

CHAPTER 8: JAPAN AND PACIFIC RIM EXPERIENCE

8.1 INTRODUCTION

Chapter 8's organization and bulk reflect careful consideration by the author and other investigators on the best way to present this research. Except for high speed intercity railroad ventures, there is a dearth of readily available research material and a general lack of familiarity with Japanese and Pacific Rim rail transit (in comparison with that of western Europe, for example). The nature and extent of Oriental shared track practices are particularly obscure. Accordingly, more detail is provided than is customary in an issue-based research assignment.

Shared track cannot be researched or accomplished in isolation. All Pacific Rim rail information, therefore, is presented here in the context of joint use. The Japanese case studies, lessons learned, conclusions, and descriptions of unique railway features are structured around this study's first four chapters; institutions/regulation, operations, physical plant, and vehicles. This brings the reader up to the same level of understanding of the Pacific Rim experience that is offered for the North American joint use experience. The "Lesson" section of this chapter mimics directly the first four chapter headings and the key issues that they raise on application to the North American rail environment.

Six case studies were selected to demonstrate a variety of shared track arrangements and the characteristics of Japanese culture, institutions, and commerce which encourage joint use. Selected case study rail operators were surveyed during the course of this research, but response has been disappointing within the time allocated for the survey. Because of the diversity of the Japanese joint use experience, the bibliography and glossary are distinct units and appear as appendices

to Chapter 8. Several of the most commonly used terms are, however, incorporated into the master glossary of this report.

Simply put, joint use of track is generally the operation of one entity's trains over another entity's tracks without the passenger having to change trains. Reciprocal running is the operation of passenger trains by two or more railways over the tracks of the other companies. Such operation serves many purposes and necessitates certain preparations. With respect to electric railways and rapid transit lines, there is frequently the need to enable passengers to board at different-height station platforms, and adapt to the partner's electrification and other systems. Throughout Japan and in other Pacific Rim metropolitan areas, these and other problems of reciprocity have been resolved in different ways, offering lessons to any North American urban area considering joint use of track. The practice has permitted and encouraged the rapid growth of electric railway services in major metropolitan conurbations and on rural railways. Positive results are achieved ranging from lower cost rail transit expansion by avoiding financing and building duplicate facilities, to rescuing lightly-used branch lines from abandonment.

Of Tokyo's thirteen fully- or partially-finished rapid transit lines, only five do not have reciprocal running. Of them, the Ginza and Marunouchi lines are too crowded, and Line 12 is a low-profile line that is physically incompatible with any other rail line so cannot participate in reciprocal running even though it employs common 1435mm (4'8½") track and 1,500Vdc catenary. Extensions are under construction that will tie two more of the lines to interurban tracks for through running. Tokyo has almost consummated

(indeed, exceeded in many ways) its bold 1985 rail expansion plan and is shifting attention farther in future efforts; 531.7 km (330.40 miles) of new railways are to be built, including more planned with reciprocal through services, and focusing new rail lines on Yokohama, Chiba, and Kawasaki. Transportation officials have concluded that with only modest public clamor to improve existing lines, uncooperative residents along proposed new alignments and public funds in short supply, they must stay with available railway rights-of-way. Reciprocal running is therefore well-established and the practice is expanding based on favorable results thus far.

The organization of railroads and rail transit in Japan is different than both North American (where the railroads have long been pillars of private enterprise) and Europe (where the railroads have long been national government entities). In at least one way, Japanese railways are becoming more like those in North America. Until a decade ago, the principal Japanese railroad network was a department of the national government. It is now well advanced in its transition to geographic groups of private-enterprise railroad corporations. Japanese National Transportation policy, however, has been more like Europe where attention and resources are more balanced between railroads, public transportation and highways. On national railroad networks, freight dominates in North America, and is important throughout Europe. In contrast, freight is decidedly subordinate to passenger service on the Japanese national railroad system.

A review of the evolution of the former Japanese National Railways into the present Japan Rail Group shows how, by contrast, the North American experience has tended to separate complementary transport and non-transport activities. This condition is traceable to anti-trust legislation, regulation, and a common

business philosophy of separating public-deficit passenger transport from private income-producing real estate.

While joint use of track/reciprocal running might be expected to be small as part of any nation's overall railroad network, it is extensive in Japan. To put this into perspective, Table 8-1 shows the extent of Japan's railroad network in terms of operating entities, the number of them, and the number participating in joint use of track. These are not just different corporate and public entities sharing track, as in U.S. trackage rights. The following joint track uses are between railways of different types which would be regarded as incompatible, physically and operationally, by North American standards.

As Table 8-1 shows, among the Japan Rail Group, the one freight and all six passenger companies participate in joint-use/reciprocal running. Among the private railway companies, 43 do so (including 6 municipal systems). Among the Third-Sector entities, 35 do. This sum of 85 amounts to 55% of all the rail operating entities in Japan participating in some form of joint use. Thirty-four other entities that operate fixed-guideway modes that cannot participate in joint use of track or reciprocal running, because of guideway incompatibility (people movers) of which half are funiculars, bringing the total number of Japanese operating entities to 189. There are also other freight-only railroads and industrial railways.

This chapter also explores the remainder of the Pacific Rim to find examples of joint-use of track. While there is growing passenger-rail development activity in the emerging Third-World nations, the established industrial/economic hubs of Hong Kong and Seoul provide the best examples of joint-use of track.

Table 8-1
Tally of Entities Providing Rail Service in Japan

HSR = high-speed rail (*Shinkansen*); ICR = intercity rail; ECR = electric commuter rail; DCR = diesel commuter-rail; INT = interurban railway; HRT = heavy rapid transit; LRT = light-rail transit; StR = street railway; FRT = freight

entities \ modes	HSR	ICR	ECR	DCR	INT	HRT	LRT	StR	FRT	adjusted totals*
Japan Rail (national)	3	6	6	6	3	0	0	0	1	7
"private" companies:										
private	0	2	0	13	39	4	33	13	36	78
public	0	0	0	0	0	8	1	4	0	10
subtotals	0	2	0	13	39	12	34	17	36	88
Third-Sector:	0	4	2	36	16	7	1	0	12	60
totals	3	12	8	55	55	19	35	17	48	155

* Because any entity might provide more than one kind of service, the row totals are adjusted to remove duplication.

8.2 OVERVIEW OF JAPANESE RAIL TRANSPORTATION

8.2.1 Cultural Context

It is essential to understand how joint use evolved and how Japanese rail projects have been conceived, planned and implemented. Consider these with caution regarding wholesale transfer of Japanese success in these ventures to America.

Politics are similar to America at all levels. Japan's constitution, instituted by the MacArthur administration following World War II, makes Japan one of the more purely democratic nations of the world. As in the United States, free enterprise is significant. Several things do set us apart.

One difference is that education is the responsibility of the municipality, *but* at high-school level, parents can enroll their children in any school that they can reach daily as a practical matter. Significantly, this contributes in great measure to riding on public transportation. In lieu of local school buses there are school-tripper trains. Some students travel very long distances, up to several hours each way, to attend the school of their choice. Student fares are accordingly very low. Otherwise lowdensity branch lines survive in part from such functions now uncommon in the U.S. Railbus services in joint use flourish modestly in such environments.

Tokyo's highways and public transportation facilities are highly used and very crowded – usually running at two to three times capacity even at Oriental levels of tolerance. But, one need travel only relatively short distances away from Tokyo, Osaka, and Nagoya to find ample capacity on roads and public transportation. Most of Japan is rural, and most cities are small. *Yet in the grouping of places of 50,000 population or more (the fundamental definition for U.S. Urbanized Areas (UZAs), only 14 of the 118 such*

places are without rail transit in some form, and most of those are on outlying islands, and include only one large city – Naha on Okinawa.

It is important to appreciate that many of the Japanese rail projects, if subjected to the U.S. process of Alternatives Analysis and Major Investment Studies, probably would not be built. At the same time, the notion that public transportation is better for the environment than automotive travel is well accepted without successive studies. Indeed, there has been some overexuberance to build and some resulting mistakes. The overexuberance is demonstrated by a national landscape marked by unfinished railroad projects – vacant bridges, viaducts, tunnels. These unfinished projects play a role in emerging third sector railways and the joint use enterprise they generate will be described.

The Japanese maintain a high standard of discipline. Failure is related to trust and less to endeavor. The slogan, "Safety First," is carried to high levels in Japan. Yes, there are sophisticated systems of Japanese train control apparatus, but the main link in the safety chain is the integrity of the individual operating employee and supervisor. A review of Chapter 6 accident reports indicates a prevalence of human failure as a cause. One cannot dwell on the benefits of joint use of track and reciprocal running without an appreciation of the simplicity and steadfastness of operating discipline in Japan. In North America, it might be regarded as a risk mitigation essential for joint use.

There are other factors at work that in some way have an impact upon the continuing development of the transportation system and of joint use potential. One is personal longevity. Japanese have long been at the top of world demographics with respect to lifespan. Accustomed to extensive quality mobility and having disposable income that easily covers travel costs, the elderly do a lot of traveling, much by train,

providing market even in remote areas where joint use thrives on the third sector railways.

In addition, Japan is land-shy. In general terms, the nation has half the U.S. population in the space of the square miles comprising Montana, and more than 80% of Japan is not developable – being steeply sloped mountains. Most of the population occurs in the contiguous coastal conglomerations of the Kanto (Tokyo-Yokohama-Chiba-Kawasaki), Tokai (Nagoya), and Kansai (Osaka-Kyoto-Kobe) regions. The joint use case studies that follow cluster in these land-scarce areas and are therefore organized by these regions.

What do these cultural characterizations have to do with joint use of track and reciprocal running? It is simply the quest for mobility for a growing travel habit constrained by land values that force the examination of making greater use of existing railroad infrastructure. The advantages of joint use of track are becoming more acute in Japan. To the extent that cost and lack of space conditions become critical in North America, the advantages of joint use become more pronounced. It's important to understand the institutional and political environment in Japan that permits (and encourages) joint use.

