THE EFFECTIVE UTILIZATION OF FREIGHT TRANSPORT FACELITY OF JNR

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1.Introduction

Analysis of JNR management reveals that while commuter transport sector in the Tokyo Metropolitan Area and the Shinkansen passenger sector are managerially satisfactory, freight transport sector and local transport sector show a terrible deficient.

Among large city areas, the Tokyo Metropolitan Area has the largest commuter traffic and the largest increment. For that reason, number of lines are in need of measures for traffic capacity buildup. On the other hand, freight facilities such as freight lines and freight yards in the center and environs of the Tokyo Metropolitan Area are less used in recent years because of decrease of railway freight transportation. Thereupon, the policy to utilize freight facilities for passenger train operation --- to alleviate congestion of commuter transport by making the most of freight lines with the small sum of investment---will contribute to the efficient management.

At present, JNR is burdened with colossal sums of long-term liabilities, and the government has decided to change its legal of public coorporation to private companies, the details of which are under deliberations by the National Deit. The important point of this reform plan is efficient management, and so the passenger train operation over freight lines will match with this point of view.

This thesis will at first analyze the present railway transportation conditions in Tokyo Metropolitan Area and then deal with the effects of passenger train operation over freight lines from the railway operator's standpoint and socioeconomic viewpoint.

2. The Transition of Railway in the Tokyo Metropolitan Area

2-1. Changes in the Urban Structure

The Tokyo Metropolitan Area (the Tokyo Metropolis, Kanagawa Prefecture, Chiba Prefecture, and Saitama Prefecture) has an area of 13,500km which amounts to no more than 3.6% of the country's total land area, but it is a huge metropolitan area with a population of 28,7 million (according to the 1980 census), a concentration of 24% of the country's total population. In addition, the Tokyo Metropolitan Area has 37% of the nation's head offices, 43% of its university students, 42% of its wholesales, 26% of its industrial shipments, 26% of its retail sales, and 23% of its firms, and it is also the center of the politics, economy and culture.

This is a result of the absorption of surplus agricultural population, which was an outgrowth of the rationalization of primary industry, by secondary and tertiary industry in the Tokyo Metropolitan Area where employment opportunities had increased due to prosperity in the 1950s. The concentration of population toward the Tokyo Metropolis brought about an energetic residential conversion of areas along existing railway lines. Densely Inhabited District (DID) land area grew 270% between 1960 and 1980

from 101,000ha to 272,000ha. (Figure 1) Along with this population expansion, the population distribution by distance zones centering on Tokyo Station has increased remarkably on the outskirts and decreased annually within the 10km zone as shown in Figure 2 exhibiting the so-called donut phenomenon.

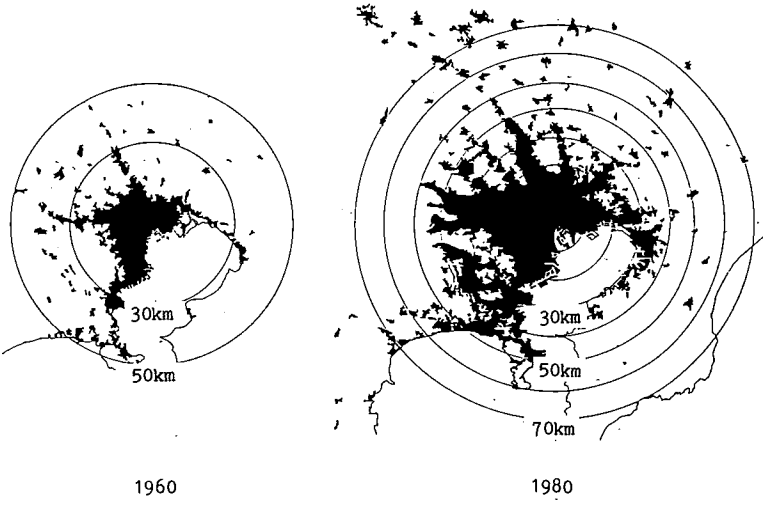

Figure 1. Changes of DID

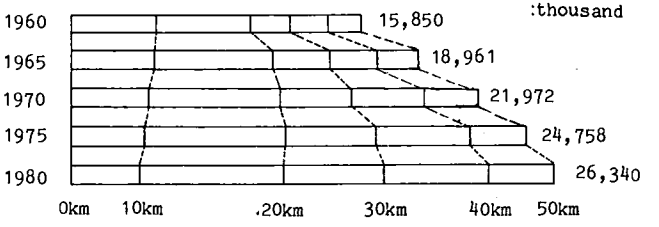

Figure 2. Changes of Population by Distance Zone

Though the night time population in the city center (Chiyoda Ward, Chuo Ward, Minato Ward, and Shinjuku Ward) decreases from 0.96million in 1960 to 0.69 million in 1980, the daytime population continues to increase as in the past going from 2.13 million in 1960 to 2.99 million in 1980 for a 20-year increase of 860,000. The population flow into the city center increased from 1.17 The million in 1960 to 2.30 million in 1980 for a total increase of 1.13 million.

Moreover, as for the number of employees, although those in primary industry have decreased and those in manufacturing are also decreasing after 1970, those engaged in clerical and administrative work are increasing. In addition, service and retail businesses are showing large increases. It may be gathered from these points the Tokyo Metropolitan Area has become a storehouse for administrative functions. (Figure 3)

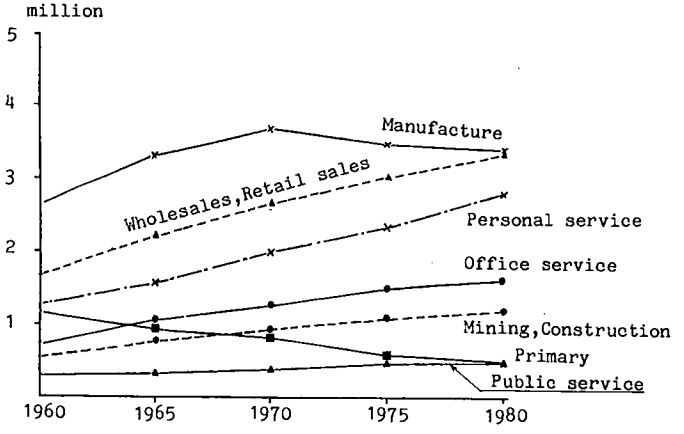

Figure 3. Changes of Working Population by Type of Industry

2-2. Change in Railway Transportation

(1) Passenger Transportation

In relation to the abovementioned changes in the urban structure, JNR has carried out the augmentation of its capacity, the improvement of its freight transportation system, and other measures. As for passenger transportation, the so-called "Five-Front Metropolitan Railway Strategy has been carried out since 1965 to increase capacity on major trunk lines in five directions from Tokyo Station. (Figure 4) This, however, has not been a radical solution to the increasing passenger demand. According to the periodical traffic volume survey of 1984, the morning rush hour period flow into the 23 wards of Tokyo was 180,000 persons/hour from the Tokaido direction, 144,000 from the Chuo, 160,000 from the Tohoku, 136,000 from the Joban, and 135,000 from the Sobu. Table-1 shows the load factors of the section shown in Figure 4.

