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The Development Effects of High-Speed Rail Stations and Implications for California

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PREFACE

This is one of a series of reports now being published as the output of IURD's study of the potential for a high-speed passenger train service in California. The present series includes twelve studies. This is the tenth of twelve studies, nine of which have already been published.

We gratefully acknowledge the support provided by the United States Department of Transportation and the California Department of Transportation [CALTRANS] through the University of California Transportation Center. Of course, any errors of fact or interpretation should be assigned to us and not to our sponsors.

PETER HALL
Principal Investigator

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Without the guidance and support of many people, this paper would not have been possible. I would especially like to thank Peter Hall, who enabled me to grow as a student and researcher under his tutelage. He has also assisted me with trips abroad to gather information for this study and others, to experience first-hand European planning, and to maintain a semblance of contact with my wife in Germany during the last two years; such guidance and assistance simply cannot be repaid. I would like to thank David Dowall for his reminders that the market is the ultimate determinate to development. I would also like to thank Steve Zimrick of the California Department of Transportation for his interest in this study and for accepting the many modifications which have occurred along the way, and all of the staff and students at DCRP and IURD for their help and support, especially Kaye Bock and Martha Conway. Finally, I'd like to thank Dan Leavitt and Joel Tranter for their contributions in reviewing and editing this paper.

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SUMMARY

High-speed rail is the most visible form of new technology accompanying and enhancing the transformation to an information-based economy, and is likely to have the greatest spatial development effects of any of these technologies. This report studies the development effects of high-speed rail stations on behalf of the California Department of Transportation (Caltrans), which is currently considering the use of high-speed rail in California.

Since high-speed rail is a relatively new technology and is in use in only a few countries, the development effects of high-speed rail stations are somewhat difficult to discern and categorize. Nonetheless, a review of the literature on its development effects in Japan, France, and Germany, and observation of stations in the latter two countries, reveals significant development effects at the regional, urban, and station levels. These include changes to the following: population and employment growth rates; ridership; business behavior; real estate values and activity; business and employment location; and residential location. A review of related rail systems, heavy and commuter rail, reveals similar effects and opportunities for value capture.

The development effects of high-speed rail stations are most clearly associated with a strong regional economy and good links with other transportation modes, especially rail links to the local city center and public sector support of development. The presence of these factors can help provide the formation of significant development activity around stations catering to the information-exchange sector, such as offices and hotels, the stimulation of retail activities in the area, and increases in overall land value of approximately 20 percent. At the regional and urban levels, concentrations of information-exchange sector employment and centers of higher education are associated with above-average employment and population growth rates, as well as access to high-speed rail.

In California, high-speed rail would reinforce existing population and employment patterns and future growth trends. In order to fully exploit station development opportunities and ensure ridership, the agency responsible for developing a high-speed rail system in California must take an active role in station area development and coordinate its activities with local transportation agencies.

1. INTRODUCTION

Context

High-speed rail is the most visible form of new technology accompanying the transformation to an information-based economy, and is likely to have the greatest spatial development effects of any technology. Although the use of new technologies may reinforce existing urban cores, they will nevertheless also have wide-spread effects at the local level.

As opposed to fax machines or electronic mail networks, which are ubiquitous and difficult to measure, high-speed rail provides clear evidence of the effect of new technologies at the local level. This effect can most easily be measured in terms of ridership and the development that occurs around high-speed rail stations. Closer analysis can reveal the effect of high-speed rail on population and employment, business behavior, real estate values, and business and residential location, as well as revealing possibilities for value capture. Such analysis can also reveal those planning strategies necessary to influence the effects of high-speed and value capture efforts.

The California Department of Transportation is currently examining the possible use of high-speed rail in California, and the state legislature may authorize substantial funds for preliminary studies and engineering. This paper addresses those topics to be investigated in the preliminary studies concerning the development effects of high-speed rail and the possibilities for value capture. In doing so, it also identifies planning strategies that must be pursued in order to take advantage of development effects.

Questions

This paper addresses the following sets of questions:

1. What are the development effects of high-speed rail? What conditions are necessary for those effects? Are value increases created and can they be captured?
2. What development effects are expected with the introduction of high-speed rail in California? What can be done to control or take advantage of them?

The focus of this paper is on the development effects of a high-speed rail system at the regional, urban, and station levels, with emphasis on the last. The primary effects analyzed are changes in the following: business behavior; real estate values; business and employment location; and residential location. Other related effects of interest are changes in ridership, population and employment growth, overall economic activity, and any public sector activity that affects development.

Methodology

The first set of questions is answered through a combination of literature review and case studies. The focus here is on the Japanese Shinkansen, French TGV, and German ICE. The

second set is answered by extrapolating past experience to the situation in California, given certain high-speed rail system characteristics and economic conditions.

Limitations

To date, little attention has been paid to the development effects of high-speed rail. This is largely due to the relative youth of high-speed rail systems, the long time period required before development effects are discernible, the difficulty in directly attributing these effects to high-speed rail, and the apparent multitude of factors influencing development outcomes. As such, there is only a limited amount of literature on the topic, and what does exist is not particularly well-organized or easily comparable.

If high-speed rail is defined as those systems operating daily at speeds of 150 mph (240 kmh) or greater, there are currently five high-speed rail systems: the Japanese Shinkansen (SKS), the French Train à Grande Vitesse (TGV), the German InterCity Express (ICE), the Italian ETR-450, and the Swedish X-2000. Because of the limited available information on development effects, only the first three are analyzed here.

The two limitations noted above indicate that this topic is ripe for in-depth, comprehensive, and comparable research. This paper merely sketches an outline of the kind of research that should be pursued in the future on one of the most dynamic influences on development in the 20th century.

2. JAPAN AND THE SHINKANSEN

Shinkansen System

This section reviews the characteristics of the Shinkansen system, its development history, and its effects at the national level. It sets the stage for the more in-depth regional, urban, and station level analysis that appears in subsequent sections.

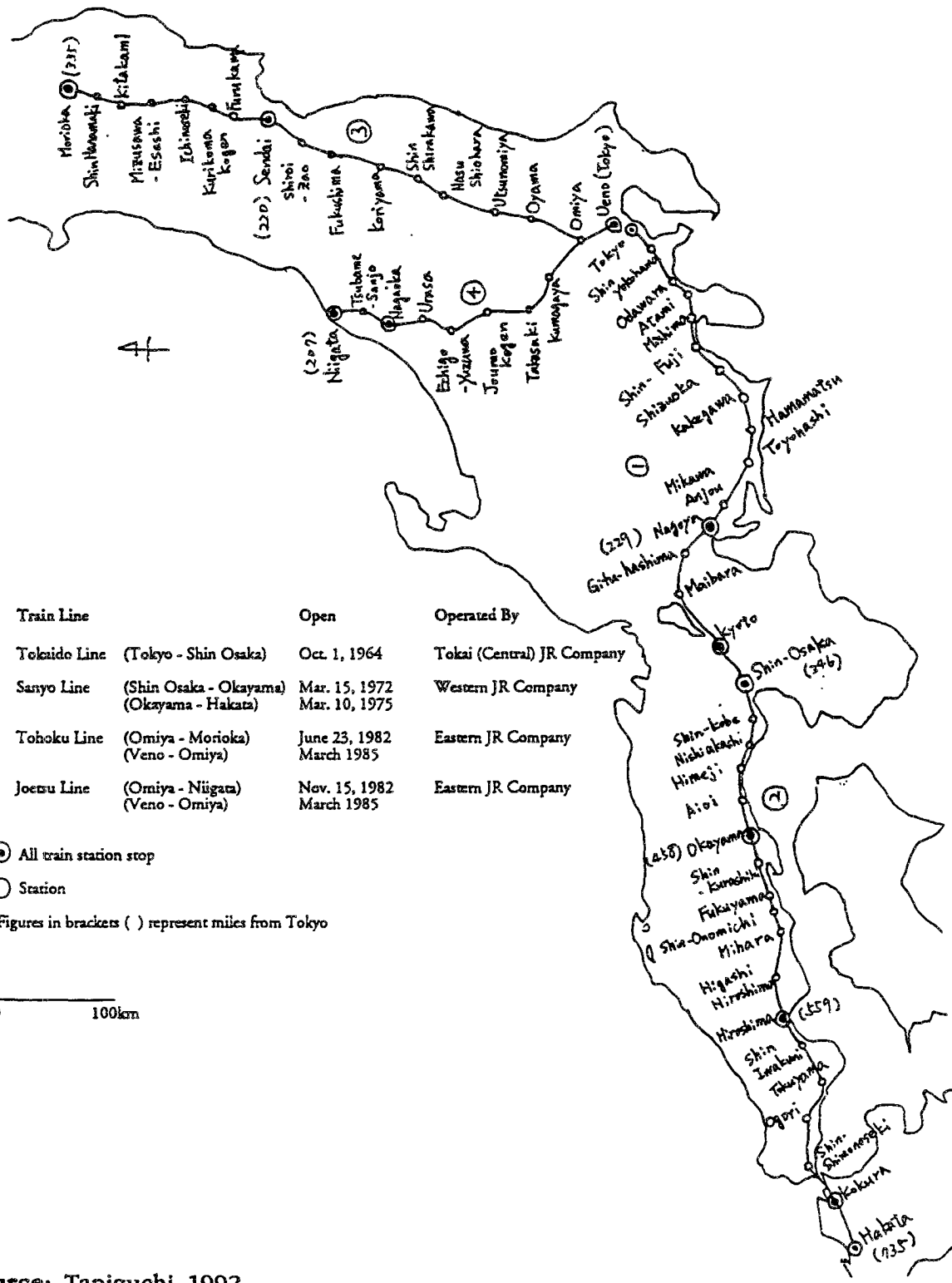
Characteristics

The Japanese Shinkansen (SKS) is the world's longest-running high-speed rail system. The first line, the Tokaido Line, opened in 1964 between Tokyo and Osaka (Figure 2.1). Since then, three other lines have opened: the Sanyo Line (Osaka-Hakata), the Tohoku Line (Omiya-Morioka), and the Joetsu Line (Omiya-Niiigata). The total Shinkansen network is currently more than 1,100 miles (1,800 km) in length and connects 56 stations, but extensions to the system are under consideration.

The Shinkansen network is served by two types of train: Kodama Express trains, which stop at every station; and Hikari Super Express trains, which stop at selected stations. Reaching speeds of up to 170 mph (275 kmh) on advanced steel-wheel-on-rail technology (Taniguchi, 1992:

Figure 2-1

Shinkansen Network



Source: Taniguchi, 1992.

2-4, 11, 18-21), and operating at minimum four-minute headways, as many as 290 Shinkansen trains may run per day on the Tokaido line alone. In addition, the Shinkansen (as of 1979) is supported by a conventional rail network 12,600 miles (21,000 km) long, with 28,000 trains per day (Nishida, 1979: 13).

Background

With an area of only 145,800 sq mi (377,800 sq km) and a population of almost 123 million, Japan is one of the most densely populated countries in the world (Fischer Weltalmanach, 1990: 354). The region from Tokyo to Kobe, commonly called the Tokaido region, which contains only 16 percent of Japan's land area, is the most important region in the country, for several reasons: it contains 34 percent of the national population; it has seven of the ten cities with populations of one million or more; it produces 60 percent of the national economic output; it carried 24 percent of national passenger and 23 percent of national freight rail traffic; and its annual passenger and freight rail growth rates average 1 percent higher than the national average of 6.1 percent and 4.1 percent, respectively (Nishida, 1979: 14).

By 1952, the conventional rail line between Tokyo and Kobe (the Tokaido Line) was approaching capacity. In 1956, a commission was established to determine how to expand capacity on the line, and two years later the decision was made to build the Shinkansen (literally "new trunk line") Tokaido Line, using standard gauge instead of the traditional Japanese narrow gauge. Because of the 122 stations and 1,100 at-grade crossings on the existing line and the inability of the existing line to handle the higher speeds of the Shinkansen (120 mph/200 kph vs. 95/160), a new alignment was chosen (ibid.: 16-17). In 1964, only six years later, the Tokaido Shinkansen began operations.

The speed with which the new line was constructed exemplified the strength of Japanese national planning as outlined in the Comprehensive National Land Development Act and the New Long-Range Economic Plan. The former was created in 1950 to coordinate land planning, provide adequate infrastructure, and improve social welfare, while the latter was implemented in 1957 to place emphasis on the construction of transportation and industrial infrastructure (Miyasawa, 1979: 262-265). Both provided powerful national economic and planning powers at the national level and were influential in the construction of the Shinkansen Tokaido Line.