There is really no equivalent of U.S. states or Canadian provinces in Japan. The first level of government below national is the *ken* ('prefecture'), of which there are 47. In turn, prefectures are subdivided into *gun* ("county") and counties into combinations of *shi* ("city"), *machi* ("town"), and *mura* ("village"). For general reference, the nation is separated into the four major islands of Hokkaido (which is also a single prefecture), Honshu, Kyushu, and Shikoku, and is divided into nine regions. One region, Ryukyu, is distant from the others and contains the island of Okinawa. It is

worth mentioning that the Japanese do not credit themselves with original thinking regarding public transportation policies and practices. They readily acknowledge that they learned from overseas. With respect to joint use of track and reciprocal running, America was a principal source of learning. Every feature we might consider adopting from Japan, North America once had here in some measure.

8.2.2 Evolution of the Japanese National Railway to the Japan Rail Group

Joint use of track evolved in several forms in large part because of the way that the Japanese railway ownership and institutions have evolved. This evolution is sometimes recorded as a cultural trait, but it reflects more societal changes which ultimately translate into goods and service delivery. Understanding unique Japanese institutions, practices, and equipment helps to grasp the environment which fosters joint use. Accordingly, Third-Sector railway joint use installations, railbuses, and other features of Japanese rail operating practice are explained below.

North American Contrasts

In the United States and generally in Canada, the railroad companies have been private enterprise corporations that function differently than most corporations in that they had been regulated by the Interstate Commerce Commission, the Federal Railroad Administration (FRA), and by individual State public utilities commissions. Now the Surface Transportation Board and FRA primarily regulate U.S. railroads.

Throughout Europe and much of the rest of the world, railroads are or were entities of the national governments. There are also lesser private-company railroads that feed the national network and are dependent upon it. There is seldom rail-to-rail competition remaining within

corridors under this national railroad structure. In Japan, until a few years ago, the railroad network evolved briefly as individual companies that were early amalgamated into a nationwide government-owned and operated network. However, many private companies continued to be formed and were only selectively merged into the national JNR network. As in most countries, each such railroad needed government sanction either through specific concession or franchise, or through articles of incorporation, endorsed through legislation and limiting the venture insofar as terminal points or routes are defined.

JNR Formation

The mainline Japanese railroads were nationalized in 1892. Japanese Government Railways (JGR) was created in 1906 for the main purpose of extending railroads into areas where they could not become profitable soon enough to attract private investors. JGR was replaced on June 1, 1949 by Nihon Kokuyu Tetsudo (Japanese National Railways —JNR).

With the advent of electric railway technology in the form of street railways and interurbans, local railways blossomed throughout the developed world. This latter disadvantage has been overcome by ingenious methods of interchange in more recent years.

In Japan, private railroad companies were granted unfettered free enterprise. Nevertheless, by specific actions, national, prefecture, and municipal governments could legislate limitations. This intention of enforcing efficiency and economy was also imposed upon manufacturers, establishing *zaibatsu* – single-purpose or single-region conglomerates. An unintended result was the creation of enormous comprehensive monopolies. Following WWII, Japan dismantled these *zaibatsu* as a means of returning to normalcy. As Japan is a refined *laissez-*

faire free-enterprise system, in time the major corporations re-created these monopolies through inter-company agreements. These monopolies and inter-company agreements created the comprehensive transportation, finance, real estate, retail, recreation, and utility conglomerates similar to those which helped develop U.S. suburbs prior to anti-trust initiatives. This diversity also created a climate of cooperation between business interests which encouraged joint use of facilities, including tracks.

Japanese Regulation and Competition

A word about competition is useful to understand joint ventures and joint use. Japanese transport companies can diversify without fear of anti-trust retribution. In the U.S., companies are usually limited to their initial purpose. In Japan, one company enters diverse lines of complementary businesses. In this way, companies adjust to changing markets and business cost centers that can complement one-another. Like North American enterprise, Japanese companies look after their primary need first, to earn a reasonable profit. Secondly, businesses are dedicated to the welfare of the community. A balance is achieved, so that neither objective smothers the other. A private railway company's intended business is to provide a useful transportation service. Because there is a point at which it would become unproductive for a transportation company to raise its fares to the level which would drive away customers, the management is obliged to find more and other ways to make money. There being no anti-trust laws, the railway companies diversify extensively to subsidize their transportation services. Until recent decades, they did not compete with the private automobile. If bus service was warranted, the railways provided it; they did not have to compete with separate bus companies. But they competed fiercely with each other, not on parallel routes, but

in different territories on the basis of "Come live and work in our service area because we offer the best travel opportunities and our area offers the finest quality of living." Joint use of track and facilities can thrive where such environments converge.

In the largest conurbations, the interurbans compete aggressively. In Tokyo-Yokohama-Kawasaki, each serves different quadrants of the region and competes in the sense of "Come and live, work, and play in our territory because we render superior service." In Osaka-Kyoto-Kobe, interurbans compete point-to-point on differing alignments between the same pairs of cities. In most instances, these independent companies compete with Japan Rail mainline or branch line service, too. This competition extends beyond schedules and levels of service. Every time one interurban announces a new feature, another will go to work to top it. The traveler benefits as improvement after improvement is introduced. The interurban's managements have stretched their imaginations to produce marvelous circular tours. In spite of competition, they also cooperate with each other and with Japan Rail when their business interest is being served commonly. The interurbans own what would ordinarily be competing bus routes and coordinate them with the rail lines. To varying extents, these companies must compete with the private automobile. In Tokyo, this is of minor concern. But, in Nagoya — Japan's automobile manufacturing center— rail operators provide more comfortable seating with greater leg room and other passenger amenities such as clean antimacassars on the seat backs of transit vehicles. The suburban city of Toyota has one of the world's most modern downtowns, with an attractive mall and multi-level skywalks between the stations of the two interurban lines that serve it. The centerpiece of this 21st-Century development is one of Japan's largest department stores (owned, in fact, by Sanyo—another interurban company) all

reflecting the great spending power of the auto workers who reach the Toyota plant by economical electric trains.

Financing Rail

The Japanese free-enterprise system allows the railways to establish credit and borrow as needed. There are no capital grants to help expand or public subsidies to maintain operating margins. To eliminate grade crossings by dropping into subways or rising onto aerial structure, they must pay for the new facilities themselves, although they often negotiate cost sharing arrangements with communities where mutual benefit can be demonstrated. (For the severe damage of the Kobe earthquake, for example, the Hanshin railroad had to sell real estate in order to raise the funds to rebuild bridges, overpasses, viaducts, and tunnels, re-lay its track, and re-erect its catenary.) Most infrastructure improvements are therefore accompanied or motivated by joint-development projects which produce immediate capital and ongoing revenue. While the new Japan Rail Group companies are obliged to seek consent of the Ministry of Transport to raise fares, they need no consent to make investments. Joint use is therefore unconstrained by business regulation. High cost and high density tend to encourage joint use ventures.

In the U.S., the railroad network is a group of competing corporations which do not rely on public subsidies. The U.S. railroad system is envied by overseas governments for its self-sufficiency. The Japanese National Railway had become an enormous financial and social burden on the federal government. Railroad overstaffing was a principal means of keeping the populace employed. While the railroad system was vital, it nevertheless had numerous lines that were an economic drain on the rest of the network. "Privatization" was long pursued in England as a conservative political

philosophy. Japan examined all other places' efforts and decided on a different path. Its simplicity is the hallmark of its rapid implementation and evident success. *In summary terms, the national government divided the Japanese National Railway infrastructure and management into six geographic-area corporations (and three other special-purpose companies), granted to them all the privileges and corporate regulatory freedom of a private railway company, and directed their managements to strive to become profitable as quickly as possible so that the government could sell its ownership through shares on the open market.*

The Japan Rail Group companies can now diversify to earn revenue through various means in addition to the transport farebox, can negotiate with other private railways just as those railways have negotiated cooperative agreements among themselves, and are enabled to cast off the worst earners among their branch lines. (See the section on Third-Sector Railways.) Notice that the old concept of the *zaibatsu* prevails – monopolies within geographic areas. Within the context of joint-use of track, take notice that one of the new corporations is Japan Rail-Freight. Freight continues to be managed and operated on a nationwide basis. *But, unlike the U.S., the freight operation is consistently the tenant on the passenger railroads.*

Institutional Rail Changes

The new companies, temporarily 'owned' until offered by the government, are:

Hokkaido Passenger Railway Company
(Hokkaido Ryokaku Tetsudo Kaisha)
([Japan Rail-Hokkaido](#))

East Japan Passenger Railway Company
(Higashi-Nihon Ryokaku Tetsudo Kaisha)
([Japan Rail-East](#))

Tokai Passenger Railway Company
(Tokai Ryokaku Tetsudo Kaisha)([Japan Rail-Tokai](#))¹

West Japan Passenger Railway Company (Nishi-Nihon Ryokaku Tetsudo Kaisha) ([Japan Rail-West](#))

Kyushu Passenger Railway Company
(Kyushu Ryokaku Tetsudo Kaisha) ([Japan Rail-Kyushu](#))

Shikoku Passenger Railway Company
(Shikoku Ryokaku Tetsudo Kaisha) ([Japan Rail-Shikoku](#))

Freight Railway Company (Kamotsu Tetsudo Kaisha) ([Japan Rail-Freight](#))

Shinkansen Property Corporation
([Japan Rail-Shinkansen](#))

The former Nihon Kokuyu Tetsudo (Japanese National Railways, JNR, or "Kokutetsu") continues as a corporation in the form of Kyu Kokutetsu (Old National Railway) as holder of debt and disposer of 2,600 Ha (6,424.6 acres) of surplus property.