Table 1. Traffic capacity, Traffic volume and Load factor(1983)

No.	Line	Number of train	Headway	Traffic capacity	Traffic volume	Load factor	Note
1	Tokaido	17	3'30"	24,310	57,740	238	
2	Yokosuka	11	5'30"	15,730	37,200	236	
3	Chuo(slow)	23	2'40"	28,840	51,980	180	
4	Tohoku	10	6'00"	16,500	42,600	258	common use
5	Takasaki	10	6'00"	16,500	41,500	252	
6	Joban(suburban)	9	8'30"	9,688	25,360	262	common use
7	Joban(fast)	10	6'00"	14,000	39,740	284	
8	Joban(slow)	19	3'10"	26,600	70,530	265	
9	Sobu(fast)	15	4'00"	21,450	54,790	255	
10	Sobu(slow)	22	2'40"	30,800	80,290	261	
11	Yamanote	24	2'30"	33,600	86,580	258	
12	Chuo(fast)	28	2'10"	39,200	101,160	258	
13	Keihintohoku	24	2'30"	33,600	35,830	255	

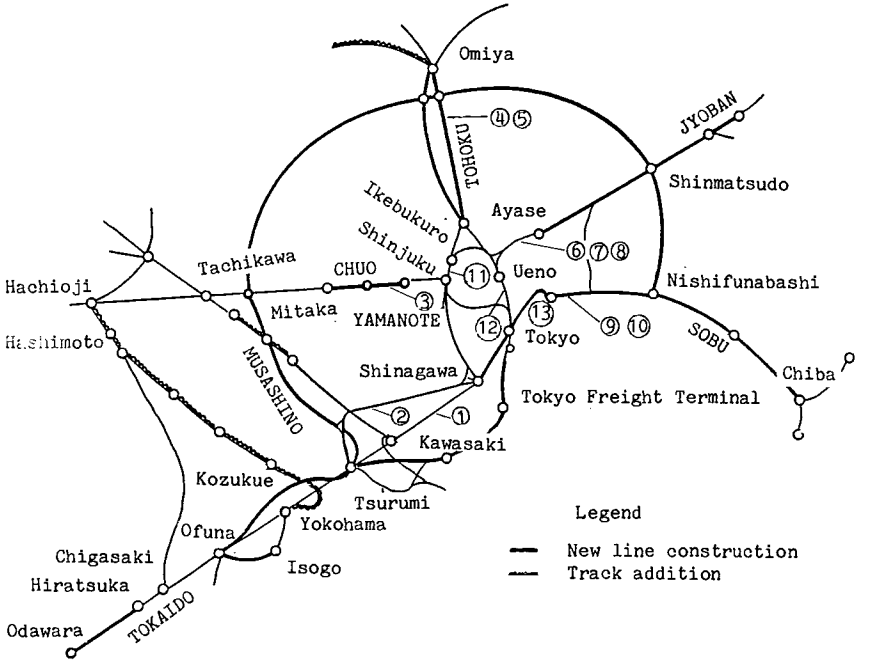

Figure 4. Augmentation of Traffic Capacity(After 1965)

(2) Freight Transportation

Business prosperity in the latter half of the 1950s naturally had a great effect on the freight transportation. Transportation units became large, and speedy, on-time delivery came to be sought. Change was also being urged for railway freight. Efforts in this regard were:

1) The integration of freight handling stations with emphasis put on base stations in order to enlarge transportation units, increase speed, and modernize loading and unloading.

2) Expansion of the freightliner network and the promotion of transportation to conform with each commodity.

3) The establishment and strengthening of a rational cooperative system with road transportation.

In order to establish a transportation system matching physical distribution needs, it became necessary to change the system. As a freight transportation route for this, an external loop line was constructed connecting the main yard of Shin-Tsurumi directly with the Omiya yard; the Tokaido, Chuo, Tohoku, Joban, and Sobu lines, major trunk lines radiating from Tokyo, were connected with the loop line; and the construction of the Mushashino and Keiyo lines was decided as freight routes to bypass the center of the city. Along with the construction of these new lines, it was also decided to construct yards and base stations such as the Mushashino yard and the Tokyo Freight Terminal. Construction began on both of these in the latter half of the 1960s.

As the first step, tracks were increased on the Tokaido Line between Tokyo and Odawara, the Mushashino Line was constructed, and a section of the Tokyo Bay coastal route which centers on the Keiyo Line was constructed from

the Shiodome yard through the Tokyo Freight Terminal and the Shiohama yard to the Tsurumi station. Through the completion of this route, the Yamanote Freight Line which was an important freight transportation trunk line in the center of the city at that time and the Hinkaku Line were expected to be able to handle a new mission.

At present, the first step construction was completed, as part of second step, construction is being carried out on the Keiyo Line, and the entire line is expected to be opened for service in 1987. (Figure 5)