The two plans, like the plans which followed them, were particularly concerned about the increasing concentration of population and economic activity in large metropolitan areas, which had created substantial disparities between those areas and more isolated areas. Although this concentration had substantial economic advantages, it created an increasingly stressful and polluted urban environment. However, as the post-World War II economic recovery has subsided, as the national economy and personal incomes have grown, and as economic concerns have been replaced

by quality-of-life concerns (ibid.: 268-272), such national planning powers have been scaled back. One indication of this phenomenon is the resistance to new Shinkansen lines and complaints about noise on existing lines (Taniguchi, 1992: 18; Kamada, 1979: 55).

Macro-Effects

The Shinkansen was designed to supplement existing intercity transportation modes, particularly from other rail lines and the airlines, and to reduce the time required to travel between cities along its route. By those standards, it has been very successful. The first Shinkansen, traveling at a maximum speed of 125 mph (200 kmh), reduced the travel time between Tokyo and Osaka to four hours, saving 2½ hours over the previous best time; today, with trains traveling at a maximum speed of 170 mph (275 kmh), the trip takes less than 3 hours (Amano et al., 1991: 40; Taniguchi, 1992: 5). In addition, from 1965 to 1989, annual ridership increased from 31 million to 236 million, and annual passenger kilometers increased from 11 million to 66 million (Taniguchi, 1992: 4). Finally, in the first 11 years of operation, the Shinkansen was estimated to have saved 2,246 million hours, the equivalent of one year of standard working time for 1.22 million people (Sanuki, 1979: 234).

On the Sanyo Line (Osaka-Hakata), actual passenger traffic has exceeded estimates by 20 percent, with 23 percent diverted from airlines, 55 percent from other rail lines, and 6 percent induced (Okabe, 1979: 110-112). The Shinkansen has proven to be particularly effective in competition with air at distances of up to 425 miles (700 km) because of its more frequent service, lower cost, easier station access, greater reliability, and increased safety (ibid.: 111-114; Sanuki, 1979: 235-237; Taniguchi, 1992: 15). The majority of Shinkansen passengers travel 90-100 miles (150-160 km) per trip, though trips in the 45-60 miles (70-100 km) range are becoming more common (Sanuki, 1979: 230).

According to some students of the system, the Shinkansen has also had an image effect, further strengthening the image of Japan as a nation of precision and reliability, not just one of cherry blossoms, Mt. Fuji, and temples (Sanuki, 1979: 231).

Urban and Regional Development

The Shinkansen has had strong effects on Japanese regional and urban structure and functions, although these effects have not always been consistent. Considerable attention has been paid to the Shinkansen's effect on the dispersion or concentration of population and economic activities. Planning policy has been to disperse activities out of the urban cores, especially the Tokaido core (Tokyo-Nagoya-Osaka), although it is not clear that the Shinkansen has helped bring about this goal.

Population

Nakamura and Ueda (1989) conducted a detailed analysis of the effect of the Joetsu and Tohoku Shinkansen Lines on regional population between 1975 and 1985. Their analysis compared population growth in 10 prefectures, six with one or more Shinkansen stations and four without, with the national average (Figure 2.2). They categorized the prefectures on the basis of those with an expressway and those without. The effect of an expressway was largely inconclusive at this level: only three of the six prefectures with a Shinkansen station had higher population growth than the national average, although none of the prefectures without the Shinkansen had growth rates higher than the national average.

In order to improve the analysis, the researchers broke down the ten prefectures into 735 municipalities. At this level, they found significant population increases in municipalities with at least one of the following characteristics: proximity to the prefecture capital or other regional centers; location of a Shinkansen station within the municipality or a neighboring municipality; and location of an expressway within the municipality or a neighboring municipality (Nakamura and Ueda, 1989: 96).

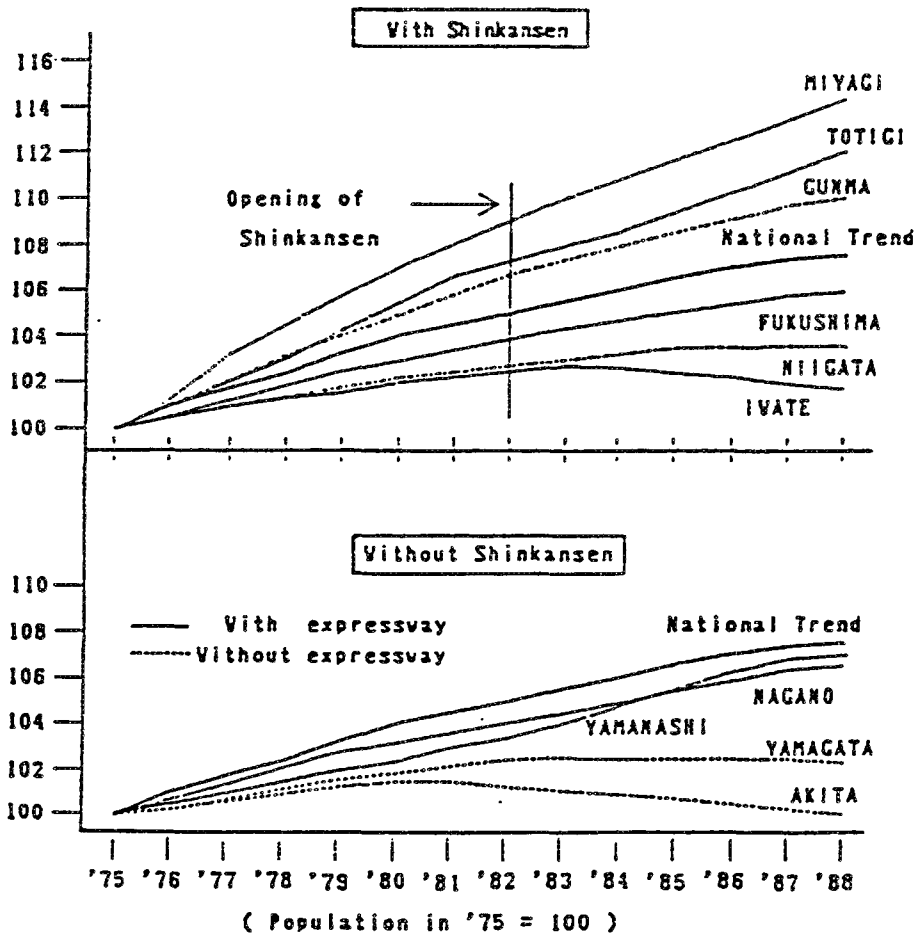
Nakamura and Ueda (1989) conducted further analysis on the municipalities by aggregating them into 104 "daily life regions," which were defined as the economic and daily life activity territories of households within the municipalities (*ibid.*: 97) (Table 2.1). There are a few interesting results. For instance, of those regions with increased population, slightly more had the Shinkansen, and of those regions that had a Shinkansen station, more increased in population (19) than decreased (14). Also, there appears to be a high degree of correlation between the effect of the Shinkansen station and the existence of an expressway, and it is interesting to note that in those regions with an expressway but no station, there were more population decreases (16) than increases (13), while in those regions with both a station and an expressway, there were more increases (17) than decreases (10).

Finally, the data suggest that the Shinkansen station was the primary cause of population increases, with the presence of an expressway enhancing the effect. However, there are few cases to examine, so the relationship seems tenuous, and the results may have been influenced by the manner in which the municipalities were aggregated into regions. Ultimately, then, it is unclear if the Shinkansen station was leading growth or growth was leading the Shinkansen.

After determining the existence of a relationship between the Shinkansen, economic development, and population, Nakamura and Ueda (1989) went on to conduct discriminant analysis on the 33 regions with Shinkansen stations in an attempt to explain the relationship between population change and Shinkansen-related activities. This analysis revealed that the possibility of growth caused by the Shinkansen could be predicted for a region with 90 percent accuracy. The analysis concluded that there were three principal conditions needed for growth in a region: a high incidence of "infor-

Figure 2-2

Population Changes at the Prefecture Level



Source: Nakamura and Ueda, 1989.

Table 2.1

Number of Regions with Population Increase/Decrease, 1980-85

	Population	
	<u>Increase</u>	<u>Decrease</u>
<u>With Shinkansen Station</u>		
With Expressway	17	10
Without Expressway	<u>2</u>	<u>4</u>
Total	19	14
 <u>Without Shinkansen Station</u>		
With Expressway	13	16
Without Expressway	<u>3</u>	<u>39</u>
Total	16	55

Source: Nakamura and Ueda, 1989.

mation exchange industries" (business services, banking services, real estate); sufficient opportunities for higher education (universities); and good accessibility to a Shinkansen station. It also concluded that there were conditions that could limit regional growth, most notably a large share of commodity-producing industries (manufacturing), and a large population of citizens over the age of 65 (*ibid.*: 100-101).

Another pair of researchers, Amano and Nakagawa (1990), examined the impact of the Tokaido Shinkansen on a number of cities along the route. They compared two cities with a Shinkansen station to four neighboring cities without a Shinkansen station with regard to population growth between 1960 and 1985 (Table 2.2). It must be noted that the sample size is quite small and that the cities are not well matched in terms of size. As a result of the latter, the higher average annual population growth rates of cities with Shinkansen stations (1.7 percent) versus neighboring cities (1.3 percent) may simply be a function of the former's smaller base size. This is supported by the ratio of 1:5.3 new residents between the city types. Data on densities in the two city types and information on general economic trends in the cities would have been more revealing, but they were not included.

Brotchie (1991) includes an analysis of population growth in cities, also on the Tokaido Shinkansen line, done by Hirota (1984) (Table 2.3). This analysis indicates that during the ten years after the introduction of the Tokaido Shinkansen, cities with a Shinkansen station had population growth rates 22 percent higher than cities without a Shinkansen station. However, it remains to be seen if the station actually caused growth or simply attracted it from elsewhere.

Table 2.2

**Population of Cities with Stations
and Neighboring Cities with Stations**

<u>Shinkansen</u>	<u>City</u>	<u>Year</u>		<u>Change</u>		
		<u>1960</u>	<u>1985</u>	<u>Absolute</u>	<u>Percent</u>	<u>Rate</u>
Station	1	41,438	59,760	18,322	44.2	1.5%
	2	<u>62,966</u>	<u>99,600</u>	<u>36,634</u>	<u>58.2</u>	<u>1.8%</u>
Total		104,404	159,360	54,956	52.6	1.7%
Neighboring	1	102,478	145,910	43,432	42.4	1.4%
	2	142,609	210,490	67,881	47.6	1.6%
	3	182,984	257,388	74,404	40.7	1.4%
	4	<u>304,492</u>	<u>411,743</u>	<u>107,251</u>	<u>35.2</u>	<u>1.2%</u>
Total		732,563	1,025,531	292,968	40.0	1.3%

Source: Amano and Nakagawa, 1990.

Table 2.3

**Change of Population and Economic Indices
in Cities on Tokaido Line**

<u>Index</u>	<u>Annual Increase</u> ⁽¹⁾					
	<u>Pre-Shinkansen</u>			<u>Post-Shinkansen</u>		
	<u>(A1)</u> <u>With</u> <u>Station</u>	<u>(B1)</u> <u>Without</u> <u>Station</u>	<u>(C1)</u> <u>A1/B1</u>	<u>(A2)</u> <u>With</u> <u>Station</u>	<u>(B2)</u> <u>Without</u> <u>Station</u>	<u>(C2)</u> <u>A2/B2</u>
Population	2.64	3.39	0.78	1.88	1.55	1.22
Retail	10.10	13.50	0.75	9.96	8.58	1.16
Wholesale	12.90	20.80	0.62	11.63	8.70	1.34
Industrial ⁽²⁾	13.70	14.20	0.97	9.48	7.81	1.21
Construction ⁽³⁾	13.80	14.90	0.93	8.01	6.37	1.26

Notes (1) Annual increase is the average of the ten years preceding and following the introduction of the Shinkansen (1964). The period following introduction is lower overall because of national economic stagnation.

(2) Industrial production in area.

(3) Construction in area.

Source: Brotchie, 1991 (based on Hirota, 1984).

Employment and Economic Activity

In a study of the Tokaido Shinkansen Line, Hirota (1984) found that the growth rates in retail, industrial, construction, and wholesale sectors were 16-34 percent higher in cities with a Shinkansen station than in cities without a Shinkansen station (Table 2.3). At a more general level, Amano and Nakagawa (1990) noticed similar results with regard to employment: average annual employment growth rates were 1.8 percent for cities with Shinkansen stations and 1.3 percent for neighboring cities without stations, although the ratio of absolute number of new employees was 1:7.2 (Table 2.4).