Shinkansen high speed lines are within the jurisdiction of only three of the companies – Japan Rail-East (JR), Japan Rail Tokai; which extends to downtown Tokyo [JR-East territory] in one direction and to downtown Osaka [JR-West territory] in the other direction; and Japan Rail-West, which extends well into Japan Rail-Kyushu territory. By 1991, these three companies that operate Shinkansen had become sufficiently profitable that they purchased the assets from Japan Rail-Shinkansen. Operation of the high-speed trains has long been a major profit base; the income from Shinkansen subsidizes those intercity and commuter/suburban operations that incur losses. The proceeds from these sales is being used to finance Shinkansen extensions inland to Nagano, north to Aomori, and south to Kagoshima, as well as to contribute to lowering the debt held

by the JNR Accounts Settlement Corporation.

The process has moved swiftly by comparison to controversial denationalization of railroads in other nations. A JNR Rehabilitation Supervision Committee presented a report and recommendation to the Prime Minister, and the Cabinet met on July 30, 1985 to endorse the government's commitment to carry out the recommendations. A primary issue was the determination of how much of the large JNR debt ought to be transferred to the new corporations. A controversial element was the drawing of boundaries for the six geographic groups; the arrangement finally accepted was to keep commuter-districts together rather than focus on continuity of intercity routes. This established a framework for future joint use.

The Shinkansen lines were treated separately at first to simplify the number of regional companies that would be responsible for them. Those who crafted the details of turning the government-run national railway system into regional railway companies were encouraged by "the success of the private commuter lines in keeping costs and fares down while providing a high level of service to their customers." The government acknowledged that at least three of the regional companies – serving the islands of Hokkaido, Kyushu, and Shikoku – were going to need public subsidy for a long period of time before they could become profitable. Although the extant private railway companies anticipated some new competition, they did not resist the movement. The date of April 1, 1987 was set for implementation, and the Minister of Transportation was instructed to draft all the necessary legislation.

The incentive splitting up of JNR and giving the group corporations the ability to compete on the one hand and the requirement to become self-sufficient on

the other hand has resulted in remarkable improvements of all sorts, not the least of which being the financial stature. Faster trains, thoroughly refurbished older rolling stock, purchase of new rolling stock, modernized stations, and better customer service brought increases in ridership and revenues. Joint real-estate development around stations, new passenger-train services, joint use arrangements with other railways, and diversified enterprise brought in additional revenue.

Japan Rail-East typifies the rapid transformation of the conservative JNR management to an aggressive stride. Some of its aggressive changes apply joint use of track and facilities as a tool for rapid expansion and improvements. Within only a few years, it had:

- extended the north network of Shinkansen lines from outlying Ueno terminal to Tokyo [Central] station;
- increased the maximum operating speed for Shinkansen trains up to 275 km/s (170.88 mph);
- worked with a Third-Sector railway to bring direct rail service from Tokyo (by an interurban company and Japan Rail-East) into the terminal buildings of Narita International Airport, then expanded the service to Shinjuku and Ikebukuro by putting freight tracks to passenger use, and to Yokohama (cutting Narita-Tokyo travel time from 90-minutes by non-stop bus to 53 minutes with capacious trains has attracted more than 41,000 average daily riders);
- remodeled sleeping cars from open berths to compartments and scheduled overnight trains for convenient departure and arrival times;
- introduced double-deck high-speed Shinkansen trains and bi-level commuter trains;

- introduced super-express trains from Tokyo to several shore resorts, some in cooperation with interurban railways; introduced commuter/suburban service through densely populated areas by using freight tracks; added the 43 km (26.7 miles) Keiyo Line to the dense Tokyo rail network;
- introduced high-speed Shinkansen commuter trains; extended electrification; improved signaling; developed ATP (automatic train protection) and ATS (automatic train stop), then merged them into ATS-P – a form of moving block train control;
- increased ridership by 13% since the company was established; and
- operated the company at a profit, thus fulfilling the underlying objective.

Japan Rail-East was the first of the Japan Rail Group to be marketed to the public. By mid- to late-1993, two million shares were put up in the Tokyo Stock Exchange by the Japanese National Railway Settlement Corporation. The issue was so heavily oversubscribed and the share value inflated that the stock exchange had to suspend sales. A starting share price of face value ¥50,000 started at ¥250,000 and skyrocketed to over ¥600,000. Cautiously, the government had held back 50% of the four million shares. Japan Rail-East's importance can be appreciated from the fact that it carries as many passengers as the other five Japan Rail Group companies combined (although not as many as the total of private railways), and passengerkm rose 23% from July 1, 1987 when the company went into business, to 1993.

On October 8, 1997, Japan Rail-Tokai stock was floated on the Tokyo Stock Exchange. The ¥385,000 for each of the 800,000 shares was higher than the expected ¥359,000, but lower than the sale price of Japan Rail-East stock in 1996.

It is clear that deregulated, decentralized decision-making, and applying prudent yet aggressive business practices, created innovative new services and a climate in which joint ventures of many types, including joint use of tracks, is encouraged.

Emergence of Passenger Rail Supremacy

A paradox observed in Japan is that due to declining freight loadings, JNR began and the Japan Rail Group passenger companies continue to turn central-city team tracks and freight yards into revenue-producing joint land developments at the same time that Japan Rail-Freight's main endeavor is to increase the rail share of cargo movement throughout the nation. Tonnekm had declined by 1988 to only 37% of the 1970 level. Adding to this dilemma is the introduction of intensive passenger service on former freight-only lines in the major metropolitan areas and relegating freight moves to nighttime, only because of high traffic density, not incompatibility. But Japan Rail-Freight has joined with Nippon Express, All-Japan Express Company, and individual Japanese shippers to form Kikusai Kamotsu Tetsudo System – a sea-rail venture between Japan and China which will also – under agreement with China's Ministry of Railways – operate freight service within China and participate in container and parcel service between Japan and Vietnam, Mongolia, Kazakstan, and Russia. Within Japan, Japan Rail-Freight maintains a fleet of 593 electric locomotives and 283 diesel locomotives.

While the Japan Rail Group companies are pressing for the lifting of certain restrictions which were introduced into the legislation creating these companies, the government has been helpful in other ways. A way was found to write off a considerable portion of JNR's debt instead of passing it along to the companies. The tax threshold on monthly tickets was doubled, making it more worthwhile for commuters to choose Shinkansen; Japan

Rail-East Shinkansen commuters increased from 3,800 in 1986 to 106,000 in 1989. One of the restrictions the Japan Rail Group wanted discontinued was a prohibition against abandoning 1067mm (3'6") lines after opening 1435mm (4'8½") Shinkansen lines in the same corridor. Japan Rail-Freight was against this capability because key links in a freight network would be lost; its only recourse would be to acquire and continue operation of such lines. In turn, because local stations would be bypassed by the high-speed trains, this would place Japan Rail-Freight in the undesirable position of having to supply passenger service. When in late 1997 the Nagano Shinkansen service was started, Japan Rail-East was enabled to and did discontinue the old line. A related fact was that the line contains a 6.7% gradient – once operated with rack-and-pinion – which is less economical for freight than longer lines that climb the mountains elsewhere. The section from the top of the slope at Karuizawa to Nagano, however, was transferred to the new Shinano Railway as a ready-made Third-Sector electric interurban line. So, Japan Rail-Freight access is preserved to the cities along the way.

For the first several years of their separate existences, the Japan Rail Group companies were exempted from taxes on their assets. Then this immunity was lifted on a sliding-scale basis.

Blending Transport and non-Transport Ventures

Japan Rail-East, again, is used as an example of how individual companies have been diversifying. Initially, the non-transportation (but transportation-related) income is being used to construct new station buildings (which in turn create more opportunities for this diverse income source). By 1996, in spite of heavy expenditures of this new-found income, the Related Business department contributed 4% of Japan Rail-East's annual profit.

Japan Rail-East has successfully established itself in station restaurants, convenience stores mostly at stations (108 outlets by 1996), rental of surplus land and buildings, developing housing projects along its lines, a hotel chain at or near stations (the eleventh opened at Nagano in time for the Winter Olympics), bed-and-breakfast facilities in stations (eight by Spring 1997), redevelopment at or near stations with hotels, office buildings, and shopping centers, and management of shopping centers, hotels, advertising agencies, and information services. In February 1993, Japan Rail-East introduced its own credit card – VIEW – which is honored at station businesses and for ticket and tour purchases. (An interesting side economy is the recycling of used ticket stock as toilet paper for the company's stations and trains.)

A focal point for income production has been the space below, above, and alongside Japan Rail-East tracks. Adding to a similar array, Japan Rail Central has concentrated on mammoth building complexes at, on, and around principal stations (Nagoya and Toyohashi so far), a major resort hotel (at Takayama) with more to follow, a tour company, investment services, and a Japanese restaurant in London. The Affiliated Business department has been the income-growth leader among Japan Rail-East departments. Japan Rail-West adds world-wide travel bureau; the Tennoji station building in Osaka, which is claimed to be Japan's largest commercial complex; the largest shopping mall in Japan; and 110 miscellaneous profit-making subsidiaries and affiliates, including a railway, two bus companies, and taxicab companies.

Summary Evaluation of Rail Systems in Japan and Application of Experience

A summary observation concludes that the break-up of JNR into the regional railway companies has been successful, and that the keys to success of the action have been (1) not requiring the new companies to

carry the full burden of past debts, (2) granting to the new companies the privileges that the private railways (indeed, any private corporations) have – coupled with the lack of stern regulation or anti-trust prohibitions, (3) adopting public-interest benevolent goals and objectives, and (4) a prevailing positive attitude of cooperation and coordination. This latter weighs heavily in the successful ventures into joint-use of track.