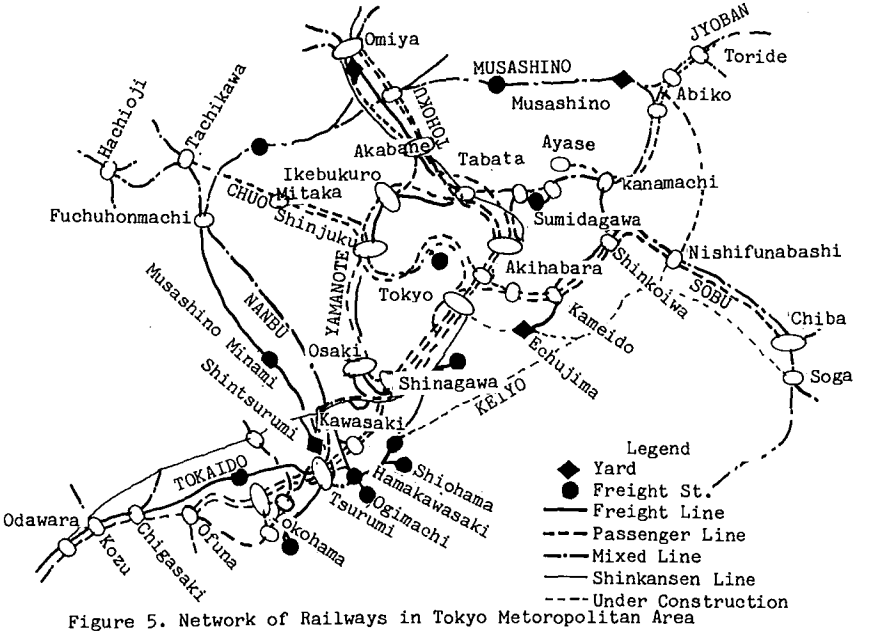

Figure 5. Network of Railways in Tokyo Metoropolitan Area

Thus, the modernization of freight transportation has advanced, however, the environment surrounding railway freight transportation has grown noticeably severe along with structural changes in the Japanese economy, and in spite of a 20% increase in the gross domestic freight traffic volume in the past ten years, JNR's freight traffic volume has decreased by half, due to the development of highway transportation and advances in the coastal shipping. JNR's freight traffic volume in 1984 was 23 billion ton-kilometer amounting to a mere 5.2% of the gross domestic freight traffic volume of 435 billion ton-kilometers.

Consequently, JNR has shifted the yard dependent transportation system to direct transport system, integrated freight stations and reduced the number of trains. The distribution of the resulting surplus capacity to passenger train operation in an attempt to alleviate congestion as well as the appropriation of aid for passenger lines which have reached the limits of their transport capacity are under study. The Mushashino Line which was initially planned as solely for freight operated passenger trains from the very beginning. In addition there have been conspicuous moves to change the land use plans for reclaimed land along the Keiyo Line which is now under construction from primarily industrial use to residential, commercial, and park use. Furthermore, there have been successive demands from communities

along the line to use it for passenger trains. thus, the Minister of Transport approved the Nishi Funabashi - Soga section for passenger use in 1978, and the construction implementation plan for conversion for passengers of the 21km Tokyo - Nishi Funabashi section received the Minister of Transport's approval in July 1983. With this, the passenger line access route to the city center has been concluded.

On the other hand, freight-handling areas and yards such as the Omiya yard (23.0 ha), the Shin-Tsurumi yard (41.0 ha), and Shinjuku freight station (4.2 ha) which have become unused land due the integration of track facilities can now be used for development. The use of these freight-handling areas can also be considered as sites for urban redevelopment, urban facilities, and balanced residential facilities, and efforts are being made to cooperate with the city while taking advantage of the merits of these large sites and their convenient transportation, aiming at increasing passengers.

2-3. Railway Passenger Transportation in the Future

Due to concentration and outward expansion of the population since the latter half of 1950s, urban problems and transportation problems are surfacing in the Tokyo Metropolitan Area. Thus, a "Metropolitan Area Redevelopment Plan" which is to be the guide for the drastic remodelling from a long-term and broad viewpoint is being studied in order to avoid the disordered development of Tokyo Metropolis and develop it as an active metropolis which supports Japan. This plan has as its basis the alleviation of overconcentration in the Tokyo Metropolitan Area by dispersing functions and setting it at an appropriate level. In other words it is an attempt to change from a structure of unipolor dependence to a multipolor city and a balanced urban structure.

In this plan, the nighttime population at a distance of 50km from the Tokyo Station is in transition from social increases to spontaneous increases, and in the future the population is also expected to increase slowly, about 4 million. The population influx into the 23 wards of Tokyo is forecasted for about 3.4 million by the year 2000, in comparison with 1980, with an increase of about 800,000.

In relation to this, the Transportation Policy Council, an advisory body of the Transport Minister, has made various studies concerning railways in the Tokyo Metropolitan Area in the year 2000, and a basic plan has been decided. Basic concepts for drawing up this plan are:

* The alleviation of congestion on lines in operation.
* Coping with the outward expansion of population, new town plans, etc.
* The reinforcement of the function of the city's subcenters and the nurturing of business nucleus cities.

Of these, the effective utilization of freight facilities -- the passenger train operation over freight lines -- receives particular attention. JNR has studied the practical measures by each freight lines and a part of them has been carried out, including, the Keiyo Line construction in Sobu direction and passenger train operation over the Tohoku Freight Line.

Chapter 3. The Effective Utilization of Freight Facilities

3-1. Sites of Yard and Station

Freight traffic is decreasing in sharp contrast with passenger traffic as can be seen, for example, by the volume of freight handled within the Yamanote Freight Line. (Figure 6) Operating ratios shown in Table 2 are poor at 400 - 500 for each line. Freight traffic in the center of the city has decreased greatly in recent years and surplus capacity has arisen in freight

facilities such as lines, stations, yards. Accordingly, the reuse of freight facilities was studied aimed at alleviating congestion on passenger lines running almost in parallel, inducing transfers from other private railways as well as new demand, and contributing to urban redevelopment.

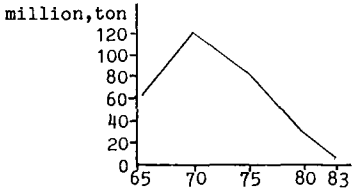

Figure 6. Transition of traffic volume within the Yamanote Freight Line

Table 2. Operating ratio of freight lines

Line	Operating ratio
Tokaido	468
Musashino	486
Yamanote	453
Tohoku	597
Shinkin	455
Etchujima	568

There are 6 freight lines and 17 freight yards and stations, large and small included, in the Tokyo Metropolitan Area. Figure 7 shows the distribution of freight lines and large scale freight yards and stations producing excess capacity at present. In developing these sites, it is important that it be done in relation with passenger lines. Therefore stations are classified as passenger station joint or independent freight facilities.