Table 2.4

**Employment of Cities with Stations
and Neighboring Cities with Stations**

<u>Shinkansen</u>	<u>City</u>	<u>Year</u>		<u>Change</u>		
		<u>1960</u>	<u>1985</u>	<u>Absolute</u>	<u>Percent</u>	<u>Rate</u>
Station	1	21,178	25,873	4,695	22.2	0.8%
	2	26,389	48,404	22,015	83.4	2.4%
	Total	<u>47,457</u>	<u>74,277</u>	<u>26,710</u>	<u>56.2</u>	<u>1.8%</u>
Neighboring	1	55,676	78,166	22,490	40.4	1.4%
	2	68,541	120,566	52,025	75.9	2.3%
	3	107,562	111,121	3,359	3.3	0.1%
	4	<u>150,924</u>	<u>223,675</u>	<u>72,751</u>	<u>48.2</u>	<u>1.6%</u>
	Total	382,703	533,528	150,825	39.4	1.3%

Source: Amano and Nakagawa, 1990.

According to Brotchie (1991), Hirota (1984) reported strong growth in the food and accommodation sectors along the Sanyo Shinkansen Line. For example, in Hakata, the terminus of the Sanyo Line, the number of hotels and rooms doubled (from 20 and 2,060 to 40 and 5,320 respectively) between 1972 and 1974, the year before the Sanyo Line reached Hakata. Similarly, in Okayama, midway on the Sanyo line, the number of hotel guests increased from 170,000 in 1971 to 236,000 in 1975, when the Shinkansen arrived (Brotchie, 1991: 26). These growth rates were certainly due in large part to the increased tourism in cities with Shinkansen stations: by 1975, when the Sanyo line was completed, all cities with Shinkansen stations along it had seen large increases in the number of tourists from other prefectures. For example, Fukuoka City, which shares a station with Hakata, had 7.5 million visitors, an increase of 93.5 percent, and Hiroshima City had 7.2 million visitors, an increase of 52.3 percent.

However, some cities along the line without a Shinkansen station saw a decline in the number of visitors, notably Onomuchi City, which experienced a decline of 9.0 percent. In addition, the number of visitors staying overnight declined in some cities with Shinkansen stations, as tourists decided to make only day trips (Okabe, 1979 116-118). It should also be noted that effects similar to these were occurring along the Tokaido Line (Kamada, 1979: 47). In sum, what all of these figures seem to indicate is that although the Shinkansen might have directed existing tourist activities, it did not necessarily induce new tourist activities.

Another indication that the Shinkansen might not have been effective in directing activities was the trend in retail and wholesale activity. Although there were increases in retail and wholesale activity in cities with a Shinkansen station (Brotchie, 1991; Hirota, 1984; Nakamura and Ueda, 1989; and Okabe, 1979), in only two cities with stations was there a rise in retail sales of more than 10 percent in the year following the 1975 opening of the Sanyo line (Okabe, 1979: 123). Furthermore, growth was concentrated in those shopping centers near the station, to the detriment of other shopping centers in the city (*ibid.*: 125). In addition, wholesale activities became increasingly concentrated in the existing centers (Osaka, Fukuoka City, and Hiroshima City), to the detriment of smaller wholesale centers, particularly those in cities without a Shinkansen station (*ibid.*: 126-128).

After discerning an apparent but tenuous relationship between the presence of a Shinkansen station and population growth along the Joetsu and Tohoku Shinkansen lines, Nakamura and Ueda (1989) analyzed the relationship between the station and economic changes in regions that experienced population growth during the period 1981-85. They noted four effects. First, per capita income growth increased significantly relative to the total average in regions with either a Shinkansen station (2.6 percent), an expressway (6.4 percent), or both (9.5 percent); it decreased (-2.7 percent) in regions with neither (*ibid.*: 99). Second, the number of employees in the retail sector increased relative to the total average in regions with just a station (0.4 percent), just an expressway (1.2 percent), or both (2.8 percent); it declined (-3.6 percent) in regions with neither (*ibid.*: 100). Third, the growth of employees in "information exchange industries" increased significantly more in regions with a Shinkansen station and an expressway (22 percent) than in those with only an expressway (7 percent) (Table 2.5). Fourth, the highest land prices in the commercial area of regions served by the Shinkansen increased 67 percent, while those in regions served by just an expressway increased 42 percent (*ibid.*).

Nakamura and Ueda's work (1989) provides evidence that the Shinkansen, like similar transportation systems, does not cause growth, but allows it to disperse from existing centers, even as it concentrates growth around locations with access to the transportation system. The fact that growth is stronger when both the Shinkansen and an expressway are present is especially convincing. Freeways (expressways) have long been known for allowing population and employment to disperse

Table 2.5

Information Exchange Industries Employment Growth (Percent)
in Regions with Population Increase, 1981-85

	<u>Shinkansen & Expressway (%)</u>	<u>Expressway Only (%)</u>
Business Services (Total)	42	12
Information, Investigation, Advertising Services	125	63
R & D and Higher Education	27	21
Political Institutes	20	11
Other	57	28
Banking Services	27	28
Real Estate Agencies	<u>21</u>	<u>3</u>
 Total	 22	 7

Source: Nakamura and Ueda, 1989.

from existing centers (witness the suburbanization of the United States) and converge around locations with good freeway access (highway interchanges and urban ring roads). The Shinkansen line allowed the growth of population, employment, and economic activities to shift out of existing centers to sub-centers. At the same time, it concentrated this growth and growth indigenous to the sub-center around locations with access to the Shinkansen.

The Shinkansen's apparent ability to cause growth is probably derived from its routing. Since the system was apparently designed to serve regions experiencing or expected to experience growth, a self-fulfilling prophecy developed: growth was dispersed from existing centers to sub-centers, and indigenous growth in the region was attracted to the sub-center by the growth taking place there. Not all growth occurred that way; there was certainly some growth above and beyond that dispersed and attracted from other locations, created by the synergistic economies that form at locations where growth concentrates. However, the relative importance of such growth is uncertain.

Station Development

With the start of operations between Tokyo and Shin-Osaka in 1964, the Tokaido Shinkansen line had 12 stations. Three of these stations were completely new and located on the periphery of the city, and therefore were excellent test cases for the impacts of the Shinkansen. The other stations were located in the traditional center of the city, and were already served by intercity rail and local rail transit services. The following sections review Amano and Nakagawa's 1990 findings of

the effect of the Shinkansen on population and employment, and on development at existing and new stations.

Existing Station Locations

There were no significant development impacts in cities where Tokaido Shinkansen stations were built within existing intercity rail stations (Amano and Nakagawa, 1990: 48). Given the scale of rail operations in Japan, this finding is not surprising. For example, the Osaka station, which is not served directly by the Shinkansen, was at the convergence of the JNR Tokaido line and two other major intercity lines (Osaka loop and Fukuchiyama line), and bordered two municipal rail line stations. More than 2,000 trains arrived and departed each day, carrying 600,000 passengers to and from the station (Goto, 1986). With such high existing levels of service and ridership, the impact of the Shinkansen on development at such train stations was likely to be limited.

In Hamamatsu, Nagoya, and Kyoto, where a Shinkansen station was located in or near the existing city center and attached to an existing station, development was shifted within the city center toward the station (Amano and Nakagawa, 1990: 48). It seems clear in those cities that although development would have occurred without the introduction of a Shinkansen station, the station did affect the location of new development.

New Station Locations

Three new stations were opened with the introduction of the Shinkansen in 1964: Gifu-Hashima, Shin-Yokohama, and Shin-Osaka. The first station was served only by Kodama Shinkansen trains, which stop at every Shinkansen station on the line, while the other two were served by both Kodama and Hikari Shinkansen, which provide express service between major stations. These three stations have provided an excellent opportunity for before-and-after comparisons of development, particularly in light of planning policies toward development and transportation system linkages.

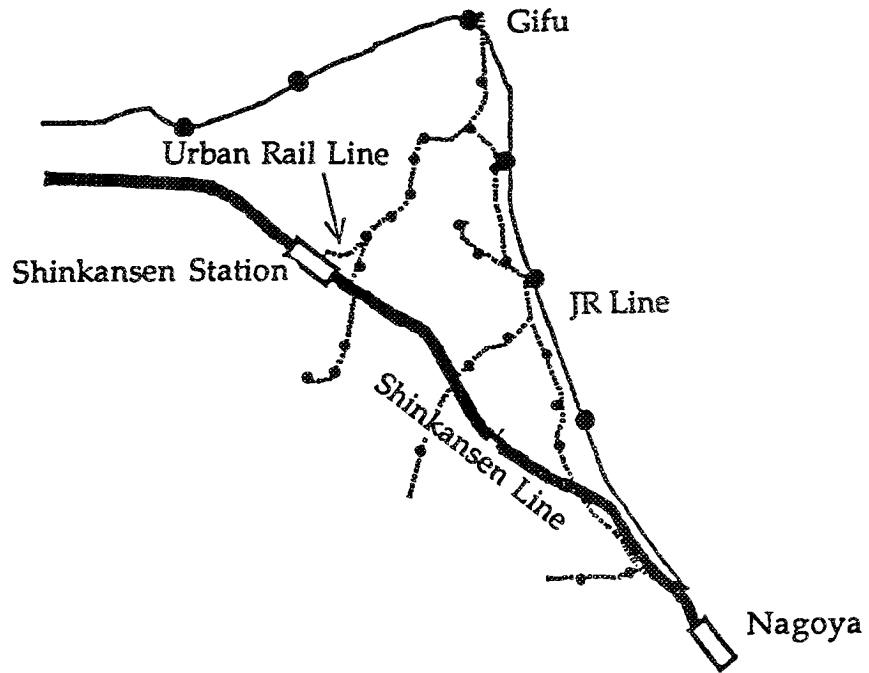
Gifu-Hashima Station

The Gifu-Hashima station, located in a rice paddy about nine miles (15 km) from the center of the City of Gifu, was intended to be a major gateway for intercity travelers entering the city. However, because the trip to the city center takes about 30 minutes by car and the trip by rail requires a stop in Nagoya, which also has a Shinkansen station (Figure 2.3), ridership peaked at just over 8,000 persons per day in 1974 and has dropped down to about 7,000 persons per day since then (ibid.: 55, 57-58).

Despite optimistic predictions, there has been relatively little development at the station since it opened almost 30 years ago (Figure 2.4). There are a number of warehouses, restaurants, entertainment centers, and toll parking lots near the station, but it still seems like a remote location. Two factors appear to be responsible for this impression. First, transportation service to the

Figure 2-3

Gifu-Hashima Shinkansen Station Location

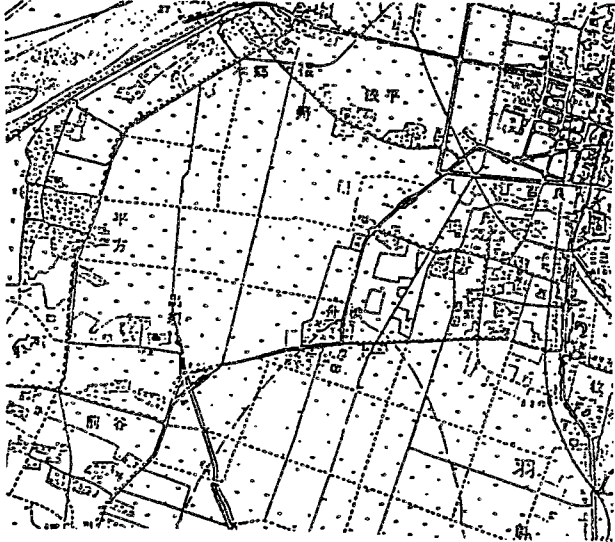


Source: Amano and Nakagawa, 1990.

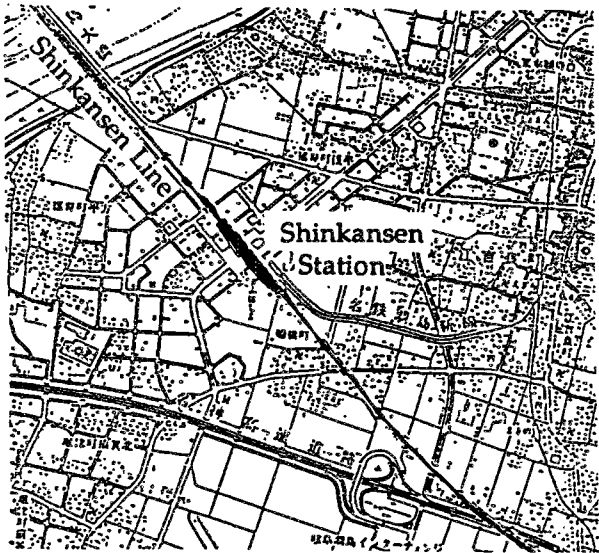
Figure 2-4

Gifu-Hashima Station Development

Prior to Station Construction



Present Situation



Source: Amano and Nakagawa, 1990.

city center has not been improved. The first attempt, a new urban rail line, was not introduced until 1982, ten years after the station opened. The new line has had no effect because the existing service via Nagoya, although longer in distance and time, has higher frequencies (ibid.: 57-60). This problem is reinforced by the fact that both the express Hikari and the local Kodama trains stop at Nagoya, while only the local trains stop at Gifu-Hashima; thus, long-distance Shinkansen travelers can bypass Gifu-Hashima for Nagoya.