A summary of significant points with respect to transferring Japan's success with joint-use of track to North America include: Freight service has been corporately separated from passenger service – as in the U.S. – but Japan-Freight is a tenant on the regional Japan Rail companies' tracks. In a reverse of the roles of Amtrak and the nation's freight railroads, Japan Rail-Freight supplies and operates its own motive power and rolling stock. The railways have long voluntarily adhered to identical standards of track gauge (although several), traction power (again, several), and clearance envelope. In Japan, anomalies are addressed rather than used as reasons to not accomplish things to gain benefits (e.g., one of Tokyo's rapid transit lines adopted the Tokyo streetcar gauge of 4'6" rather than require an extensive interurban company to convert to standard gauge.) This also reveals how one action to achieve a standard for joint use can cascade through the system to compel other changes in standard which are otherwise unjustified. The surge in Third-Sector railway projects created a sudden market for economical, efficient, easy-to-maintain railbuses (and the willingness of the railcar manufacturers to take orders of only a few at a time).

8.2.3 Japanese Private Interurban Railways

The American interurban industry was a natural outgrowth of the early electric street railway and urban rapid transit. Typically, but not always, the interurban trains ran into and out of cities on streetcar

tracks, but between cities on railroad-like private rights-of-way. Rather quickly, the interurban railway developed into a unique rail form with its own kind of rolling stock capable of running slowly in mixed traffic among the streetcars and fast on the open railroad-type track. In time, numerous instances of joint use of track emerged, although the practice was not at that time heralded as anything unusual.

It is more the interurban than the streetcar that was reborn as light-rail transit, with all the versatility introduced by the interurban railway. The historical timing was such that the defining interurban features of either running cross-country to link urban centers or radiating from urban cores were applicable to Japan as it underwent its rapid Meiji-Era transition from a feudal state to a modern industrial nation. In Europe, the emergence of regional railways and independent Stadtbahn reflect a return to the interurban, but in a contemporary form.

Although some historians erroneously credit the automobile with the rapid outward growth of Los Angeles, it was actually a well-planned interurban network that set the pattern for metropolitan growth. The automobile merely took advantage of it. Similarly, it was the interurban railway that defined the low-profile but extensive pattern of growth experienced at the same time by Tokyo, Osaka, and Nagoya.

The interurban railway has become a dominant practitioner of joint use/reciprocal running in Japan. The Japanese interurban railways – both private and third Sector – practice joint use/reciprocal running to a greater extent than the other rail modes. Nevertheless, among the interurban systems' partners in the practice, the urban rapid transit systems, though numerically fewer, have a larger percentage of participants in joint use/reciprocal running.

When interurbans were introduced in Japan, the Japanese had progressed sufficiently to carry on their own entrepreneurship. They followed U.S. practice closely and created American-style electric interurban railways. A century later, the interurban has evolved into the dominant mode for travel in Japan's major conurbations. The technology and operating practices have advanced to the state of the art. The natural course of continued development in Japan shows how the interurban might have evolved in the U.S. and Canada had not other forces intervened.

Interurbans shoulder most of the commuting burden in the major Japanese urban areas. Their role is vital. In the vast Kanto region (i.e., the Tokyo-Yokohama commutershed), the large Kansai region (Osaka-Kyoto-Kobe commutershed), and the Nagoya region, the sharing of average weekday passengers among urban transportation modes was as shown in Table 8-2 in 1980.

The interurban companies carry the greatest share of passengers each day. In the Kanto region, they carry 41.62% of all rail passengers in a network having the world's most extensive electrified suburban/commuter-rail network (Japan Rail-East's) and the world's most extensive heavy rapid transit ("subway") network. In the Kansai region, the interurbans carry 54.61% of the rail passengers, and in Nagoya, 51.56%.

There are 38 private companies and 15 Third-Sector companies operating electric interurban railways in Japan. In addition, three of the Japan Rail Group companies operate a total of 16 interurban lines in 11 localities; predecessor JNR acquired these over the years and added them to the national railway network. No matter how you count them, there is a greater concentration of electric interurban systems in Japan than in any other nation of the world.

There are other private companies and Third-Sector companies operating electric railways in other forms, such as heavy rapid transit, light-rail transit, street railways, and more operating diesel railways.

Interurban versatility is underscored by a variety of track gages: 1435mm (the North American standard gauge of 4'8½"), 1372mm (4'6"), 1067mm (Japanese "standard" gage of 3'6"), and 762mm (2'6"). Versatility continues with a variety of electrification systems: 600vDC trolley wire or catenary, 750vDC third rail, 1,500vDC catenary, and 20,000vAC catenary, as well as some diesel railcars and railbuses operating under catenary. This diversity may have suppressed some joint-use track ventures, but where gauge compatibility exists, joint use by interurbans and other carriers flourishes. Even where track gauges are different, the problem has been overcome by joint use of rights-of-way, or three-rail track. New interurban lines continue to be built. All feature some degrees of joint venture, joint use of track, or reciprocal running. Since the institution of the Third Sector arrangement, the following eleven electric interurban lines have been opened: (Note those that participate in reciprocal running/joint use of track with Japan Rail group railway companies are indicated by "*", and those that participate in reciprocal running/joint use of track with other private railways are indicated by "#".)

- Abukuma Railway – 1067mm (3'6"), 20,000vAC catenary – 54.9 km (34.11 miles).*#
- Aichi Loop-Line Railway – 1067mm (3'6"), 1,500vDC catenary – 43.5 km (27.03 miles).*
- Chiba Express Electric Railway – 1435mm (4'8½"), 1,500vDC catenary – 10.9 km (6.77 miles).#

**Table 8-2
Interurban Market Share**

mode	Kanto Region		Kansai Region		Nagoya region	
	riders	% of riders	riders	% of riders	riders	% of riders
JR commuter rail	9,234,218	31.24	1,482,000	12.47	462,296	15.11
heavy rapid transit	5,195,897	17.58	2,568,442	21.61	826,112	27.00
interurban	10,446,513	35.34	5,060,750	42.57	1,432,287	46.81
light-rail transit	225,278	0.76	155,937	1.31	57,457	1.88
rail subtotal	25,101,906	84.92	9,267,129	77.96	2,778,152	90.80
motor bus	4,457,000	15.08	2,620,310	22.04	281,384	9.20
totals	29,558,906	100.00	11,887,439	100.00	3,059,536	100.00

- Hokuetsu Express – 1067mm (3'6"), 1,500vDC catenary – 59.5 km (37.00 miles).*
- Hokushin Express Electric Railway – 1435mm (4'8½"), 750vDC catenary – 7.5 km (4.66 miles).#
- Kamogawa Railway – 1435mm (4'8½"), 1,500vDC catenary – 2.5 km (1.55 miles).#
- Kansai Airport Access Line — 1067mm (3'6"), 1,500vDC catenary – 6.9 km (4.29 miles).*#
- Narita Airport Rapid Railway – 1067mm (3'6") 1435mm (4'8½"), 1,500vDC catenary – 8.7 km (5.41 miles).*#
- Shinano Railway – 60.4 km (37.53 miles).*
- Toyo Rapid Railway – 1067mm (3'6"), 1,500vDC catenary – 16.2 km (10.07 miles).*#
- Yagan Railway – 1067mm (3'6"), 1,500vDC catenary – 43.5 km (27.03 miles).#

In addition, the following were developed as non-electrified railways using diesel-propelled rolling stock as a vanguard for future electrification:

- Ise Railway – 1067mm (3'6"), railbuses – 22.3 km (13.86 miles).*
- Kita Kinki Tango Railway – 1067mm (3'6"), railbuses – 30.4 km (18.89 miles).*
- Tokai Transport Development Agency – 1067mm (3'6"), DMUs – 11.2 km (6.96 miles).

Many interurbans operate networks of bus routes, and often extend their influence into resort areas with funiculars and aerial cableways. Several operate fleets of taxicabs. Some operate ferries or excursion boats. Such diversification, of course, expands their transportation sphere, putting more passengers into their electric railway

cars and trains. They extend their travel influence by encouraging hiking in regions that they serve, and even maintain hiking trails. They have expanded into travel bureaus and publishing travel-oriented periodicals.

Copying their U.S. counterparts of earlier decades, Japanese interurbans developed family amusement parks to generate off-peak riding on their lines. Some of the amusement parks have graduated to theme parks. The sponsor and local partner for Walt Disney Enterprises' Disneyland near Tokyo is the Keisei Railway interurban company. The interurban companies have built sports stadiums strategically located so sports fans must ride their trains to reach the games, and they own their own baseball teams. Of the twelve major league Japanese baseball teams, five are owned by interurban companies: Seibu [Railway] Lions, Hankyu [Railway] Braves, Kintetsu [Kinki Nippon Railway] Buffaloes, and Nankai [Railway] Hawks in the Pacific League, and Hanshin [Railway] Tigers in the Central League.

In retailing, they have ventured into non-traditional transport businesses such as small stores (like florists), at one extreme, and into shopping malls at the other extreme. Many of the nation's major department store chains are owned by the interurbans, and their principal stores often serve also as the main railway terminal. Takamatsu-Kotohira Electric Railway Company on the island of Shikoku operates a major chain of supermarkets, with the stores alongside stations. Notice that in addition to making a profit themselves, all of these non-transit ventures are expected to generate travel on the interurbans. The interurbans have expanded their activity to hotels, including major chains and overseas locations. The interurban companies are also involved in planned communities and new-town development. Some build their own rolling stock, and a several sell their products to other railways in Japan and

abroad. Hence, there is no need for public subsidy of these private railways.

These joint business arrangements among the interurbans and other Japanese railways are uncommon in North America where, for anti-trust reasons or profit motives, real-estate/land development and public transportation were separated over the past six decades. Attempting to preserve themselves, and in the face of real-estate taxes, U.S. railroads divested themselves of real estate at the very time Japanese railways were continuing these investments. In separating transport from non-transport, freight from passenger, and railroad from rail transit, the climate for joint ventures, much less joint use of track and facilities, diminished.

The interurban railways range from vast and modern (e.g., the Tobu Railway with 293 miles of line and 1,951 units of motive power and rolling stock) to small and quaint (e.g., the 2.6-mile Kambara Railway with only a few cars).