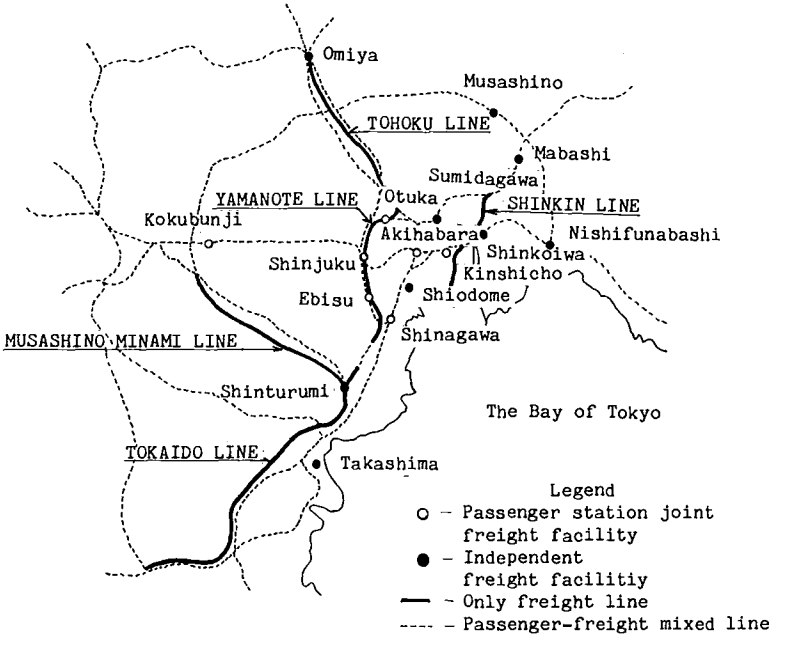

Figure 7. Distribution of freight facilities in Tokyo Metropolitan Area

Further, the center of Tokyo Metropolis is concentrated with head offices of various organizations to an unparalleled degree in the world and therefore in developing these facilities, it is important to carry it out not only from an enterprise standpoint but also from a national viewpoint. For this reason, a special committee was instituted by the state government and it is studying large-size land development: development of the freight handling sites of Shinjuku and Shiodome stations which occupy first-class land areas in the center of the Tokyo Metropolis.

Now that JNR is being oriented private management, and although these sites should be utilized to contribute to city improvement because of their importance, profitability for the enterprise must be the first requisite to make railway management sound. At present, JNR is burdened with great amount of accumulated debts and their amortization is a serious problem. Most of the yard sites are objects for sales now and the sales should be conducted to contribute to the development of cities and also to increase railway passengers. It is important for JNR to work out the land use plans under close cooperation with city authorities. For the development of freight sites, the Metropolis-center is considered for business purposes and the suburban area for residential purposes.

On one hand JNR is required to judge the internal effects of the revenue, etc. from the sales and developments and on the other hand to take into consideration the effects of their effective utilization as city facilities for more comprehensive judgment as shown in Figure 8. Besides, passenger train operation over freight lines through yards, etc. and addition of new passenger stations will all the more increase the improvement effects of freight sites.

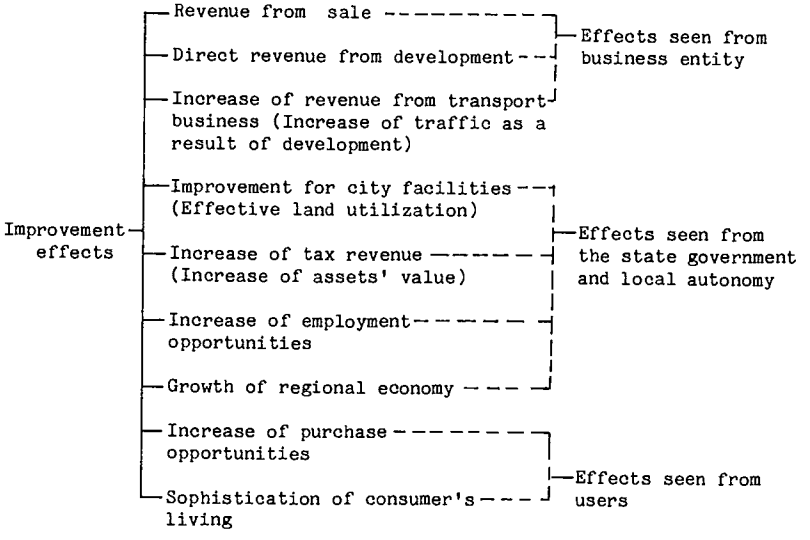

Figure 8.Freight yard site,etc. redevelopment effects

3-2. Macroscopic Study of the Freight Lines

(1)Basic Idea

Routes presently carrying out passenger service in the tokyo Metropolitan Area were classified as shown in Table 3. As a strong point,

the railways radiating from the city center were made the foundation with accompanying loop railways to function as a fast connection between working areas in the city center and suburban residential areas. In addition, while the loop railways distribute the radially distributed population circularly, they can also be expected to serve as interconnections between radial railways and to contribute to the future development of nucleus cities. For this, it is also necessary to plan on the besis of roles of radial lines (Tokaido line, Tohoku line),loop lines (Mushashino line, Yamanote line) and others in passenger train operation over freight lines.

Table 3. Classification of lines in Tokyo Metropolitan Area

Radial lines	Tokaido, Chuo, Tohoku, Joban, Sobu
Loop lines	Yamanote, Mushashino

In case of the passenger train operation over freight lines, various factors should be judged comprehensively, the resulting effects on railway management should be taken into account and detailed studies should be made on conditions of location such as differences of radiating and circling of lines, proximity to passenger lines and land use along the lines. Here, for the macroscopic judgement, the possibility of passenger train operation over freight lines will be analyzed based on the available data.

Cross analysis will be made on the relations of the present passenger-line management and population distribution, etc. Based on this, the estimation will be made if the present freight lines were used for passenger traffic, what shape their management conditions will take.

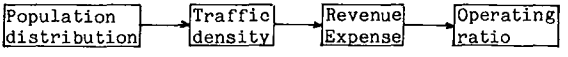

Figure 9. Basic Idea

(2) Traffic Density Estimation Method

Traffic density will be estimated assuming that the traffic density and the along-the-line population have interrelations. As shown in Figure 10, the present population density along the lines, number of tracks, and type of lines (radial or loop) for each passenger line are regressively analyzed and the each of the above variables of the object freight lines will be given to estimate the traffic density.

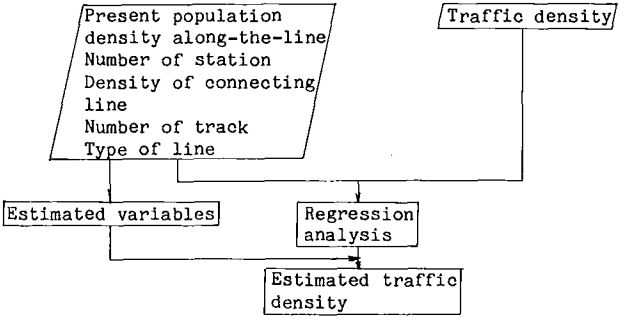

Figure 10. Traffic Density Estimation

(3) Revenue Estimation Method

Revenue is obtained first estimating traffic in passenger-kilometer by multiplying the estimated traffic density by route-kilometers and then by multiplying this by the rate of the adjacent line or the average rate of the area.