The second factor contributing to the sense of isolation at the station is the land speculation that has occurred, apparently discouraging many developers (ibid.: 57-58). One result is that residential commuters are using increasing amounts of the area around the station for parking. All this is occurring even as Hashima, unlike other cities of its size (100,000), gains population and employment and seems to offer the promise of strong development pressures (ibid.: 60). It would appear that poor planning is causing these development pressures to go elsewhere, when they would probably be best served by Gifu-Hashima.

Shin-Yokohama Station

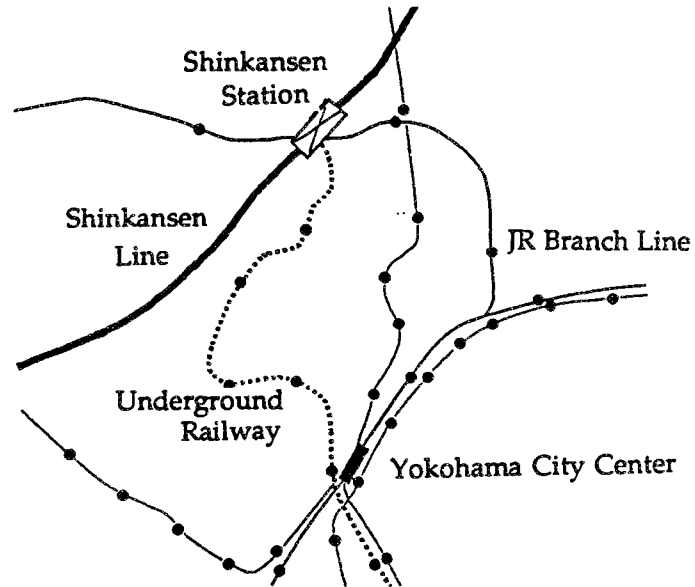
The Shin-Yokohama station is located about four miles (seven km) north of the city center in an area of undeveloped hills, and is connected by a JR branch rail line to the center of Yokohama (Figure 2.5). However, the trip to the city center on the JR line was about 30 minutes because of the low frequency of service and the need for a transfer en route, and after a peak of 15,000 in 1974, ridership only averaged about 10,000 per day for the next decade. Ridership jumped to 27,000 in 1989, however, giving the station the highest ridership increase of any Shinkansen station since the system's introduction in 1964 (ibid.: 50-51, 53).

Three reasons are cited for the jump in ridership. First, an underground municipal railway was built, linking the station to Yokohama's city center and reducing journey times to 12 minutes. The frequency of service on the existing JR Yokohama line was also boosted. These improvements in service made the Shin-Yokohama station one of the main entrance points to the city. Second, some of the express Hikari Shinkansen began to stop at the station, supplementing the local Kodama. By 1990, 48 of the 105 Hikari trains in Japan called on Shin-Yokohama daily (ibid.: 52-53). Finally, heavy development of the area around the entrance of the station led to the formation of a new city center (ibid.: 54).

The role of planning in allowing and encouraging development at high-speed rail stations is illustrated by a comparison of the north and south sides of the station. Both sides were designated for development, but because of resistance from residents on the south side, only the north side has followed through with their plans. As a result, the north side now has a modern road network and numerous new buildings, while the south side remains undeveloped (Figure 2.6). This contrast points to the value of long-range planning before and after the introduction of high-speed rail stations (ibid.: 55).

Figure 2-5

Shin-Yokohama Shinkansen Station Location

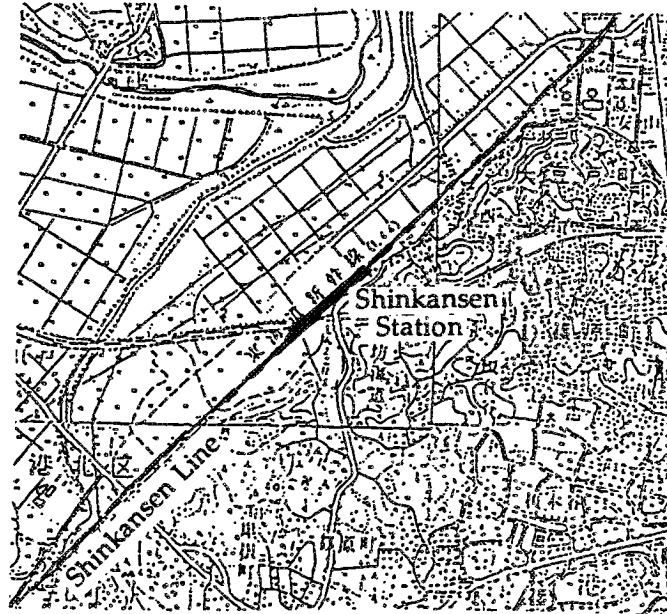


Source: Amano and Nakagawa, 1990.

Figure 2-6

Shin-Yokohama Station Development

Immediately After Station Construction



Present Situation



Source: Amano and Nakagawa, 1990.

Shin-Osaka Station

The Shin-Osaka station is located about 3.5 miles (six km) from the center of Osaka and was linked to it upon the opening of the Shinkansen by a JR line and an underground municipal railway (Figure 2.7). Ridership peaked at over 11,000 per day in 1975 and has since leveled off at just under 10,000 passengers per day (ibid.: 60-62).

Although the station is near Osaka's city center, development around it was initially limited because the area is separated from the city by the River Yodo. In recent years, however, development has been strong around the station, primarily because of several planning strategies (Figure 2.8). First, large-scale development projects were initiated around the station. Second, as mentioned above, excellent transportation linkages to the city center were opened at the same time as the Shinkansen station. Third, a large new town was developed at the terminus of the municipal railway north of the station (ibid.: 62-65).

Summary

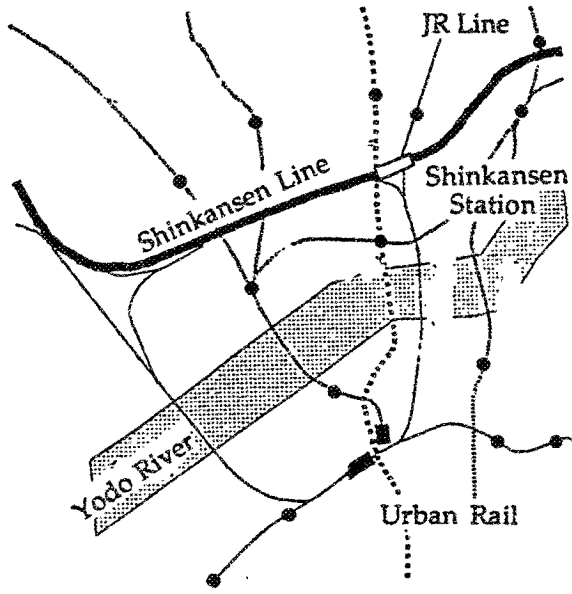
The Shinkansen has had strong development effects in Japan at the regional, urban, and station levels. Regions served by the Shinkansen generally have higher population and employment growth rates than those without direct Shinkansen service. These higher growth rates are positively associated with three factors: a high incidence of "information exchange industries" (business services, banking services, real estate); sufficient opportunities for higher education (universities); and good accessibility to a Shinkansen station. In addition, the combination of an expressway and the Shinkansen had an especially strong effect on growth rates. There are also two factors that seem to limit growth: a large share of commodity producing industries (manufacturing), and a large population of citizens over the age of 65.

However, what remains unclear is the direction of causation: does the Shinkansen cause the increases in growth rates, or is it constructed in regions that are already increasing and thus simply concentrates growth within those regions? The latter explanation seems more likely, although detailed analysis of route planning policies and growth rates would be necessary to provide a definitive answer.

At the urban level, the Shinkansen's correlation with population and employment growth rates increases is clear. Although rates vary between studies, population and employment growth rates were consistently greater in areas with Shinkansen service than in those without. Employment growth and development activity were especially strong in the information exchange sector, as well as the hotel and food service sectors. Although there was also increased growth in the retail and wholesale sectors, there is evidence that these were merely shifts within communities, not general growth. This last observation lends further support to the theory that the Shinkansen has served to shift growth, not induce it.

Figure 2-7

Shin-Osaka Shinkansen Station Location



Source: Amano and Nakagawa, 1990.

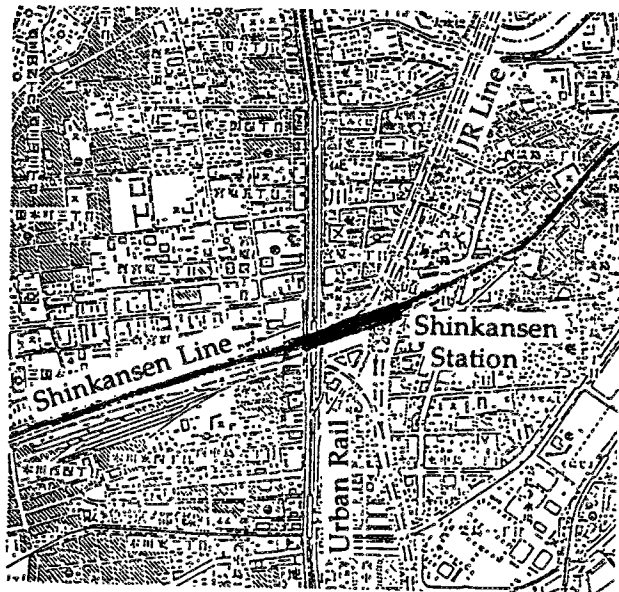
Figure 2-8

Shin-Osaka Station Development

Immediately After Station Construction



Present Situation



Source: Amano and Nakagawa, 1990.

At the station level, development has varied. The expansion of existing stations for Shinkansen service has had little or no effect on development around the station. At the new stations built on the fringes of existing communities, development was found to be highly dependent on the provision of good transportation links to the new station— especially rail transportation from the existing urban center —and on planning policies that encouraged development and resisted speculation.

The only reference to land value increases was made by Nakamura and Ueda (1989), who found that land prices in the commercial areas increased 67 percent when served by the Shinkansen. No information was found on value capture. However, given the scale of Japanese rail operations, value capture is likely to be quite extensive. A review of the development effects of Japanese heavy and commuter rail confirms this supposition.

3. FRANCE AND THE TGV

TGV System

The French Train à Grande Vitesse (TGV) has been in operation in France for more than ten years. There are currently two TGV lines: the TGV Southeast line (Paris-Lyon) and the TGV Atlantic line (Paris-Le Mans/Tours) (Figure 3.1). The network is a mix of high-speed dedicated track and upgraded track, totaling 2,920 miles (4,702 km) in length. On the 436 miles (702 km) of dedicated track, trains run at speeds of up to 186 mph (300 kmh), while on the remainder of the network trains run at a maximum of 136 mph (220 kmh) (Hall et al., 1992: Table 2.1; Streeter, 1992: 24).

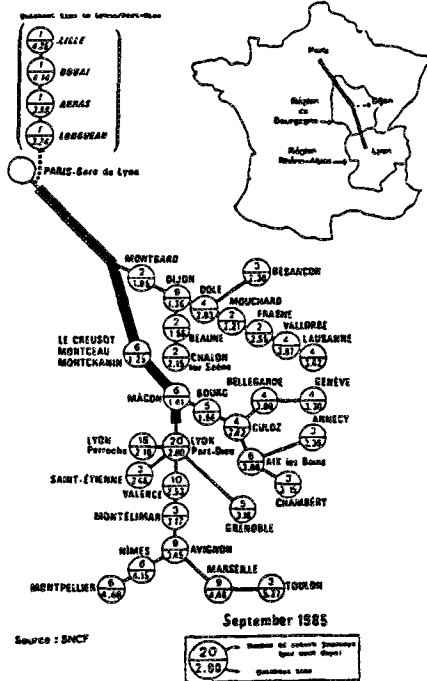
Since the introduction of the TGV, there have been definitive signs of its development effects. Planning, Economic and Development Consultants (Pieda), a British firm retained by British Rail to compare the impacts of four alternative high-speed rail routes linking the Channel Tunnel with London, has conducted an extensive review and analysis of the literature on the development effects of the TGV (Pieda, 1991). Its analysis is based on the following sources: Bernadet, 1988; Bonnafous et al., 1981; Buisson, 1989; Cointel-Pinell and Plassard, 1986; Gac, 1990; Le Monde, 1990; Plassard, 1990, 1989, 1987a, 1987b. Pieda's information is combined with other English- and French-language literature, as well as a site visit to Nantes.

