research Institute Dr. Kyotani - Leader of Maglev R&D

Table 1.1 (continued)

Japan Transport Economics Research Center	Dr. R. Kakumoto - Director (was engaged in early-stage planning of the Shinkansen)
Japan Railway Construction Corporation	Dr. T. Shinohara - President
Fukuoka Prefecture	Mr. Yamazaki - Deputy Governor of Fukuoka Prefecture Government Mr. Yasukochi - Planning and Development of Fukuoka Prefecture Government Mr. Takagi - Transportation Development of Fukuoka Prefecture Government Mr. Kuwasaki - Regional Office of Ministry of Construction Mr. Ishikawa - Regional Office of Ministry of Construction Mr. Imai - Regional Office of Ministry of International Trade and Industry Mr. Yamazaki - Economic Federation of Fukuoka and Yamaguchi Prefectures
Nomura Research Institute	Mr. M. Abe - Director, International Studies Department Mr. T. Kuramata - Associate Director, Socio and Economic Systems Department Mr. N. Nakasawa - Director, Life Science Department Mr. H. Inoue - Chief, Documentation Section, Information Service and Development Department
Mitsubishi Research Institute	Dr. Morisugi
IBM Tokyo Research Center	Dr. Matzusaki
National Institute for Public Health	Dr. T. Suzuki, Vice Director
National Institute for Environmental Studies	Dr. Sasa, Director Dr. Gotoh, Senior Researcher
Nagoya Residents Association against Shinkansen Pollution	Lawyer - Mr. Masao Yamamoto of Secretary of Nagoya courtsuit lawyers group.