8.2.4 Japanese Third-Sector Railways

The Third-Sector railway, a relatively-new form of railway corporate entity is not exclusive to any one rail mode, or transportation or economic development enterprise. There are over 5,400 third sector (Daisan) ventures of all types in Japan, representing over \$10 billion in investment. It is explained to help understand the nature of this increasingly popular railway organization. Understanding Third-Sector railways is vital because these type railways are principal participants in joint use of track/reciprocal running in Japan. There are no examples of such entities in the U.S., although their formation has been promoted indirectly by encouraging private-sector participation and joint public/ private ventures. Various state and local legislative bodies are making or considering legislation that will enable transportation entities to employ joint

ventures as a means to bring about new facilities or services. In some ways, super-turnkey projects embrace some Third-Sector characteristics. The third sector railway's closest equivalents are the new LRT DBOM ventures in the U.S. The manner and extent to which they have been used in Japan to affordably restore failing or discontinued passenger railroad services and to establish new rail lines has potential application on such entities in North America. It is no coincidence that Third-Sector railways, joint ventures, and shared track appear to be related.

Accompanying the breakup of the Japanese National Railways (JNR) into the Japan Rail Group was the selective screening out of "unproductive" branch lines and the discontinuance of construction (most of which had long been dormant anyway) of new lines. Arrangements were promulgated to make these facilities available to other existing or new operators. Because much of the service on these low-density candidates for discontinuance was regarded as vital to regions or municipalities, various levels of local government stepped forward to rescue lines, usually in joint ventures with private investors. Facilities or services that did not suit national or large-scale priorities were often important to the locales they served.

The disposition of branch lines by Class 1 railroads to local county economic development agencies, councils of government, and their contracting with private short-line railroad operators is a process paralleling Third-Sector formation in Japan. A major difference is that the branch lines in the U.S. provided freight service while the Japanese lines were predominantly for passengers. Technically, there already were third-sector railways in Japan, but they were not separately categorized. They were grouped with the private railways. The casting off of certain lines as part of the creation of the new Japan Rail group of

railways, however, was an inducement to the quick formation of a multitude of such railway ventures and the "Third Sector" term was introduced.

Previously, Japanese railways were separated into two general groups: *Kokutetsu* or JNR (i.e., the "first-sector") and *shitetsu* or "private railway" (hence, the "second-sector"). In Japanese railway lexicon, "private" *does not necessarily denote exclusive private sector ownership*. The term encompasses all railways other than JNR, including municipally owned and operated rapid transit and street railway systems. For this new wave of joint municipal/private-enterprise railway ventures the term *Daisan Sekuta* (i.e., "Third Sector") was introduced. The Third-Sector pattern followed by Japan is very similar to many of the smaller railways of Switzerland which are owned jointly by corporations and cantons or municipalities. Absent prohibitions, this process initiates and happens from the bottom up rather than being prescribed by the national government.

The municipal investors in these third sector railways include villages, towns, cities, counties, and prefectures. The private investors range widely from interested individuals to corporations formed expressly for the purpose. Some also include shippers and existing private railway companies.

Some are bold ventures of heavy public financing with goals of opening new territory for development – both on a city scale, such as the tunneled Hokushin Express Railway in Kobe, and on a regional scale, such as the Yagan Railway into the isolated interior of Honshu Island north of Tokyo. Typically, the Third-Sector railways are single lines. Most often, they are on the fringe of urbanization or in rural areas. This stems from their heritage as cast-off Japanese National Railways branch lines.

Japanese branch line railways are commonly picturesque and endowed with unique local character. How are Third-Sector railways financially self-sufficient? The basis for assuming operation of a JNR financial loser and making it financially viable local operation required lower than JNR wage rates, part-time employees, and volunteer marketing efforts. The railways employ retired JNR employees as dispatchers and train operators, housewives as ticket collectors at stations, and teenage students for station maintenance work. The service areas are saturated with promotional literature aimed at gaining more use of the railway.

Other Third-Sector projects which complete unfinished JNR lines or build anew are high-quality facilities with first-class rolling stock and modern operating practices. These usually have the prefecture within which they occur as a participant, and are pursued for the purpose of opening new territory for economic development. Without exception, these have become significant partners in reciprocal running arrangements.

While the foregoing characteristics typify the Third-Sector Railways, there is more variety than can be portrayed here. Their scope and variety could justify a separate research effort. Some of these new railways are profitable even at prevailing Japan Rail or transit authority wage rates. Some are not at all modestly capitalized, but have made enormous capital investments which must be repaid essentially through the farebox.

Third-Sector railway practices that are performing financially superior to the former JNR operation include the widespread use of diesel railbuses, which cost little more to purchase and no more to run than highway buses, *wan-man* ("one-man") operation – dispensing with conductors and placing fare-collection apparatus within view of the engineer/motorperson, and elimination of staff at

stations other than at crew operating points. The national government and the JNR holding companies have been helpful, too. Many of the rights-of-way and physical plant remain in national-government/JNR ownership and are made available at little or no charge, thereby reducing the debt incurred locally to take over a railway. Surplus JNR rolling stock – usually diesel multiple-unit (DMU) *railroad* cars (comparable to TCRP A-17 Category 1 DMUs) – have been made available for rebuilding (or at least repainting) to provide initial service while replacement railbuses are being manufactured. Because the service is locally, or regionally regarded as essential though not profitable, local subsidies keep the trains running. Because the local governments are part-owners, there is not the American-style concern for putting public tax money into the hands of private operators. Early results in converting former JNR lines to Third Sector Railways show an increase in farebox recovery rates from 10-or-20% to 70-to-more-than-100%, thus demonstrating that railways can be basically economical, with ingenuity and enthusiasm packaged in locally/regionally-fashioned institutions.

The emergence of this new category of railway in Japan has caused a renaissance for the manufacture of railbuses. The characteristics of these new Third-Sector railways has placed new expectations on railbus design, construction, and performance. Third-Sector railways are distributed throughout the nation. They are often operated and maintained by relative novices, who have neither spacious shops nor sophisticated tools. Their operating requirements are seldom for more than two to five vehicles. The challenge to manufacturers of these versatile, economical, reliable vehicles is to fill very small orders and to maintain parts inventories.

By January 1, 1998, there were 54 Third-Sector companies operating intercity,

commuter/suburban, interurban, heavy rapid transit, or light-rail transit rail services. Nine others operate monorailways, people-movers, or funiculars.

8.2.5 Japanese Diesel Railbuses

If the Third-Sector is a prime practitioner of joint track use, then the diesel railbus is a major tool in implementing joint track use on a local scale.

A principal item of motive power/rolling stock employed throughout Japan in instances of joint-use of track/reciprocal running is the railbus. Railbuses were used in Japan as early as they were found across the United States. They disappeared here, and they nearly disappeared in Japan. There was a momentary resurgence following World War II in light-weight railcars, including railbuses, even in the U.S. The vehicle, however, did not really come into broader use until the advent of the Third Sector railway. This parallels the popularity of these vehicles, called *Schienenbusse*, in Germany. Suddenly, Third-Sector railways needed affordable rail vehicles that could be operated and maintained by semi-skilled neo-railroaders and would be dependable, economical, and efficient. Their rapid deployment results in their use now by all six of the regional Japan Rail Group corporations, 18 private railway companies (including some interurbans), and 34 of the Third-Sector railways. This represents 37½% of all railroad ventures in Japan.

Japanese, like Europeans, tend not to categorize and separate their rail modes, such as high-speed rail, intercity rail, commuter rail, heavy rapid transit, light rail transit, and street railway. These are all just "rail," the only distinction being if they are electrically propelled. The one word *densha* ("electric car") applies to everything from streetcars to the high-speed 16-car Shinkansen trains. While the term "DMU" (diesel multiple-unit) is internationally recognized, including in

Japan, the general reference to the topical vehicles is *rerubasu* (railbus), although *deizeruka* (diesel car) is common. They are *not* called DMUs or diesel LRVs in Japan. Distinction between *railroad* DMU (Category 1) and *rail transit* railbuses (Category 2) is blurred in Japan.

It is, however, their combination of light weight and short length that distinguishes the Japanese railbuses as the smallest among other self-propelled rail-bound conveyances. The conventional diesel multiple-unit (DMU), of which there are thousands in Japan, are typically of 21,500 mm (70'7") length and are powered by underfloor pancake or side-mounted engines – somewhat comparable to the venerable Budd Rail Diesel Car (RDC). Railbuses are shorter than DMUs and employ smaller engines, all evolved from bus and coach technology. They would be considered FRA non-compliant in the U.S.

The first of the new generation of railbuses used conventional bus bodies. Then, reacting to customer comment, manufacturers made the bodies wider and longer than would be suitable for a highway vehicle, and evolved the vehicle into a better-riding double-truck version rather than the two-axle version.

In the rapid but intermittent evolution from buses on rails to small railroad coaches, a significant feature was the introduction of train doors to enable crew (and sometimes passengers) to move from car to car when they are coupled into trains. *This feature deprives Japanese rail-buses of their motor-bus appearance* (see Figure 8-4a). Another significant step, less obvious, was equipping the railbuses to operate multiple-unit with each other *and with their larger DMU counterparts*. This required upgrading the control, performance, coupler, and other mating surfaces to railroad standards. The shell and structure remained bus derivative, however. In train with larger DMUs, the railbuses do not

serve merely as extracapacity units at the ends of trains, but in the opposite direction, they take on the important role of control cab. The railbuses have been built in additional variations such as married pairs and three-car train sets. Some have streamlined ends. Some have been styled to appear as vintage trolley cars. Those assigned to long-distance trips are equipped with lavatories. They would not be considered FRA-compliant in America. The Japanese railbus has become a very versatile passenger-rail vehicle. Hence, their numbers have grown rapidly. By the end of 1997, there were more than 780 of these "non-compliant" railbuses operating throughout Japan.