TGV Southeast

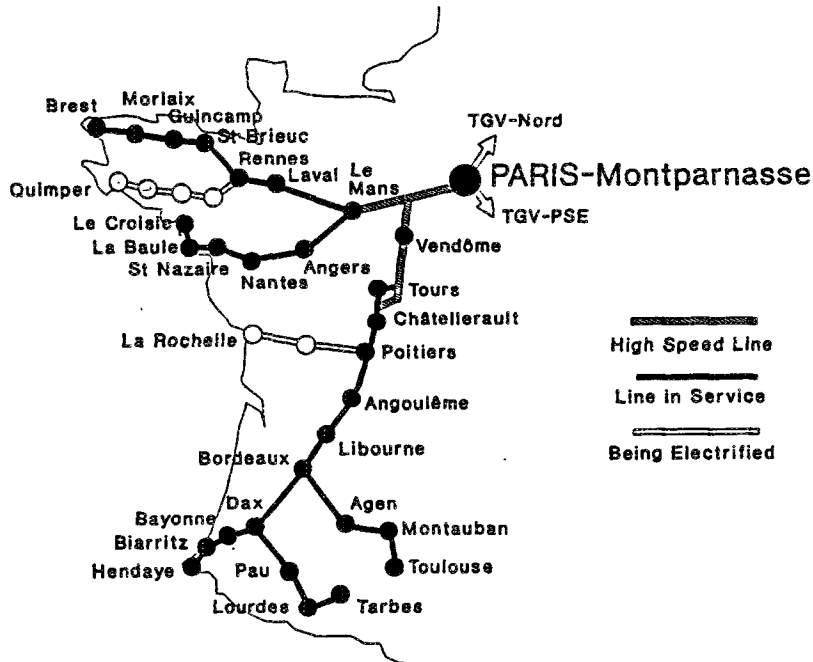
The TGV Southeast (Paris-Lyon) has been in operation since 1981 and currently serves 30 cities with non-stop or one-stop service to Paris (Figure 3.1). The line connects the two strongest economic regions of France, Paris and the Rhone-Alps region, and ridership is very high, with farebox revenues more than covering its costs.

Figure 3-1
TGV Network

TGV Southeast



TGV Atlantic



Source: Bonnafous, 1987; Streeter, 1992.

Since 1979, several agencies have examined the socioeconomic impacts of the TGV Southeast: the Laboratoire d'Economie des Transports (LET); Societe Nationale des Chemins de Fer (SNCF or French National Railways); DATAR (Regional Planning); and the Ministry of Transport (INRETS and OEST). Their focus has been on service industries, centralization, tourism, and business location and development (Pieda, 1991: 15). After a brief review of the first three subjects, this section will conduct a more in-depth analysis of business location and development impacts, with emphasis on several specific examples.

Services, Centralization, and Tourism

The largest increase in ridership after the introduction of high-speed rail services between Paris and Lyon was in business journeys related to the sale or purchase of services. While total business journeys increased 56 percent, those related to the trade of services jumped by 112 percent (Pieda, 1991: 18).

Before the TGV Southeast began service, it was feared that Paris-based service sector companies would expand their operations and displace those based in the Rhone-Alps region (around Lyon). In fact, as Rhone-Alps companies— particularly medium-sized firms— have expanded into the Paris market, the opposite appears to have occurred. In addition, the fear that Lyon-based service companies and head offices would relocate to Paris has also been unsubstantiated. However, as companies attempt to expand into the international market, this fear may eventually be realized (ibid.).

Tourism underwent two contradictory changes: there were fewer overnight stays, but there were also new travel packages for users of the TGV. The former was the result of an increase in the number of same-day return trips, while the latter was a function of increased promotion by areas along the line. Winter tourism apparently was not affected by the TGV (ibid.: 19).

Business Location and Development

Surveys of managers assessing the link between the TGV and the location of businesses were conducted in ten cities in the Rhone-Alps and Burgundy regions. These assessments were conducted only two to three years after the introduction of high-speed rail services and during a regional economic depression, so longer term impacts might be of greater magnitude, particularly given better economic conditions (Pieda, 1991: 19).

The TGV was only one factor considered by businesses in the decision to locate in a town or city, and no business relocated primarily because of TGV service. Other important factors included the profitability of the company, proximity to the market, the complete transportation network (including road and rail links), and public sector assistance (site identification, site provision, and/or facilities assistance).

Only three new stations were built along the TGV Southeast line: Lyon Part-Dieu, Le Creusot, and Macon. Of the three, only Lyon Part-Dieu was the site of significant economic development. The three stations and the reasons for the success or failure of their development are examined in detail below.

Because development in Lyon's traditional downtown is constrained by rivers, Part-Dieu was promoted as part of a standing policy by local authorities (Figure 3.2). As a result, the area around the TGV station is now the most sought-after location for office space in Lyon: it has almost 40 percent of the city's total office space, and in 1990 it had 60 percent of the city's planned office projects. From 1983 to 1990, office space around the TGV station rose from 1,883,000 sq ft (175,000 sq m) to 2,702,000 sq ft (251,000 sq m), a total increase of 43 percent and an annual increase of 5.2 percent. According to local property agents, there are four factors responsible for the strong growth: easy access to and from the station by foot; convenience for customers; a steady flow of businessmen through the district; and high visibility of the firms from the TGV trains (*ibid.*: 21-22).

Based on the previous observations, it seems that the impact of the TGV is limited to a relatively small area of Lyon near the station, and is limited thereof mainly to advanced service firms that require good access to Paris. It also seems that much of the new development is leased to firms that have simply relocated from the traditional downtown, not to newly formed or attracted firms. Moreover, it has been suggested that much of the economic activity has been the result of joint ventures between the public and private sector, in the form of financing for construction and redevelopment (*ibid.*: 21-22). The specifics of such financing is not given in the literature.

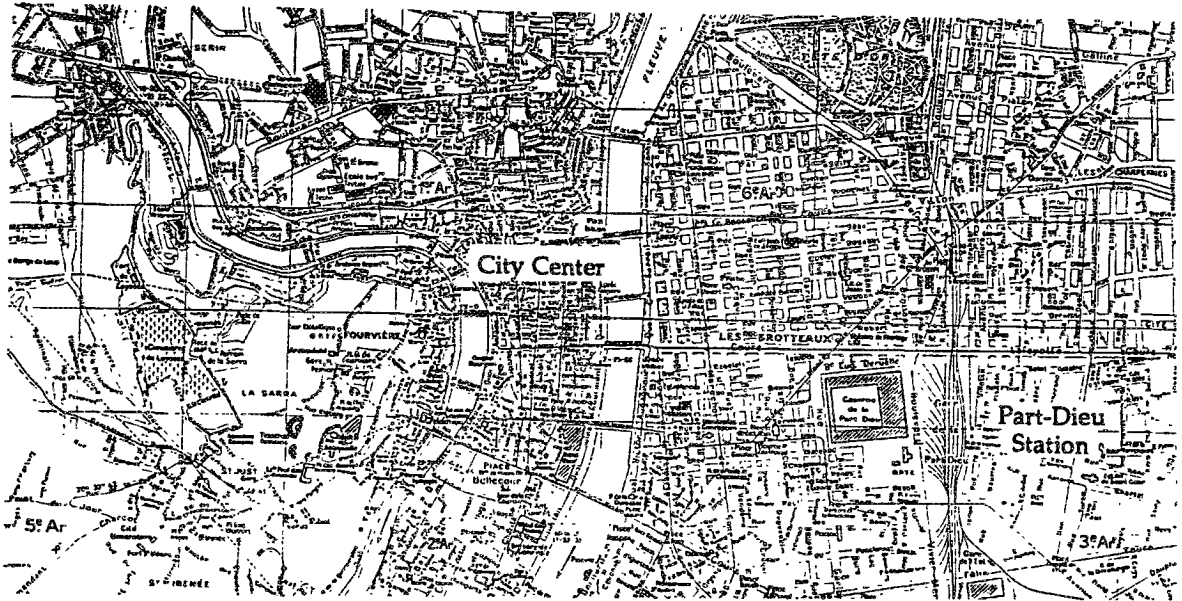
The town of Le Creusot provides an example of a new TGV station that has failed to stimulate development. The town, located in a region undergoing economic restructuring because of the closure of local coal mines, had hoped to capitalize on its access to Paris to stimulate industrial growth. However, in 1990, six years after the TGV began service and reduced the travel time from Paris to 85 minutes, only two firms, both marginal, had located near the isolated TGV station. The main reasons for the weak development impact of the TGV seem to be a general lack of demand for new development, the isolated station location, and the station's poor road access and image (*ibid.*: 20).

TGV Atlantic

Operations on the TGV Atlantic line between Paris and Le Mans were only begun in 1989 (Streeter, 1992: 6) (Figure 3.1), so there are few studies about the line and few detectable development impacts. In the future, however, development impacts will be better recorded because of extensive pre-TGV studies made along the route. Property development subsidiaries of SNCF and

Figure 3-2

Lyon: Traditional City Center and Station Part-Dieu



Source: Lan Uide Lay, 1967.

local authorities have taken an active role in promoting development near the TGV Atlantic stations, and preliminary studies of Le Mans, Vendome, and Nantes indicate their apparent success.

Le Mans

One year after the TGV Atlantic put Le Mans only 55 minutes from Paris, the City of Le Mans already had an active and diverse development program to promote the area around the station. A new business center with 108,000 sq ft (10,000 sq m) had already leased half of its space to an insurance company, 21,500 sq ft (2,000 sq m) to the local economic development agency for new industry, and 28,000 sq ft (2,600 sq m) to the second-largest dairy company in France. By the end of 1991, an additional 237,000 sq ft (22,000 sq m) were to be provided. A new technology center is also planned near the existing university and has already attracted the new European Institute of the Musical Profession, with 350 trainees. The Institute chose Le Mans in part because of the TGV, but also because of a new highway linking it in 1996 with Belgium and the rest of northern Europe. General economic indicators are also very strong in Le Mans: the number of transactions of raw land and building sites doubled in three years; land prices doubled from \$82.07 to \$164.14/sq ft (FF5,000-10,000/sq m) in four years; and apartment prices rose from \$9.52 to \$18.06/sq ft/year (FF580-1,100/sq m/year) in three years.¹ However, the TGV is viewed as a catalyst to this development and economic activity, not its main cause or even a critical element (Pieda, 1991: 22-23).

Vendome

Vendome was an unknown village before the TGV Atlantic reduced its time to and from Paris to 42 minutes, down from 2 hours 15 minutes. Within three years, the price of property in the town had increased 35 percent and real estate exchanges had increased 22 percent. A new business park with 370 acres (150 hectare) was scheduled to open in September of 1991 and is expected to include a European graphics industry research and training center. All of this activity has sparked fears that the town will become a commuter suburb of Paris, for those able to afford the monthly \$357 (FF2,000) fare (ibid.: 23).

Nantes

This section details the development effects observed during a visit to Nantes, located on the TGV Atlantic, in January 1992. Prior to the TGV Atlantic connection to Nantes, an extensive study was conducted to create a baseline against which to examine the impacts of the TGV Atlantic over time. The study will allow changes in the following property and urban form factors to be tracked: economic activities by type, location, and intensity; property values and rents; and

¹Prices calculated using an exchange rate of \$1=5.66 French Francs (New York Times, 1992).

development programs and projects (Gac and Paumier, 1990: 8). Although it is still too soon to conduct meaningful comparisons with the baseline, anecdotal evidence suggests that the TGV is having a substantial impact on development in Nantes.

Background

Nantes, 230 miles (380 km) from Paris on the northwestern coast of France, is France's seventh largest city and the political and economic center of the Pays-de-Loire region. The city had a population of 232,000 in 1988 (Gac and Paumier, 1990: 11), while the greater metropolitan area had a population of 500,000 (Audic, 1992). Nantes has a growing and diverse economy, specializing in food processing, materials research and manufacturing, electronics, data processing, medical research, and finance. In France it is second only to Toulouse in high-technology industries (Audic, 1992).

The opening of TGV Atlantic service in 1989 reduced rail travel times between Paris and Nantes from three hours to one hour, 59 minutes. Automobile travel time is three hours, 30 minutes. Nantes is currently served by three highways, and it will soon complete a 42 km ring road and expand its two existing tramlines (ibid.).