(4) Cost Estimation Method

Cost is classified into fixed cost (capital expenses) and variable cost as shown in Figure 11. In order to operate a passenger train over freight line, facility investment such as for installation of passenger stations will become necessary and this cost should be reflected in the fixed cost. The sum of this facility investment can vary according to whether the station is underground or on the ground, and also according to the number of stations or type of stations. The construction of railway lines in Tokyo Metropolitan Area is old. However, various construction work for improvement and rolling stock investments have been made in recent years and these costs have been reflected in the fixed cost of present passenger lines. This experience can be utilized for rough estimation. But, in making detailed studies for each case (mentioned later), it is of course necessary that the sum of investment is correctly estimated. As for variable cost, personnel cost, business cost, motive power cost, and maintenance cost are all totaled. The fixed cost and the variable cost thus calculated are totaled as passenger cost. (Figure-11)

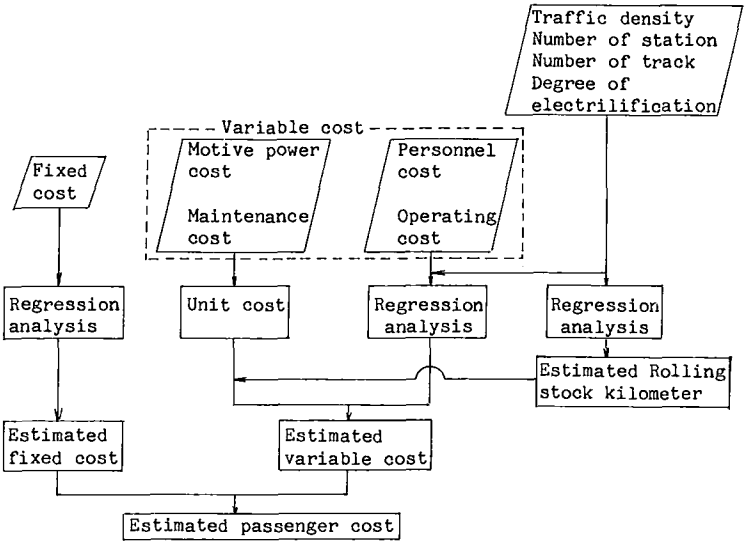

Figure 11. Cost Estimation

(5) Judgement of Possibility

From the revenue and the cost so far obtained, the operating ratio will be used for unified management judgement. This is shown in Figure-12. For the operating ratio, the existing passenger lines are included but the revenue and cost of the existing freight lines are excluded. If the operating ratio is over 100, the possibility of passenger train operation

over freight line will be judged few. However, effects, especially the alleviation of congestion,etc., on the other line located in parallel are taken into consideration, and a further study will be made again. If the ratio is less than 100, the utilization of the freight line for passenger traffic is judged possible. To finalize the judgement, a detailed demand forecast will be conducted and revenue-cost calculation, etc. will be used for the management judgement. Freight revenue and cost are added on to the passenger line and the change in total revenue and cost are also obtained.

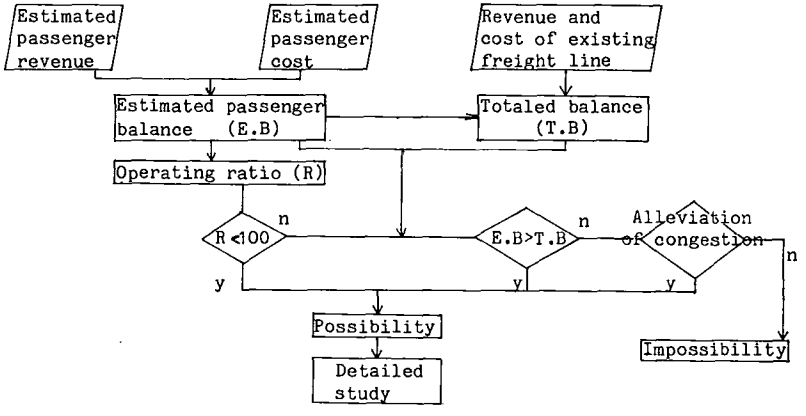

Figure 12. Judgment of Possibility

(6) Trial Calculation

The operating ratios obtained by the method as stated above are shown in Table 4. Where freight line and passenger line run in parallel, the operating ratio can be considered as integrated operating ratio of passenger train operation over freight line and the existing passenger line. According to results, the estimated operating ratio of the Yamanote Line, the Shinkin Line and the Tohoku Line are all less than 100, and these projects are judged favorable.

Table 4. Estimated operating ratio

:¥billion

Line	Revenue	Cost	Balance	ratio	Section	
Yamanote	41.0	19.1	21.9	47 (28)	Ikebukuro-Shinjuku	
	70.9	34.3	36.6	46 (34)	Ikebukuro-Osaki	
Shinkin	4.0	3.6	0.4	89	Kanamati-Shinkoiwa	4 st.
	4.2	3.7	0.5	88		7 st.
Etchujima	2.5	3.2	-0.7	126	Sinkoiwa-Etchujima	Unelc.
		2.6	-0.1	104		elc.
Tohoku	61.1	45.1	16.0	74 (73)	Omiya-Tabata	
Tokaido	66.3	58.8	-7.5	89 (95)	Hiratsuka-Tsurumi	
Mushashino	8.7	9.1	-0.4	105 (92)	Kawasaki-Fuchuhonmachi	

Value in ( ) shows present operating ratio

Table 5 shows the total balance of revenue and expense of existing passenger line and freight line and total of estimated balance of revenue and expense of passenger line and the balance of those existing freight

line. In the lines where operating ratios are over 100, the lines where the balance of revenue and expense is judged to improve compared with the present are the Etchujima Line (electrified) and the Mushashino Minami Line.

Table 5. Totaled balance

:¥billion

Line	Present	Estimated	Improvement	Section	
Yamanote	17.6	21.6	4.0	Ikebukuro-Shinjuku	
	36.4	35.6	-0.8	Ikebukuro-Osaki	
Shinkin	-0.9	-0.4	0.5	Kanamati-Shinkoiwa	4 st.
	-0.9	-0.3	0.6		7 st.
Etchujima	-0.4	-1.0	-0.6	Sinkoiwa-Etchujima	Unelc.
	-0.4	-0.4	0		elc.
Tohoku	10.5	10.7	0.2	miya-Tabata	
Tokaido	-18.1	7.0	25.1	Hiratsuka-Tsurumi	
Mushashino	-9.6	-4.5	5.1	Kawasaki-Fuchuhonmati	

Thus, by the project, the balance of revenue and expense is generally on the trend of improvement compared with the present and some of the lines show remarkable improvement. And all the lines except for the Etchujima Line (not electrified) are judged worthwhile to conduct detailed study.