The types of service in which railbuses have found their niches are many:

- rural branch lines, including Third Sector railways, that otherwise would have been abandoned
- as means to open new rural or urban railway lines and serve until larger cars become necessary
- urban shuttles – more effective than short bus trips on congested streets
- school trippers on commuter/suburban rail lines
- means of reaching parks, natural features, shrines and temples, and places where automobiles and other vehicular traffic might be unwelcome
- vanguard for future electrification, to develop a ridership constituency before the catenary is erected
- temporary services during special events, world's fairs, expositions, etc.
- replacement of older DMU stock, the large capacity of which is not needed

Very early in the new era of railbuses in Japan, with the impetus being the smaller railways and the third-sector movement, the Japan Rail Group found it useful and economical to buy their own railbuses. This is a similar circumstance to the German Federal Railways who, after permitting Karlsruhe urban light-rail vehicles to venture onto its main line/branch line rails, observed the resulting economy and bought and operates its own LRVs to replace older commuter/suburban trains.

Because of the synergy with bus design, railbus manufacturers are willing to fill small orders for a few or only one unit. In addition, they are willing to tailor them to each customer's unique needs. The railbuses are maintained and repaired by the individual owning railway companies. While a variety of national and local laws pertain to such matters as safety (e.g., grade-crossing protection) and environmental issues, railbuses *per se* are not "regulated."

The history of the modern Japanese railbus is brief. Few changes in design through the Japanese railbus' short evolution have resulted in a record of reliability. The newer vehicles keep pace with advances in bus and railway technology. The use of off-the-shelf components contributes to favorable maintenance experience.

Both the railbus and light DMU are derived from non-railroad vehicles; the DMU from the LRV and the railbus from the bus. The railbus and the light DMU (Category 2 and 3) are following separate functional and evolutionary courses.

Other than a temporary effort by the Sapporo Municipal Transport Bureau with operation of diesel-electric streetcars, there has been no effort to make the railbus adopt characteristics of light-rail vehicles, nor to create a low-floor version, nor to operate them on tracks in paved streets with automotive traffic. Sapporo's use of

diesel-electric streetcars was a means of extending street railway service into growing urbanization areas in advance of erecting trolley wire (which eventually was done). The cars were converted to straight electric and in that form found their way to other street railway systems when Sapporo renewed its fleet. They operated in diesel mode from 1958 to 1968, and continue in 1998 running in electric mode. These Sapporo LRVs were not dual power vehicles but were diesel-electric drive, never running off wire until their conversion to all-electric power. There has been no repeat or imitation of this special mode, which, incidentally was neither an experiment nor a demonstration, just a financial and operating expedient.

Dual-power exists in the U.S., Japan, and elsewhere. In the U.S., there are several parallels with the Japanese railbus and its German counterpart, the Schienenbusse. The Mack FCD railbus on the New York, New Haven & Hartford Railroad in the 1950s was most common among an otherwise rare vehicle type. Mack mated a conventional transit bus body on stock PCC-car trucks – at least two models were produced by Mack. Ten were built by Mack's Allentown, Pennsylvania plant during 1951-1954² and in view of the respective dates *may have* influenced the Sapporo cars, or at least the decision to build them.

8.3 JOINT USE RATIONALE, THE JAPANESE EXPERIENCE

Some specific regional transportation policies and rationale underlie Japanese joint-use of track experience. The Tokyo Tozai Line's implementation provides examples of the rationale in practice, and is subsequently described. Purposes of joint-use of track arrangements in Japan and the Pacific Rim include the following examples:

8.3.1 To Eliminate Transfers

- By offering a one-seat ride via central-city rapid transit lines instead of having to transfer from commuter/suburban trains or interurban trains at the periphery. This feature is demonstrated in multiple instances of reciprocal running focused on the rapid transit networks of Tokyo, Osaka, Kyoto, Kobe, and Fukuoka.
- By offering a one-seat ride via feeder lines; Japan Rail reaches popular destinations on tracks other than its own, such as from Tokyo to the Izu peninsula resorts over Izukyu interurban tracks beyond Ito, or the rural Wakasa Railway's railbuses over a Japan-Rail-West mainline to reach the city of Tottori.
- By running interurban trains over Japan Rail (without having to change trains) to alternative terminals not on the interurban system, e.g., Odakyu interurbans running to Gotemba, the eastern gateway to Mount Fuji, on Japan Rail-East tracks.
- By allowing special train through service such as school trippers so that groups of students do not have to transfer.
- By running private branch line or suburban trains over Japan Rail track to reach a central city; Third-Sector railways running direct to the core city instead of transferring passengers to Japan Rail mainline trains.

8.3.2 To Improve Service

- By reducing travel time through elimination of transfer and wait times.

- By reducing terminal congestion of both passengers and trains.
- By overlapping passenger-train service both to conveniently distribute passengers and to enable same-platform transferring from train to train. One transfer in any of Tokyo's Asakusa Line subway stations, for example, allows passengers from Yokosuka on the Keihin interurban to continue on the Keisei interurban to Narita International Airport without two transfers using an intermediate subway train.
- By enabling special excursion service; Nagoya Railway special trains from Nagoya to Tateyama on the opposite coast, using interurban trackage at both ends and a Japan Rail-Tokai mainline between.

8.3.3 To Save Money or Better Use Existing Infrastructure Investment

- By obviating the huge investment needed for duplicative large-volume capacity.
- By exploiting the large capacity of city rapid transit subways (so that suburban trains can reach many in-city destinations without building redundant infrastructure).

8.3.4 To Extend Existing Services or Introduce New Services

- By extending the service of an urban subway by using another railway's tracks (such as employed by both of Tokyo's central subway operators to reach well into the suburbs without having to build extensive new infrastructure).
- By enabling significant shortcuts for longer-distance trains by operating over sections of private railway or interurban companies.

- By bringing coordinated rail services to major airports like Narita International, New Kansai International, Haneda Domestic, Fukuoka International, and Miyazaki International. (Chitose International Airport, serving Sapporo, is directly served by Japan Rail-Hokkaido express electric suburban trains.)

8.3.5 To Support Land Use and Economic Development Initiatives

- By opening new territory for development, both in metropolitan areas by serving new-town sites, and in a broader sense, to open heretofore inaccessible interior regions.
- By allowing continuation of local passenger-train service on trackage taken into the high-speed *Shinkansen* network (such as on the newer Yamagata Shinkansen and Akita Shinkansen).

The reciprocal-running practice has been spurred particularly by several recent developments. One is the growing need to provide more suburban Tokyo and Osaka train service in order to keep abreast of growing population. Another is to restore some of the severed links resulting from the separation of the former government-owned Japanese National Railway into regional Japan Rail companies, and the resulting discontinuance of numerous uneconomical (by JNR standards) branch lines. Several of these branch lines have been rescued by public-private Third-Sector railway ventures.

This concentration of service resulting from overlapping train service in Japan is responsible in large measure for the popularity of the individual services.

One lesson derived from Japan's experience with joint-use of track/reciprocal running, is that it requires

conventional dual rail technology as a base. Those cities that have chosen unconventional transit guideway systems such as proprietary monorailway and people-mover systems have, in doing so, forfeited opportunities for joint use. In spite of two predominant track gauges, extensive reciprocal running and joint use of track prevail in Japan. In spite of a wide variety of rolling stock and traction power options, Japanese transportation providers enter into agreements for joint use and coordinated services. The attraction of riders by the one-seat ride provided by reciprocal running/joint use of track is superior to even the most convenient transfer facilities.

8.4 PROBLEMS AND ISSUES THAT HAD TO BE RESOLVED TO ACCOMMODATE JOINT USE

To accomplish joint-use of track, one rail operator (the tenant) has to conform with another rail operator's (the host) physical and operating characteristics. In reciprocal running, two railroad entities negotiate mutually-agreeable terms, each yielding to the best characteristics drawn from both parties. The initial reciprocal running operations in Japan caught the attention of railway managements and transportation planners. As joint use results have been positive, risk tolerable, and mutual benefits apparent, negotiations to form new partnerships or expand existing ones are not contentious.

In most instances, individual railways were built and rolling stock acquired without the expectation of ever running on other trackage. As shared track practice spreads, it encourages more standardized equipment among participating carriers ordering replacement rolling stock.

To initially implement reciprocal running in the major-city subways, the participating operators agree on common standards such as:

- rolling stock of compatible dimensions and performance characteristics,
- cars with identical signal/train-control apparatus,
- coordinated work and operating rules,
- an integrated schedule, and
- divisions of responsibilities for operating and maintenance functions, operating costs, and revenues.

Because the rapid transit configurations are more demanding and more restrictive than other rail modes, they tend to prevail. Following are some of the ways found throughout Japan to resolve problems and concerns that were encountered, or to achieve compatibility. The subject of this report's first four chapters and related key issues appears here again, this time in a Japanese context – institutional matters, operating/labor practices, physical facilities, motive power and rolling stock, and combined features:

8.4.1 Institutional Matters

- Japanese local government regulation prevails over alignments and operating rights in the same manner of local "public rights of convenience and necessity" in the U.S. For example, in order for a railway company incorporated in one prefecture to extend into an adjoining prefecture, it must alter its charter. Licensing had to be revised to enable connecting links to be built and to allow railways to run over each other's tracks in certain instances.
- In metropolitan Tokyo for the eastern end of the Tozai Line, Teito Rapid Transit Authority rights (to do business) had to be extended into adjoining Saitama prefecture.
- Cost-sharing arrangements are negotiated. In the Tokyo rapid transit situation, reciprocal-running operating entities using the Teito Rapid Transit Authority rapid transit lines lease trains to each other on a set-fee basis, necessitating a complex accounting method. But the operating entities using the Tokyo Municipal Transport Bureau rapid transit lines work out arrangements of train runs and distances designed to achieve 50:50 usage, and necessitate no exchange of money. At joint stations where two corporate entities meet, the one with the greater amount of business operates the station and the other pays a fee. Train crews routinely change at these common points and do not run into each other's territory, as do the trains. Again, details of these arrangements are set locally.
- The first of the joint-use ventures was negotiated for reciprocal running over the Teito Rapid Transit Authority's Hibiya Line. It prescribed equal running lengths by through-running trains among the three participating entities (Teito Rapid Transit Authority, Japan Rail-East, and Tokyo Express Electric Railway, Tokyu) with no running permitted over third-party tracks. This meant that Japan Rail could run its commuter/suburban trains through the central subway, but not onward over Tokyu tracks, and Tokyu could run its interurban trains through the central subway, but not onward over Japan Rail tracks.