Nantes has an active economic development program that assists existing and start-up companies and is actively involved in the redevelopment of land around the TGV station. Existing companies interested in expanding or relocating to Nantes are provided with assistance in locating sites and with the planning process. They may also participate in redevelopment activities around the station, as discussed below. Start-up companies may qualify to begin operations in one of the 60 incubator spaces the city has at six locations throughout the city; these spaces offer rents approximately 25 percent below the city-wide average of \$9.03-10.66 sq ft/year (FF550-650/sq m/year), as well as shared business services (ibid.).

Urban Effects

According to Phillippe Audic (1992), the Managing Director of the Nantes Development Department, the TGV has had three types of effects on the city: qualifying, image, and direct. The qualifying effect springs from the improved connection between Paris and Nantes: reduction of the travel time between Nantes and Paris to two hours qualifies it for consideration by businesses for location, expansion, or relocation. This notion is especially important for international companies.

The image effect relates to the TGV's style and service: sleek, smooth, fast, and exciting. All of the stations have been architecturally updated with wave- and sail-like detail work that reflects the network's connection to the Atlantic Ocean and its smooth modernity. In addition, because the train itself is a technical and commercial success, it has an "osmotic" effect on the cities it serves, invigorating them with promise and vitality. Before the TGV, Nantes had never

advertised itself, as many cities now do, as a prime location for economic development. Now it actively courts companies and takes steps to assist them in locating to Nantes.

The direct effects of the TGV are the reduced travel time, guaranteed arrival, lower travel costs, increased productivity, and the cumulative effects of the decision by businesses to locate in Nantes.

Business Behavior

Although it is still too early to test fully the impact of the TGV Atlantic on business location decisions, preliminary information indicates that the TGV plays a large role in the decision of businesses to locate in Nantes. The Waterman Company, a producer of writing instruments sold worldwide, recently relocated its headquarters from Paris to Nantes, despite the fact that construction of a new headquarters in Nantes cost the equivalent of two years' rent in Paris. Its manufacturing plant, with 1,000 employees, was already in Nantes, and the company had indicated that it could conduct its sales and marketing activities in Paris and beyond with the use of the TGV connections to Paris. Other companies relocating from Paris include Sonye du Val d'Electricite, an electrical transformer manufacturing company with 150 employees (with plans to add 50 more). The company considered only cities on the TGV network for relocation. Similarly, a large insurance company with 100 employees that is relocating to Nantes considers the TGV vital to maintain contact with Paris (*ibid.*).

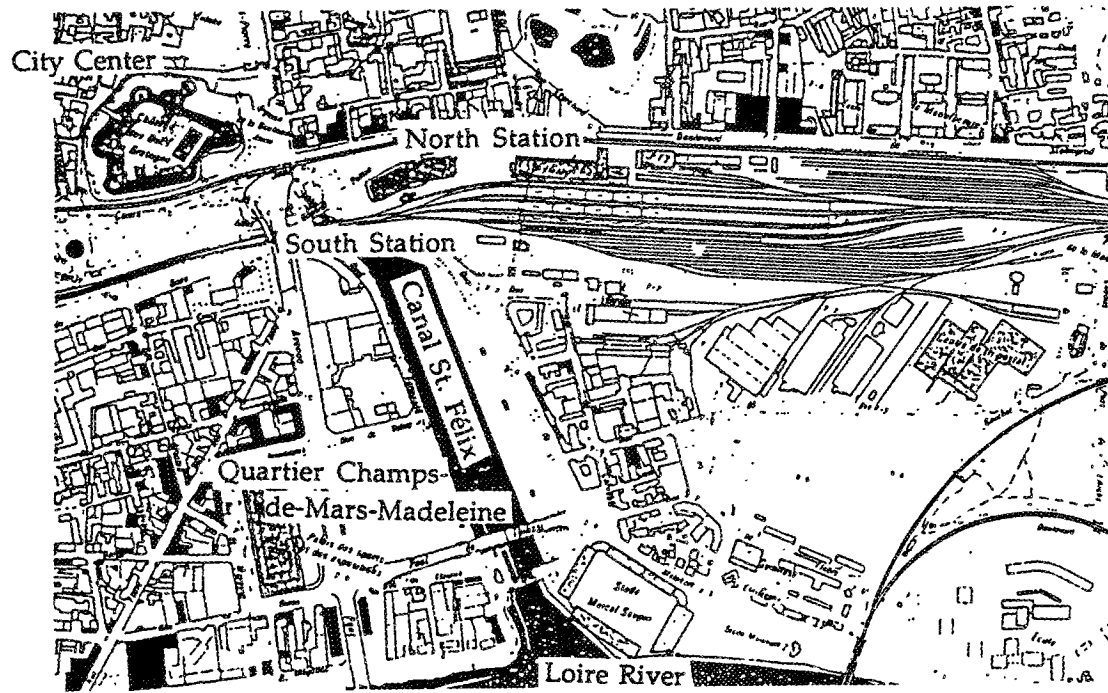
However, not all of the TGV's effects are beneficial. Arthur Anderson France had intended to locate a regional office with 100 people in Nantes, but then realized it could serve the regional market from Paris. This is not the only reverse impact: some medium-sized French companies which had been located in small towns in the countryside are beginning to relocate to cities served by the TGV. This has an especially disruptive impact on the small towns, which have come to rely on the companies as their major or only source of income. SNCF is attempting to counteract this problem by improving service to towns that have rail service to cities served by the TGV (*ibid.*).

Station Development

Nante's TGV station is located in the heart of the city, about ¼ mile (0.5 km) from the city center, which is northwest of the station (Figure 3.3). The railway runs through Nantes from east to west, paralleling the Loire River. The station is about ¼ mile (0.5 km) north of the river and is almost connected to it by a canal (Canal St. Félix) running from the Loire to the western edge of the station. To the north of the station is a residential district. Buildings here are four to five stories in height, with some offices and ground floor retail. To the south and east appear to be former manufacturing districts, now dominated by offices, some five to six stories in height. To the southwest of the station is a former manufacturing district that borders a mixed residential

Figure 3-3

Nantes TGV Station and Surroundings



Source: Gac and Paumier, 1990.

and light manufacturing district. This last area is the focus of major redevelopment efforts and is discussed in detail below.

The station itself is divided into a northern and southern side, with the tracks between them and an underground passageway making it possible to reach the four platforms (Figure 3.4). The northern side is the city's traditional train station, with a long two-story building housing various railway passenger functions and an eight-story SNCF office building to the east (Figure 3.5). There is also a large five-story parking structure to the west of the station's north side (estimated 400 spaces). This side of the station is served by a main east-west road and tram line. There are numerous small hotels, restaurants, cafes, and small retail stores lining the northern side of the road.

As its architectural design indicates, the southern side of the station is new and was built specifically for the coming of the TGV. It is dominated by a large entrance hallway on the southwest corner of the station that contains passenger service functions (Figure 3.6). Stretching to the west of this is a long one-story structure that also contains passenger service functions and a large five-story parking garage (300 spaces) (Gac and Paumier, 1990: 71). Stretching to the northwest is a one-story complex of restaurants and cafes, and a five-story hotel and office building with a ground floor restaurant and car rental offices (Figure 3.7).

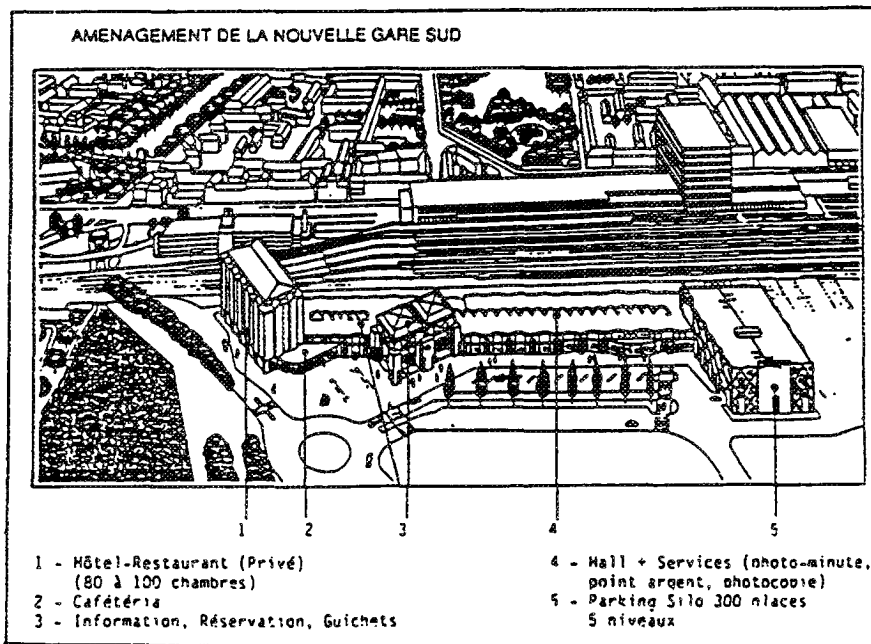
Redevelopment

Redevelopment in the Quartier Lu (officially called the Quartier Champ-de-Mars-Madeleine) in Nantes provides the most striking evidence to date of the development effects of the TGV Atlantic. The Quartier Lu is just southwest of the train station, only 300 feet (900 m) across the St. Félix Canal, and measures about 0.6 sq mi (1 sq km) (Figure 3.3). The western edge of the redevelopment area was formerly the main manufacturing plant for the Le Petite Beurre company (commonly called "Lu"), a world-wide manufacturer of cookies and cakes. The company has relocated to modern facilities in Nantes, thus opening up the parcel for redevelopment. The remainder of the redevelopment area is primarily residential, with some ground-floor retail to serve local residents, and some small offices and light manufacturing.

Redevelopment of the Quartier Lu serves the following functions: it is part of a plan to focus the growth of services in the city's center while not restricting it to the immediate center, thereby creating a service center growth pole; it fosters the redevelopment of underutilized property; it encourages economic activity by lowering development costs; and it increases and improves the supply of housing in the area (Audic, 1992; David, 1991: 3-5). The redevelopment area designation gives the city both the right of first refusal on all property for sale in the Quartier Lu and the right to designate the price at which it will buy the property. The designated price is determined by a city-wide annual review of property exchanges and rents, and an appraisal of the particular

Figure 3-4

Nantes TGV Station: View of North and South Sides

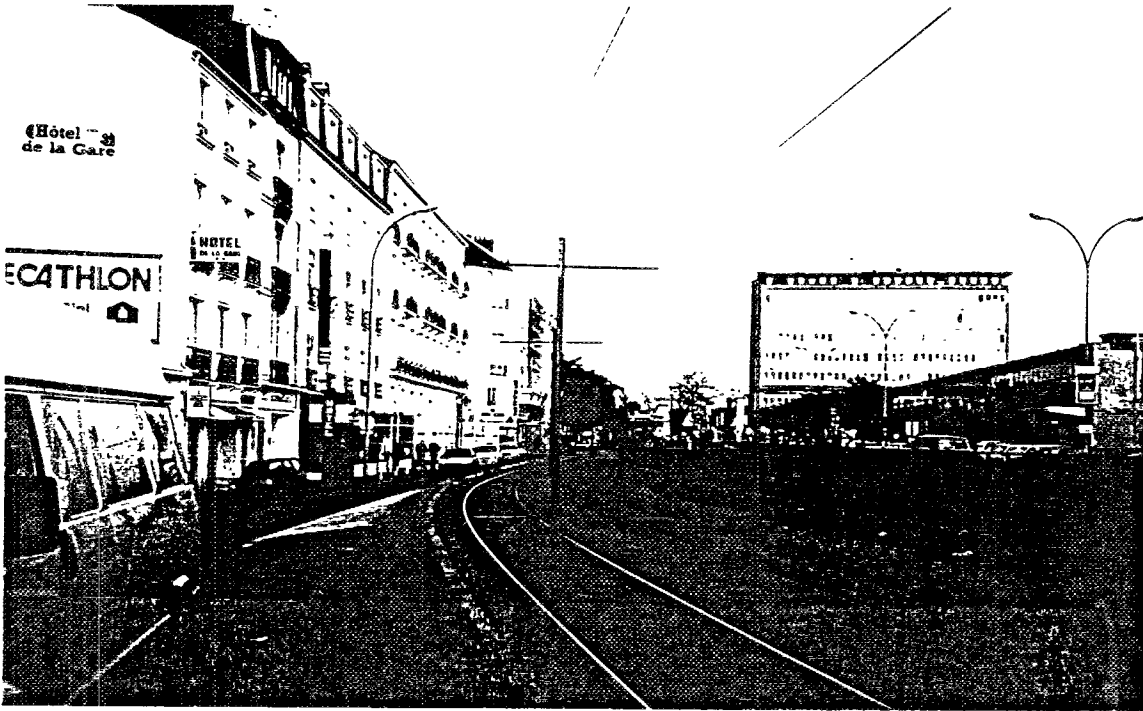


Source: Gac and Paumier, 1990.