The operating ratios of lines where freight line and passenger line run in parallel are estimated to exceed the present ratio and to worsen. However, these lines will bring forth the effect of alleviation of congestion which dose not appear in the operating ratio.

4. Detailed Study of Passenger Train Operation on Freight Lines

In Chapter 3, possibilities of passenger train operation over freight line have been generally judged as a trial, and detailed study and judgement must be conducted before implementation. Here the effects of passenger train operation over a freight line will be measured and its feasibility will be judged.

4-1. Effects

When passenger trains are operated over freight lines, the sum of the investment can be far smaller than constructing new lines, and therefore, the demand effects such as production inducement, etc. are few. However, by the effective utilization of the present track facilities with the small sum of investment, almost the same facility effects such as time saving and cost saving for passengers can be created as with new line construction. The facility effect can be classified into direct effect and indirect effect according to the stage of the generation and spread.

(1) Direct effect is the effect generated immediately through the use of the facilities without relying on any other entities concerned. For example, for those commuters who commute through a certain route, if commuting time to their work place is shortened by passenger train operation over a freight line, they are expected to switch to the trip through the freight line. This is a direct effect of time curtailment.

For railway operator, new passengers can be induced through the passenger train operation over a freight line and also management improvement effects can be expected with small sum of investment. There are

more effects of passenger train operation over freight lines. The present passenger lines will be able to have more room for a flexible train operation diagram at the time of rescheduling. Therefore on-time operation and improvement of safety can also be expected.

The effects other than those of the above are indirect effects. The first is the alleviation of congestion for the passengers on the existing passenger lines. This effect has been the target of the plan of passenger train operation over freight line, just like the buildup of transport capacity so far carried out by track increase, etc.

If new residents are expected to locate their residence along the line seeking convenience of life, this will generate a developed traffic. And it will be an extremely important indirect effect in the traffic market. Generally, indirect effects are said to be great outside of the traffic market. Figure-13 shows the above effects.

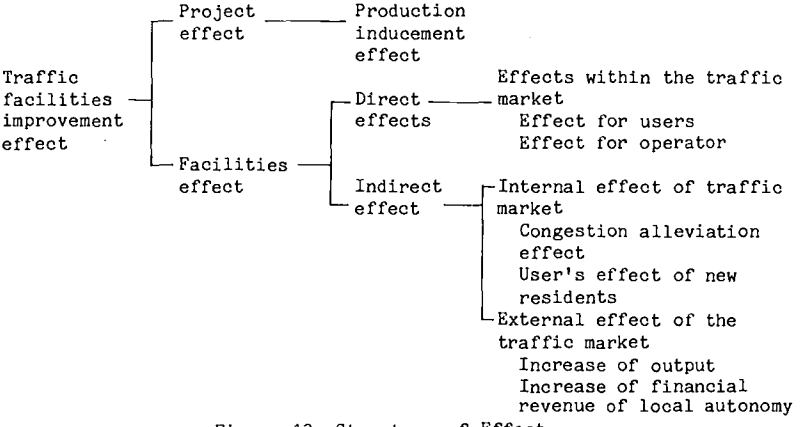

Figure 13. Structure of Effect

4-2. Measurement of Effects

Effects of passenger train operation over freight lines come out in various forms as seen so far. Table 6 shows effects considered to be measurable and the general measurement methods.(2)

Figure 14 shows the total flow of the exclusive measurement of the time saving effects which are largest for commuting passengers.

Outline of data and model in effect measurement are as follows:

1) The existing passenger lines and freight lines run in parallel in many sections and this necessitates analysis by small zones. Therefore the object areas for analysis are divided into small segments by standard mesh (1 km x 1 km) of area mesh statistics.

2) Time saving effects are measured by consumers surplus increment of traffic demand function.(3)

3) Time value is set at W = ¥22.0/minute. (1985)(4)

4) As there are uncertain factors in selecting reduction rate r, here the r is set at 4% and 8% and measure the effects.

Table 6.Effect and Measurement Method

Assessment Body	Assessment items effects	Assessment method	Assessment indices and measurement method
Users	Cost saving	Change is method by with and without the investment	Tariff to the destination by way of freight line and by other way are compared and measured by the difference
	Time saving	Users benefits of time saving are measured	Time saved x original unit of time-value x traffic volume
	Alleviation of congestion	Benefits of congestion alleviation are measured	Willingness to pay for alleviation of congestion x traffic volume
Operator	Profitability	Analysis of revenue and cost	Convert revenue and cost to net present value and compare
	Efficiency of the project	Difference of cost compared with new line construction	Measurement is made on the difference of costs between new line construction and this project
Local Society	Industrial location, development of residential area	Regional economy model, land use model,etc.	Make forecast by population and income by each model

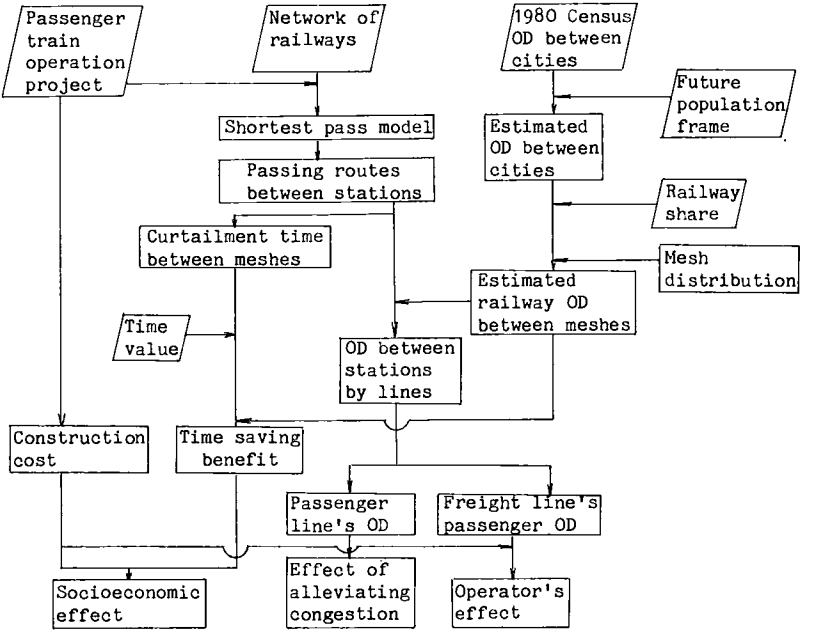

Figure 14. Effect Measurement Flow of Passenger Train Operation over Freight Lines

4-3. Case Study

Passenger Train Operation over Freight Lines is now under way between Akabane and Omiya on Tohoku Freight Line (during morning rush hours only) and the section between Shinjuku and Ikebukuro on Yamanote Freight Line is under preparatory works for the operation from March, 1986. The Musashino Minami Line, Tokaido Freight Line (between Shinjuku and Hiratsuka)and Yamanote freight Line (between Osaki and Shinjuku) are now under study. The Tokaido Freight Line (Shinjuku-Hiratsuka) and Yamanote Freight Line (Ikebukuro-Shinjuku) have been selected for case study and the effects have been measured.