This restriction was subsequently discontinued as a requirement and not applied to subsequent Tokyo area reciprocal-running projects.

- While common standards are agreed to by partners sharing track, every arrangement is negotiated separately. There are no commonly accepted model agreements. Decisions are negotiated locally. Any common terms, however, are carried from old agreements to new agreements among existing partners rather than revisiting already-settled matters.

8.4.2 Operating/Labor Practices

Japan Rail had to revise some of its operating regulations to permit joint use with rapid transit, railbus, and interurban operators. The following are examples:

- Rolling stock can be outfitted for some alternative uses to accommodate differing operations. For example, the Fukuoka rapid transit is operated *wanman* ["one-man"]. But, its track-sharing partner Japan Rail-Kyushu trains employ a two-man crew (motorman and conductor). Japan Rail conductors work through the "one-man" territory inasmuch as the rapid transit line provides the only link with the city's major Japan Rail railroad station (Hakata) and operating headquarters. The organizations representing railroad and rapid transit operating employees cooperated to reach this arrangement.
- A significant concern which has not been handled in any standard fashion is the assignment of operating employees. Generally, the employees of one entity do not venture onto the property of another, unlike the train consists which migrate back and

forth. Train crews change at common stations. Station staff is comprised of the employees of the entity that owns the station. However, some reciprocal running agreements assign station staff according to dominant usage of the facility in terms of train runs or number of passengers. Exceptions abound. For one example, Abukuma Railway interurban operators bring their trains into Fukushima over the tracks of Japan Rail-East and Fukushima Transport, possibly because of the nuisance factor of changing crew twice over very short distances; but at the north end of Abukuma Railway, the trains that continue many miles to Sendai change crews at the common junction station.

8.4.3 Physical Facilities

- So as to obtain sufficient clearances in height-restrictive structures; direct-fixation track construction to the tunnel floor is employed (except where a subway passes under buildings or residences). This is in lieu of conventional track needing the added height of ballast and ties.
- Low subway clearances brought into extensive use overhead third-rail (called "trolley bar") in lieu of catenary, which required too much space. (See also "Motive Power and Rolling Stock," below.)
- System-wide communications were installed with two-way radio contact between train operators and dispatchers and an open public-address system to communicate with passengers in stations.

- When Ise Railway purchased railbuses to run over its own line, to reach the center of the city of Yokkaichi, Japan Rail-Tokai required the railbuses to be outfitted with the wireless ATS (automatic train stop) that it has installed on its newly-electrified Kansai Main Line.
- Not formerly seen, but now quite routine is the passing of city subway trains over suburban at-grade road crossings. As a result, some rapid transit equipment has been retrofitted with skirts, fenders, or "cow catchers." Crossing safety experience in Japan is remarkably good. On lines with several classes of trains, anticipators are used which provide the same warning time for slow trains and fast trains. This serves to discourage "beating the train to the crossing." Japanese traffic rules require automobiles, trucks, and buses to stop at grade crossings even if the gates are up and the lights are not flashing. Driving in Japan is still regarded as a privilege. It is a costly privilege that can be taken away for infractions that might be regarded in North America as minor. If the Japanese do not obey the laws as a matter of principle, they obey them to keep their licenses.
- For 1067mm- (3'6"-) gauge Odakyu Electric Railway Company interurbans from Shinjuku (Tokyo) to run into the mountains over the 1435mm- (4'8½"-) gauge Hakone Mountain-Climbing Railway Company, it was necessary to lay a third running rail from Odawara to Hakone-Yumoto. On this dualgauge track with half the trains off center, trains draw 1,500Vdc power from a common catenary contact wire, set within lateral tolerances of both company's pantographs.

8.4.4 Motive Power and Rolling Stock

- In the least complex situation, it has been adequate to revise rulebooks to include the signal practices of other railways over which a crew may have to operate. But where sophisticated systems prevail, it has been necessary for the newcomer partner to outfit its rolling stock for the higher-grade system, lest safety be compromised. Around Tokyo, Osaka, and Nagoya, where the interurban companies operate especially large fleets of cars, some economy has been achieved by ruling out the use of certain series of cars from running through on the city subway tracks. This restriction encompasses the fleet extremes: the oldest cars, and the luxury limited express trains, which continue to operate exclusively on the owning railway's tracks.
- Achieving compatible electrification schemes required that the railways design a double-sprung pantograph that exerts equal pressure on the contact wire at low height in subways and at high height out from underground.
- Compatible couplers were needed in the event that one train must push another in emergency. In the case of Japan Rail-East running through Tokyo subways, these trains yielded their railroad-type couplers in favor of the rapid transit-type couplers. Japan Rail elsewhere uses knuckle-type couplers with flexible cables for trainlines and control. Rapid transit systems use transit-type couplers with trainlines and control contacts.

- Throughout Japan, high-station platforms and level boarding prevail for all rail passenger modes except street railways. When reciprocal running is introduced, the participants have to agree to a uniform car-floor level and a common station platform height. When one of the pair of shared facilities is built anew, this matter is taken into account during design. In other more common instances where two existing facilities are connected, small variances are tolerated. There is no ADA-type minimum gap requirement or height deviation for wheelchairs, although the railways voluntarily do the best they can to accommodate wheelchairs economically.
- A common carbody width *at sill level* was necessary for joint use. With few exceptions, all stations in Japan have high platforms. For narrower cars, this necessitated welding a plate at each door to span the gap to the platform of the wider rapid transit clearance line. In the case of Nagoya Railway's light-rail transit lines radiating from Gifu, new LRVs were outfitted with a retractable plate so that they would not be in the way during boarding and alighting at level boarding platforms.
- Though uncommon, some rolling stock in Japan is capable of loading passengers at high (car-floor-level) station platforms and low (curb-level) platforms, as is done with rotating, folding, or retractable steps in North America at Buffalo, Pittsburgh, and San Francisco.
- In instances of reciprocal running using rapid transit lines, it has been necessary for the non-rapid transit rolling stock to have additional multiple side doors to assure that the suburban trains could abide by the rapid transit system's short station dwell times and maintain joint schedules on the shared trackage. Dwell times at stations are a major concern of scheduling trains on short headways.
- Cars are equipped with end doors for evacuation in subways and tunnels. Many subway car end doors hinge outward and down, forming steps. This feature ruled out the through operation of interurban streamliners with tapered or rounded car ends (although newer models have been designed with disguised end doors). (An American example from the past is instructive: When the Lehigh Valley Transit Company (LVT) put modern second-hand high-speed cars from Ohio and Indiana interurban lines into use on its Liberty Bell Limited run, which used the third-rail-electrified tracks of the Philadelphia & Western Railway (P&W) to reach Philadelphia, P&W required LVT to install end doors in the rear of the cars for emergency evacuation. Although no subway was involved, P&W's long viaduct over the valley of the Schuylkill River had a catwalk on only one side; passengers exiting a side door on the blind side would have dropped directly into the River. Accordingly, it was necessary to move the emergency doors on LVT's second-hand interurbans from the sides to the rear ends.)
- The extensive use of diesel railbuses has been introduced as a key means of introducing joint use of track and/or reciprocal running. In the Karlsruhe, Germany, metropolitan area, after permitting the operation of urban dual-voltage light-rail vehicles on the Deutsche Bahn AG (DBAG) tracks, the host DBAG bought a fleet of its own lower-

operating-cost LRVs to replace some of its locomotive-hauled suburban trains. Similarly, after the railbuses proved their reliability on new Japanese Third-Sector railways, Japan Rail became the owner/operator of the largest fleet of railbuses on its own services. Under these businesses circumstances, issues of rolling stock compatibility become moot for the operator as long as their decisions fit within a flexible regulatory standard.

- Diesel railcars run beneath catenary, even in one of Nagoya's downtown subways.

What appears *not* to have become an issue in Japan is incompatible crashworthiness of rail transit and railroad rolling stock. Over time, as life-expired rolling stock is replaced, the rolling stock of the partners in joint use becomes similar or identical – thereby reducing or overcoming any safety or risk concerns. Rather than rolling stock evolving to a crashworthiness or some other national standard, joint use partners evolve their car designs toward uniformity and compatibility with the unique infrastructure and market that they share. The Japanese reliance on employee discipline and in sophisticated signal/train control systems is applied to crash avoidance. As an example of Japanese practitioner attitudes, the use of anti-climbers is not prevalent on newer rolling stock. The impact-vulnerable couplers are expected to serve an attenuation and override function. No other explanation is offered by the Japanese joint-use carriers surveyed by this research team.

New Japan Rail railbuses are compatible with their larger brethren DMUs and often operate multiple-unit with them, even with their different buffing and design strengths. Railbuses on rural lines that run on Japan Rail rails to reach major cities are equipped with conventional railroad-type knuckle couplers. The Abukuma Railway interurbans are equipped with the same

multiple-unit coupler as Japan Rail-East's fleet of EMUs. The railbuses of the Kita-Kinki Tango Railway are equipped with the same multiple-unit couplers as the high-speed diesel trainsets operated non-stop over this Third-Sector railway's tracks by Japan Rail-West. There are places where incompatible rolling stock comes nose-to-nose, such as the end of catenary on the Aizu Railway, where Yagan Railway electric interurbans with multiple-unit couplers meet Aizu's railbuses with knuckle couplers. Ordinarily, the two railways trade passengers at the rural end-of-wire Aizu-kogen station, by arriving and departing from the different sides of an island platform. However, although the interurbans cannot venture onto the sanscatenary diesel section, the railbuses can and do run under the catenary in the interurban's territory.