Figure 3-5

Nantes TGV Station: Northern Side

View looking east (standing slightly west of station)



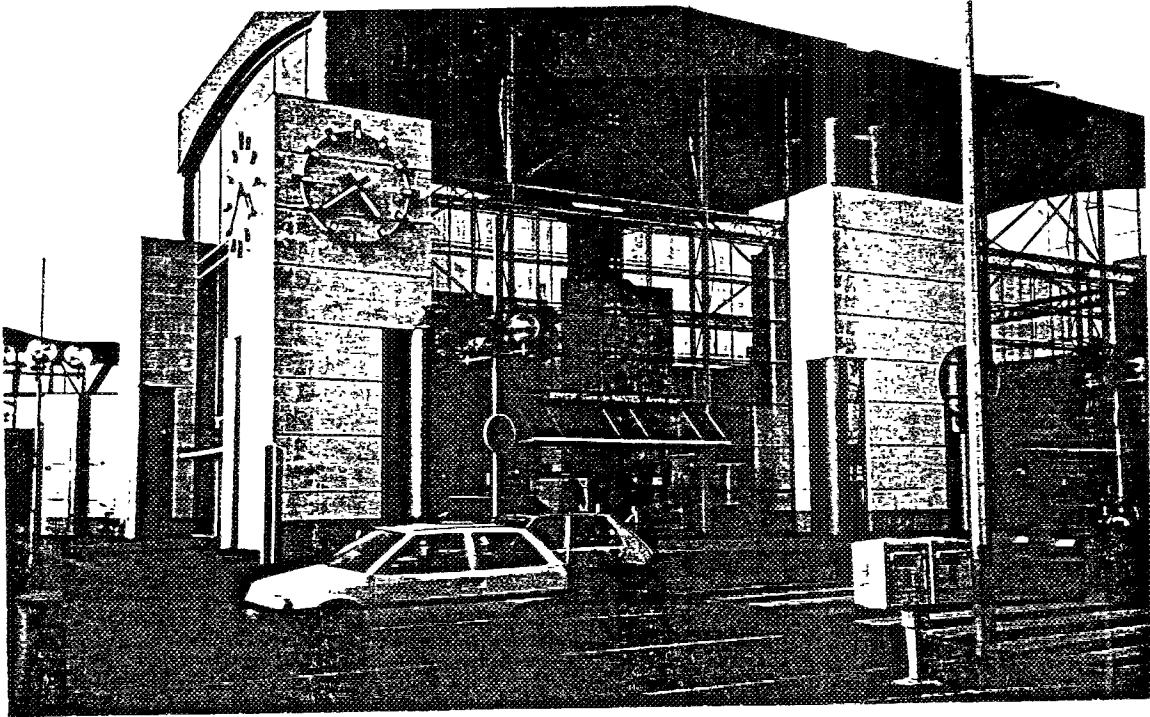
View to west



Figure 3-6

Nantes TGV Station: Southern Side

View of entrance (looking north)



View to east

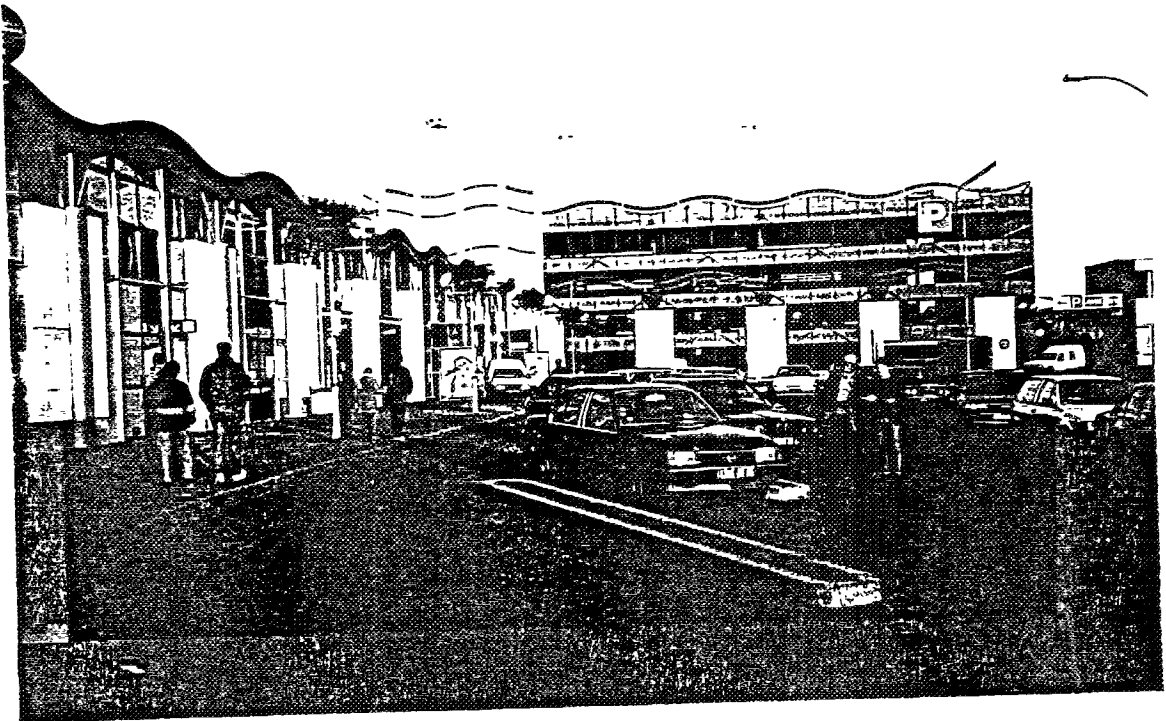
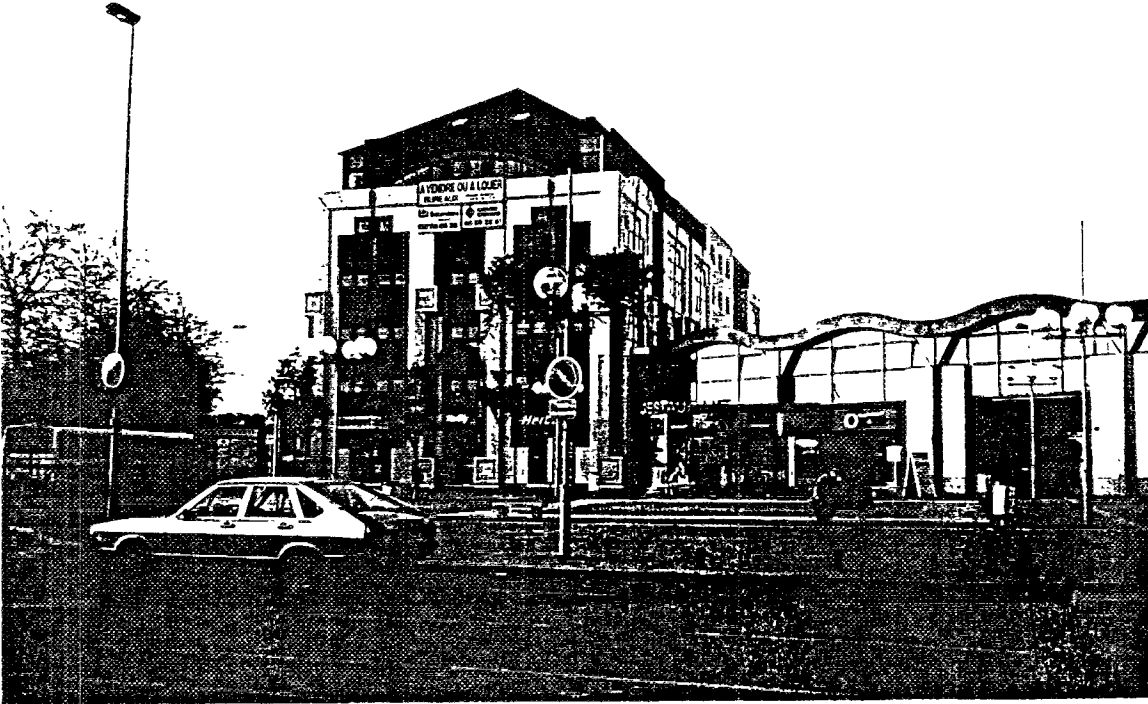


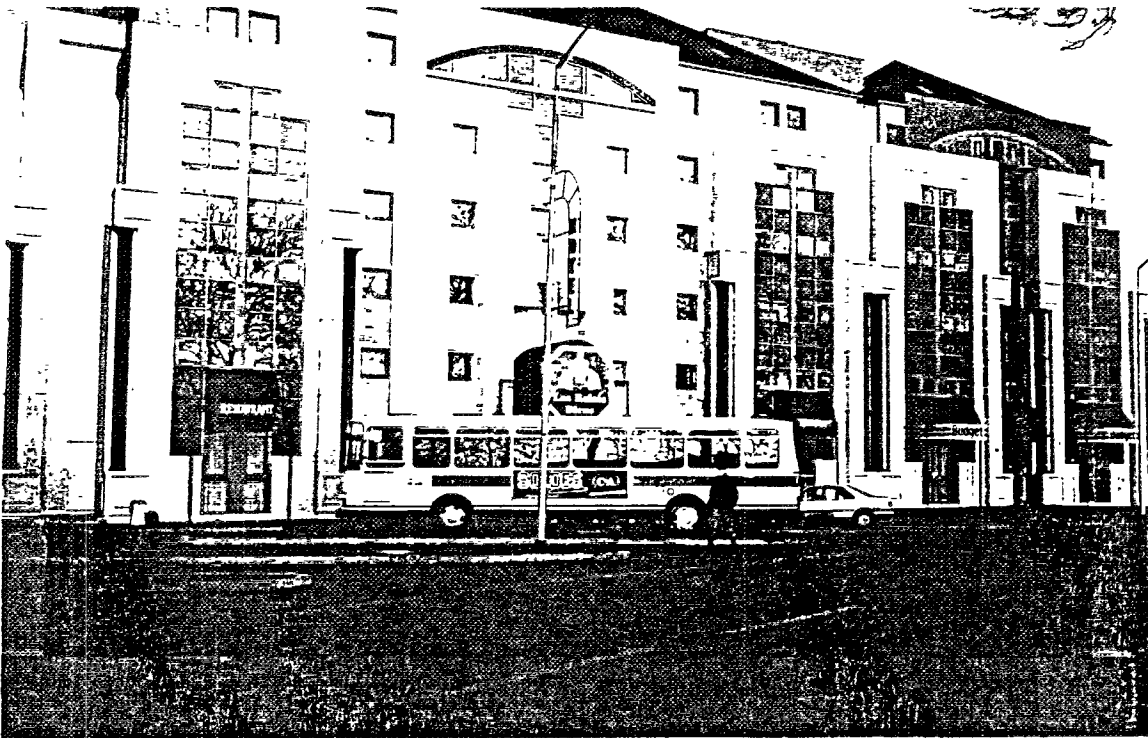
Figure 3-7

Southern Side of Station: Hotel/Office Building

View of South Side



View of west side



parcel's value. If the landowner chooses not to sell the property to the city at the designated price, the property cannot be sold to any other party. As in most redevelopment plans, the city assembles and reconfigures the properties for more efficient use, allows more intense land use of the property, and improves the infrastructure serving the property. The city then resells the property to developers at the price for which it was originally bought. This process is used as a means to retain a larger degree of control over the planning and development of the property, making it an indirect form of value capture.

Construction of a mixed-use development is progressing rapidly on the 6.7-acre (2.7 hectare) site of the Lu factory. About one-half of the site will be offices and a convention center/hotel complex, and the rest will be residences (Figure 3.8). The development will have approximately 592,000 sq ft (55,000 sq m) of built space in a mix of four- and five-story buildings. A new pedestrian bridge across the St. Félix Canal will provide a direct connection between the development and the TGV station. Total development costs are estimated at \$53 (FF300) million, about 10 percent of which is land costs. The convention center is scheduled to open in September 1992, with the remainder of the project to open sometime thereafter (Audic, 1992; David, 1991: 127).

Another major project in the redevelopment area is a bank and office building complex directly across the street from the convention center (Figure 3.9). It opened in the fall of 1991, employing 1,000 people in a building complex of 108,000 sq ft (10,000 sq m). In addition, the residential population of the area is scheduled to rise from 3,000 to 6,000 in the near future, indicating a large amount of new housing development and subdivision of existing units (Audic, 1992).