(1) The Tokaido Freight Line (Shinjuku-Hiratsuka)

Passenger train operation over the Tokaido Freight Line aims at the alleviation of congestion of the existing Tokaido Passenger Line, and counterattack against private railways providing direct service from Yokohama and Shonan area to Shinjuku subcenter of the Tokyo Metropolis so that JNR can meet the needs of the passengers to Shinjuku from those areas through the Tokaido Freight Line combined with Yamanote Freight Line. And this is under study.

By this project the travel time from Hiratsuka to Shinjuku will be cut by 10 minutes to 75 minutes by rapid service and omitting transfer at Shinagawa. The present travel time for the section is 85 minutes through the Tokaido Passenger Line and Yamanote Passenger Line.

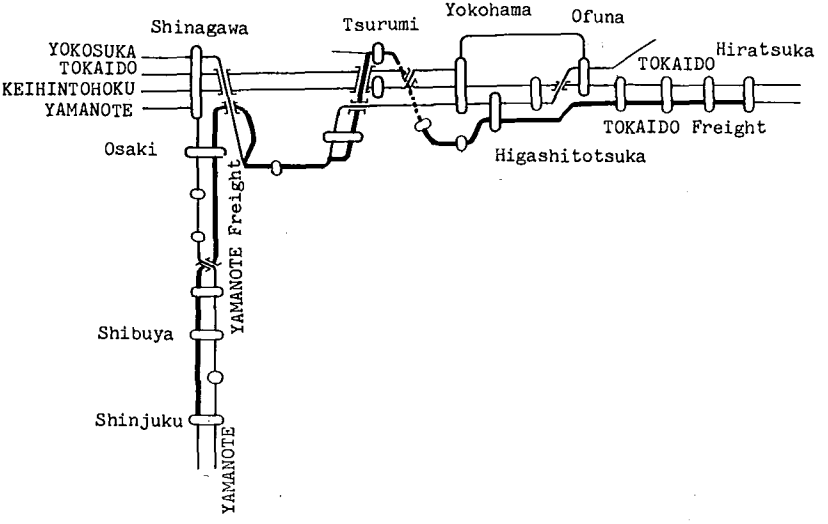

Figure 15. The Tokaido Freight Line over which Passenger Trains will be Operated

Table 7 shows the measurement results of users effects and operator effects. The total present value by reduction rate of 4% and 8% will be plus ¥22.6 billion and ¥6.4 billion respectively.

Table 7.Measurement Result of Effects on Tokaido Freight Line

:¥million

		With the project (31years)*		New line construction (35years)*	
		r=4%	r=8%	r=4%	r=8%
User's effects-Time saving		53,476	30,813	40,637	17,314
Operator's effects	Operating revenue	138,433	76,819	105,204	44,823
	Residual value	2,012	613	117,185	24,052
	Total Revenue	140,455	77,431	222,389	68,875
	Operating cost	144,724	80,288	114,140	48,630
	Construction cost	9,011	8,084	648,525	567,599
	Rolling stock cost	17,550	12,585	12,823	6,800
	Total cost	171,285	100,957	775,448	623,029
	Balance	-30,830	-24,431	-553,099	-554,154
Total(1985 price)		22,646	6,383	-512,462	-536,840

* value in ( ) shows project life.

Estimation will be made on the alternative project of constructing new line on almost the same route instead of this project. In this case, the route will pass through urbanized area most of the sections and land acquisition will cost extremely high. As a result, construction cost will be colossal ¥800 billion in total. (1985) The term of works set to 10 years, project life is set 35 years and the present value is calculated. As the Table 7 shows, the results with reduction rates 4% and 8% will be minus ¥512.4 billion and ¥536.8 billion respectively.

On the other hand, from the viewpoint of railway operator, if the profitability of the operator will worsen, most of the projects will not be adopted even if the project will be effective from socioeconomic viewpoint. In order to judge the profitability for the future, the operating ratio of passenger line and freight line will be integrated and by this integrated ratio the judgment will be made.

Table 8 shows the results of the year of 2000 comparing with and without the project. In case of without the project the integrated operating ratio is estimated 79, while with the project, it is estimated 82. Thus,with the project is estimated a little worse.

However, through the implementation of the project, operating ratio for the management will be less than 100, the load factor of the existing passenger line will be alleviated from 251% to 235% (Table 8) and thus the policy objective will be achieved. Further, such a great effect of Y53.5 billion by the reduction rate of 4% can be provided for the users as time saving effect.

As seen in the above, Passenger train operation over freight lines can be said highly appraisable effective project from socioeconomic point of view, and worthwhile for railway operator to study.

Table 8. Changes of load factor and Operating Ratio (Tokaido line)

Condition	Line	Load factor		Operating ratio		
		1983	2000	1983	1990	2000
without	Passenger line	251%	251%	99	75	68
	Freight line	-	-	468	362	504
	Total	-	-	117	87	79
with	Passenger line	251%	235%	-	78	71
	Freight line(passenger)	-	196%	-	125	110
	Total of passenger sector		-	-	81	73
	Freight line(freight)			-	162	160
	Total				91	82

(2) The Yamanote Freight Line (Shinjuku-Ikebukuro)

The Yamanote Freight Line (Shinjuku-Ikebukuro) runs in parallel with the Yamanote Passenger Line. At present,morning and evening rush hour congestion is so severe that a plan for passenger train operation over freight line has been worked out and the works are under way.

The section between Shinjuku and Ikebukuro will be nonstop and from Ikebukuro onward will be through operation to Saikyo Line and Kawagoe Line. The number of trains will be 140 per day in each way and 14 trains will be operated in one hour during rush hours.