8.4.5 Combined Features

- To bring Nagoya Railway (Nagoya Tetsudo) suburban light-rail vehicles into downtown Gifu on one of the company's interurban line's private right-of-way instead of the slower street railway, it was necessary to purchase dual-voltage rolling stock capable of operating on two catenary contact voltages: the 600vDC of the suburban trolley line and the 1,500vDC of the interurban railway. It was also necessary to equip these cars with folding steps so they can load passengers from the trolley line's low platforms and from the interurban's high platforms.
- In another through-running instance, Nagoya Railway light-rail vehicles are equipped with both folding steps and retractable gap fillers in order to run on an urban street railway line and a rural interurban line with high platforms.

Hiroshima Electric Railway solved this same problem by rebuilding each suburban station with a high section and a low section connected by stairs.

8.4.6 Unusual Results

Ordinarily, reciprocal running depends upon compatible infrastructure and rolling stock. But implementation throughout Japan has resulted in some unusually diverse features. The Tokyo rapid transit network alone contains an unusual variety of features. Represented are:

- three track gages: 1435mm (4'8½"), 1372mm (4'6"), and 1067mm (3'6");
- two electrification contact voltages: 600Vdc and 1,500Vdc;
- three means of power distribution to trains: track-level third rail, overhead third-rail (on Eidan underground), and overhead catenary; and
- four car widths ranging from 2600mm (8'6.4") to 2865mm (9'4.9").

One observed result of widespread joint use of track/reciprocal running in Japan's larger urban regions is diminishing numbers of distinctive designs, sizes, and shapes of commuter/suburban-rail, rapid transit, and interurban trains. In developing more common characteristics for compatible joint operation, the operators of commuter trains and interurbans have tended to favor rapid transit rolling stock characteristics (though not necessarily standards). Except for color schemes, logos, and some leeway in styling, the trains look increasingly similar. Outside the city rapid transit territory, however, shared trackage still carries a broad variety of rolling stock. The interurban companies still run unique streamliners side-by-side with the rapid-transit-like trains, using their original terminals instead of running through the subways, where they are

unwelcome without end doors and other safety modifications. Japan Rail likewise operates unique trains of attractive styling on its own parallel tracks. As might be expected in any evolution of this sort, the city rapid transit trains are taking on a more modern appearance inherited from the more-style-aggressive interurban companies.

While not a commonly regarded attribute of joint running in Japan, selective standardization has evolved on Japanese railways which share facilities and rolling stock.

8.5. CASE STUDY SELECTION

Purpose: "To arrive at the few best and most applicable (to North America) examples of joint use in Japan, compile matrices identifying such factors as: track gauge compatible with freight service; national, private/municipal, or joint ownership; whether modern installation, wholesale rebuilt, or recently outfitted with new rolling stock; electric or diesel propulsion, or in transition; whether urban, rural or intercity; and other pertinent information. ..." A multi-step process is used. This activity was carried out separately for Japan and for the remainder of the Pacific Rim. It proved instructive for the research investigators to inventory and classify these rail operators and it is therefore being appended to this report in Appendices K1a, b, and c.

8.5.1 Japan

Starting with a complete list of all the railways operating in Japan, a process of elimination was followed. It was believed useful to have a relatively few that would represent individually or in combinations the following circumstances or characteristics: electric propulsion, diesel propulsion, a facility in transition (e.g., diesel to electric), light rail transit, interurban (country cousin of LRT), heavy

rapid transit, commuter rail, private railway, Third-Sector railway, urban setting, short-intercity setting, rural setting, and at least one example in each of Japan's major conurbations (Kanto, Kansai, and Nagoya). Brief descriptions for review were prepared for the resulting set of examples, with a goal of reducing the examples to six. Lastly, a modification was made in order to include an example encompassing the operation of rail vehicles in paved city streets.

Following is the final choice of joint use/reciprocal running examples which are described in the next section of this chapter:

Gakunan Railway in the Kanto region (a light rail also operating heavy freight trains under common track ownership and management);

Hankyu Electric Railway in the Kansai region with multiple examples (a diverse enterprise whose interurban trains link two major cities while sharing tracks with rapid transit operators at both ends);

Ise Railway in the Nagoya region (a pre-electrification, third sector railway as a key link with operating reciprocity with Japan Rail);

Nagoya Railway at Gifu (high- and low-platform LRVs and interurbans operating jointly in a variety of track and urban environments including on-street trackage);

Sanriku Railway in the Kamaishi and Miyako urban areas (a rural railbus third sector railway owner/operator having reciprocal running with Japan Rail); and

Tozai Line in the Kanto region (a public rapid transit authority combined with Japan Rail and a public/private suburban railway to extend rapid transit quickly and provide CBD distribution through reciprocal running).

8.5.2 Pacific Rim Outside Japan

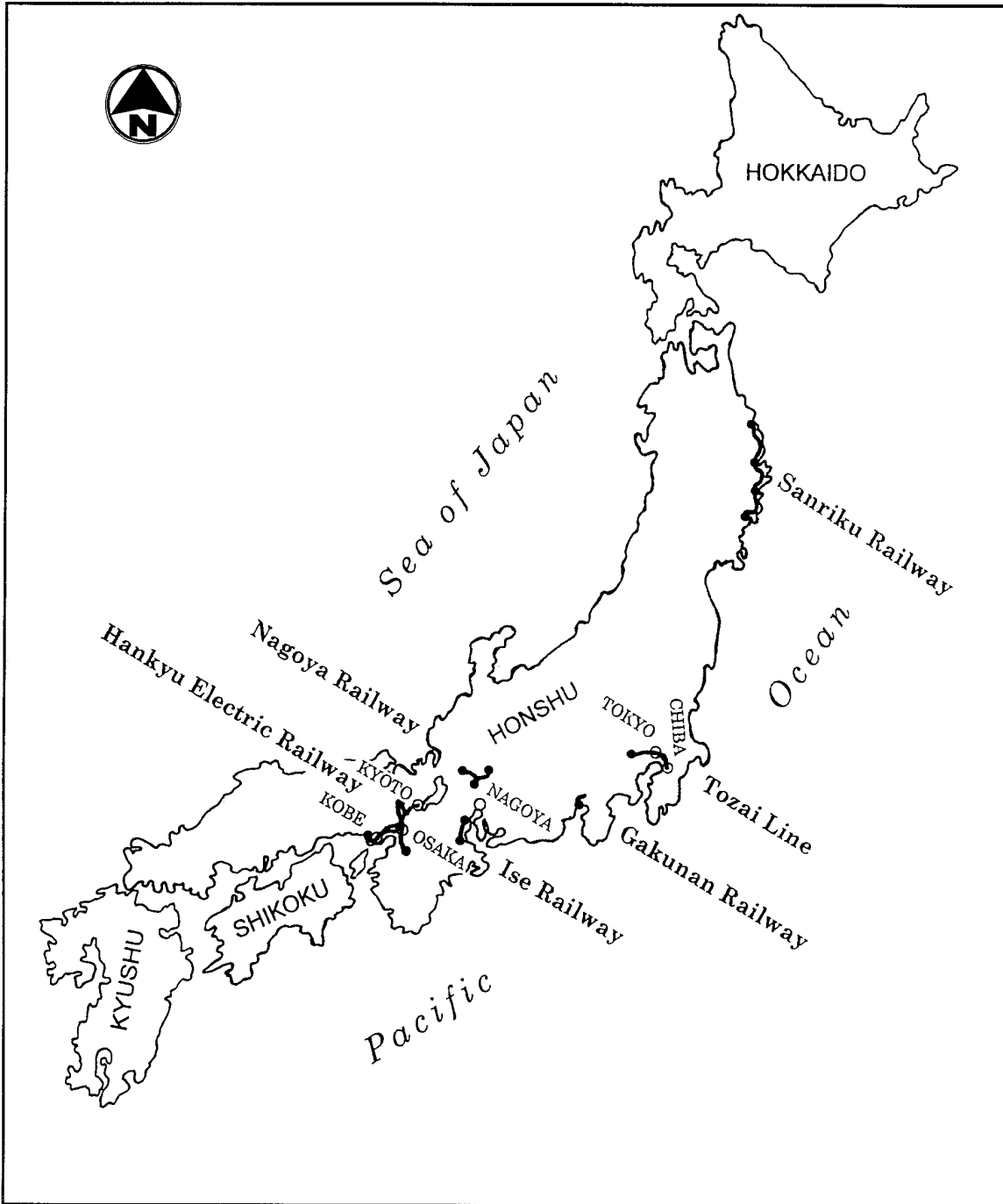
This research scope was extended into the principal cities of eastern Russia, South and North Korea, eastern China (including Hong Kong and New Territories), Vietnam, Cambodia, Laos, Thailand, Malaysia, Singapore, Indonesia, T'ai-wan, The Philippines, and the Pacific islands. Thirty-four cities were found to have been constructing or planning urban rail or other fixed-guideway systems. Appendix K-c included with this chapter shows this starting list. Initial screening reduced the 34 down to 18 places that were examined for any indication of trackage rights, joint use of track, or reciprocal running. Examination revealed that only two places had true joint use/reciprocal running examples, but that seven other places have features worth brief mention: Anshan+Liaoyang (China), Djakarta (Indonesia), Hanoi (Vietnam), Kuala Lumpur (Malaysia), Shenyang+ Fushun (China), T'ai-pei (T'ai-wan), and Wuhan (China).

Following is the final choice of joint use/reciprocal running examples which are described in the "Other Pacific Rim Examples" section of this chapter:

Hong Kong and New Territories (Victoria and Kowloon), China

Seoul and Inch'ön, South Korea

Japan shared Track Case Studies - Figure 8-1



JAPAN - SHARED TRACK CASE STUDIES
Locations of Selected Examples of Joint Use of Track