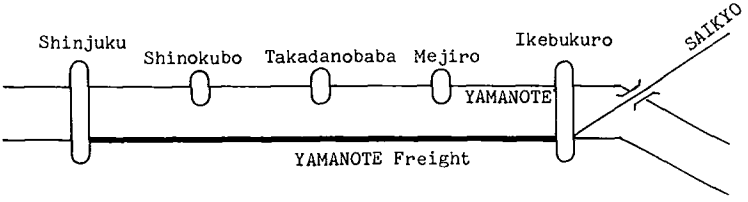

Figure 16. The Yamanote Freight Line over which Passenger Trains will be Operated

Measurement results of effects are shown in Table 9. In the case of passenger train operation over freight line, the user's benefit is enormously large as ¥130,900 million with reduction rate of 4%, but for railway operator, it is the ¥3,210 million. The internal return rate is 7.34%. If the present JNR reduction rate of 7% is applied, plus ¥217 million is estimated.

On the other hand, in case of constructing a new double-track line instead of using freight line, the location of construction route will face various restrictions concerned with land acquisition, and the Shinjuku Station will have to be an underground station and the construction cost will be a colossal sum of about ¥55,100 million. (1980) As a result the estimated loss of operator will be ¥23,685 million with reduction rate of 4%. However, in either case, socioeconomic effects will be expected to be great.

Table 9.Measurement Result of Effects on Yamanote Freight Line

:¥million

		With the project (27years)*		New line construtution (35years)*	
		r=4%	r=8%	r=4%	r=8%
User's effects-Time saving		130,900	82,908	126,788	70,076
Operator's Operating revenue		30,901	19,703	40,351	24,433
effects	Residual value	981	375	9,193	2,152
	Total Revenue	31,882	20,078	49,544	26,585
	Operating cost	20,115	12,919	22,104	11,838
	Construction cost	4,174	4,041	47,171	43,760
	Rolling stock cost	4,383	3,281	3,954	2,604
	Total cost	28,672	20,247	73,229	58,202
	Balance	3,210	-169	-23,685	-37,617
Total(1985 price)		134,110	82,739	103,103	38,459

* value in ( ) shows project life.

Comparison of operating ratios is as shown in Table 10. The Yamanote Freight Line runs in parallel with the Yamanote Passenger Line and therefore inducement of passengers by Passenger train operation over the freight line is few and the integrated operating ratio will worse from without 20 to with 26.

Passenger train operation ratio over the Yamanote Freight Line was planned mainly to alleviate congestion of the existing Yamanote Passenger Line. The estimation of congestion for the year of 2000 was forecast to reach 302% even if 24 trains are operated in one hour. On the other hand, if this project is implemented the congestion is estimated to be alleviated to 185%.

As is stated above, the effects of passenger train operation over the Yamanote Freight Line are: for users the effects of alleviation of congestion and time saving are great; and for operator the maximum effects can be achieved by the least investment and therefore this is a worthwhile project.

Table 10 . Changes of load factor and Operating Ratio

Condition	Line	Load factor		Operating ratio		
		1983	2000	1983	1990	2000
without	Passenger line	258%	302%	28	20	20
	Freight line	-	-	406	347	512
	Total	258%	302%	30	22	21
with	Passenger line	258%	185%	-	34	33
	Freight line(passenger)	-	165%	-	15	15
	Total of passenger sector		177%	-	24	23
	Freight line(freight)			-	121	129
	Total				26	26

5.Conclusion

The Effective utilization of freight facilities is being studied nationwide in JNR. However, the Tokyo Metropolitan Area has been taken as an example for its importance and dealt with in this thesis.

Japan achieved high economic growth in the past and passenger traffic increased remarkably in large cities. To cope with this situation, a large scale improvement of railway facilities has been carried out. however, the concentration of population into the Tokyo Metropolitan Area and the land price rises in the city center have been more than expected, and these have brought about sprawling of population. The congestion on radiating railways are still continuing.

After the high economic growth period, trucks have got advantageous position in transporting small-lot variety of commodities and railway freight traffic is decreasing. As countermeasures, railway freight transport system has been undergoing specialization to the area where it can display its own characteristics. As a result, existing freight facilities are used inefficiently. Therefore a study was started to divert them for passenger facilities in order to relieve passenger transport and also to make up the loss of freight transport. The closed freight yard site, etc. are under study for development in conjunction with the land use plan of surrounding areas or for sale. Further, passenger train operation over freight lines is also being studied because in many cases it is possible with relatively small sum of investment.

As stated in Chapter 3, a macroscopic study of passenger train operation over freight lines reveals that the profitability of considerably many lines are generally on the trend of improvement. Even if operator's management effects are few, as this train operation contributes to the improvement of services such as alleviation of passenger lines, etc. the appraisal should be made separately including these effects.

Hereupon, the Tokaido Freight Line and the Yamanote Freight Line were further studied as examples in Chapter 4. The result showed that the effects were, besides alleviation of congestion, substantial time saving for users by wider choices of route selection, checking the increase of deficit of freight transport sector, and thus contribution to the management. This is because present passenger lines show the congestion to be called "at saturation point" during peak hours, further studies on both of hardware and software should be carried out for implementation of the project.

The most congested section in the Tokyo Metropolitan Area is between Ikebukuro and Shinjuku on the Yamanote Passenger Line. For the alleviation of congestion, the demand for passenger train operation over the Yamanote Freight Line is very strong, and now works are under way to run passenger trains of the Saikyo Line through to the Yamanote Freight Line.

This thesis stands on the assumption that passenger sector and freight sector belong to the same company. Even if these sectors will become separate companies as the National Diet is now deliberating, the idea of this thesis is considered fundamentally applicable, because when both companies use the same line, as their balances of revenue and expenses will be comprehensively improved and therefore advantageous for both of them.

In area other than the Tokyo Metropolitan Area, traffic demands on the existing passenger lines are not so great that not only the passenger train operation over freight lines but also other measures to increase traffic demands including improvement of cities along the lines should be implemented, otherwise the management will be difficult. However, this matter will be left for the study in the future.

NOTES

1) Periodical Traffic Volume Survey : The JNR carries out a traffic volume survey of each route annually in March and October. In this survey, investigators visually count the number of passengers on sections between stations with high load factors on each route.

2) Load Factor : This is indicated by dividing the number of passengers by the passenger capacity and multiplying by 100. Passenger capacity includes strap capacity along with seating capacity. Trains in the Tokyo Metropolitan Area are divided into two types, short-distance trains (long seat) with a capacity of 140 passengers/car and medium distance trains (semi-long seat) with a capacity of 110 passengers/car. Load factors and degrees of congestion can be summarized as follows.

Load Factor	Degree of Congestion
100%	All seats and straps are occupied
150%	Some slight bumping of shoulders
200%	No feeling of being cramped;some space in area of doors
240%	Almost completely full but still some feeling of room
260%	Completely full with no extra room; the limit which commuters can tolerate
over 260%	Extraordinary congestion; getting on and off takes time delaying trains; congestion becomes even worse and transportation lapses into chaos

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