New development in the redevelopment area as a whole is considered to be unsurpassed in the city because of its modern qualities and its proximity to both the TGV station and the city center. As a result, rents are subject to a 20 percent premium above equivalent space in other areas of the city—new office space on the former Lu factory site already is leasing for \$13.95-16.41/sq ft/year (FF850-1,000/sq m/year) (ibid.). These rents are not for a lack of development in Nantes, though: since 1980, an average of 604,000 sq ft (57,000 sq m) of office space has been constructed annually in the Nantes greater metropolitan area, and more than half of it has been within the city boundaries (David, 1991: 26).

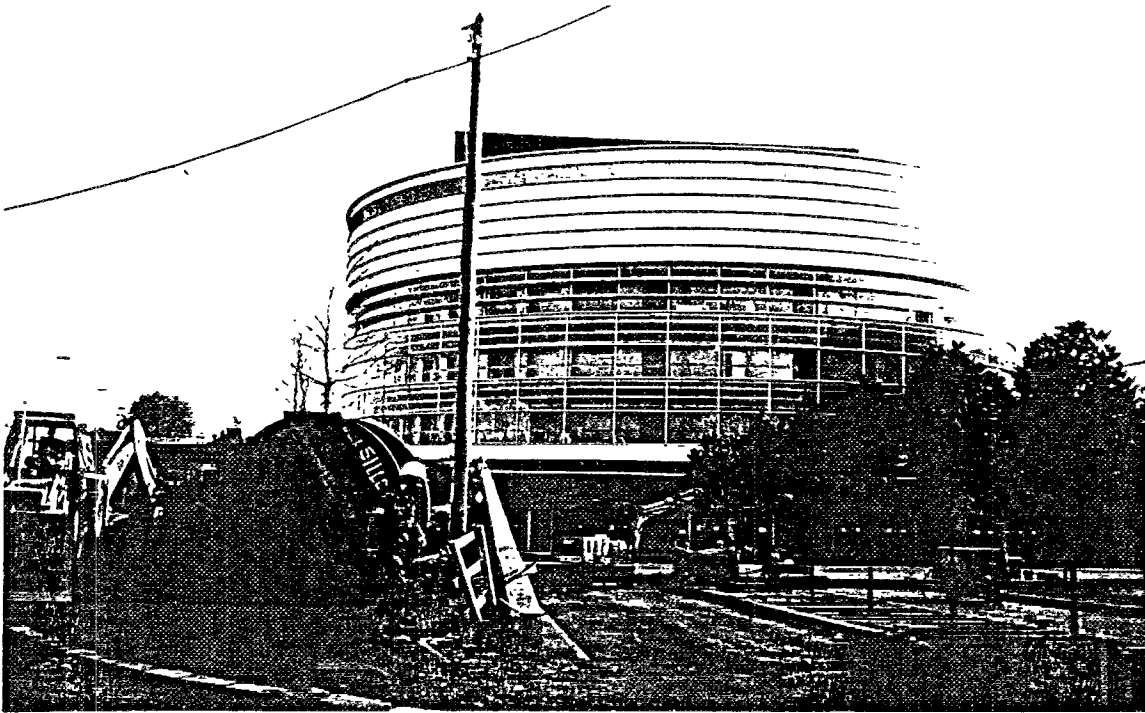
Summary

The TGV has affected the behavior and location decisions of businesses and has had noticeable development effects around some stations. Introduction of the TGV Southeast (Paris-Lyon) had several discernible effects: total business trips by rail increased 50 percent; service sector business trips by rail more than doubled; tourism increased; overnight hotel stays dropped; and medium-

Figure 3-8

Lu Factory Redevelopment Site

Convention center (looking south)



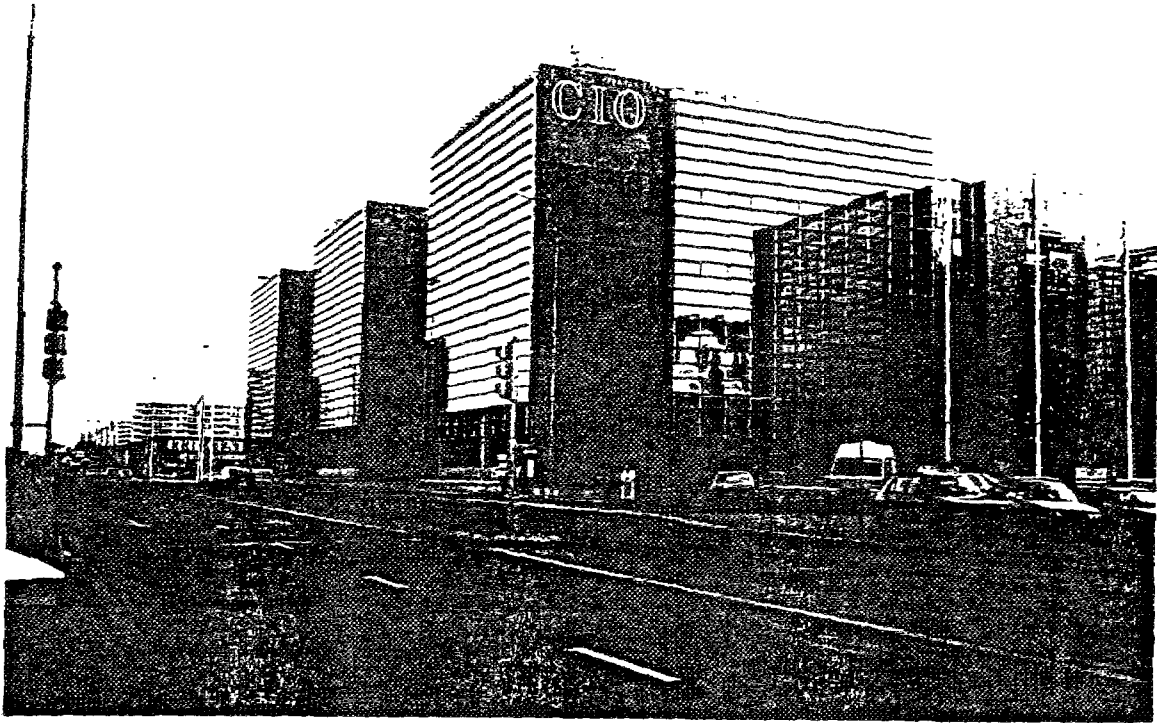
Hotel/Office Complex (looking southwest)



Figure 3-9

Bank Office Building Complex

Bank Complex (looking southeast)



Bank and Residences (looking west)



size information sector firms in hinterland areas used the TGV Southeast to enter Paris markets. However, when making business location decisions, access to the TGV Southeast was just one of a number of factors cited in business relocation decisions. Other factors included the overall economic situation; the entire transportation network (roads and rail); and public sector assistance. Development was inconsistent across station locations, with effects generally limited to the area around the station, but the level of development was determined by the overall economic strength of the community and the presence of service sector firms requiring access to Paris.

Although the TGV Atlantic (Paris-Le Mans) has only been in operation for three years, some development effects are already detectable. Real estate prices and transactions have risen sharply in several communities with stations, and in Nantes the network is perceived as qualifying the city for the location of businesses. Nantes has attracted a number of large businesses out of Paris (although the TGV is also used by Paris-based firms to serve customers in and around Nantes), and the presence of the TGV has spurred a major redevelopment project near the station as well as helped to produce a 20 percent rent premium on space in the redevelopment area.

No information on value capture was found in the literature, but in Nantes, some form of value capture was in effect on the redevelopment site near the station.

4. GERMANY AND THE ICE

ICE System

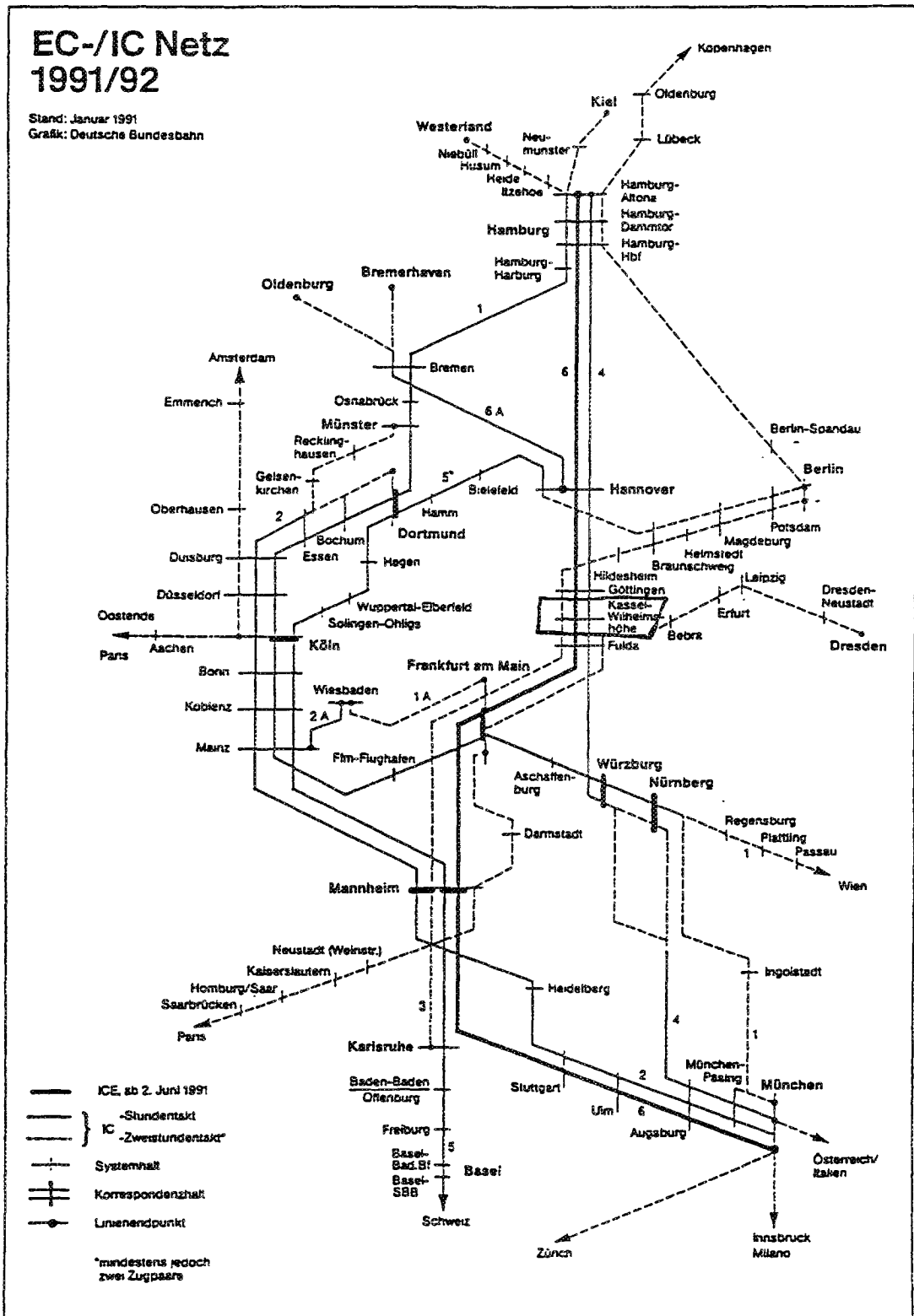
The German InterCity Express (ICE) began operating in June, 1991, and connected 11 cities over a single north-south line 648 miles (1,043 km) in length (Figure 4.1). 20 trains per day traveled between Hamburg and Munich at scheduled speeds up to 155 mph (250 kph), with a maximum of 173 mph (280 kph) to make up for lost time. Deutsche Bundesbahn (DB) plans by the end of the decade to double the number of miles over which high-speed operations are capable. It also plans to expand ICE operations to 10 or 11 lines, several of which will run into the eastern portion of the country, and expects to be operating at speeds of 186 mph (300 kmh) on at least one of those new lines. With the integration of the European high-speed rail network, the next generation of ICE trains will operate on lines extending into Switzerland, The Netherlands, Belgium, France, and perhaps Great Britain (Sands, 1992: 3, 17, 20, 23, 33).

The InterCity Express (ICE) is part of an effort to relieve congested freeways and airports by diverting intercity travelers. Prior to the unification of the former East and West Germanys, it had been used mainly to serve the north-south corridor that had been overburdened ever since the post-World War II division of the country had disrupted the rail lines' traditional east-west orientation.

The introduction of the ICE presents an excellent opportunity to observe the effects of high-speed rail on development at the national to local levels. Unfortunately, no formal studies

Figure 4-1

ICE and IC Network



Source: Deutsche Bundesbahn (January 1991).

have been initiated by the Deutsche Bundesbahn nor, apparently, by any other national agency (Lange, 1992). Given the level of resources necessary for the reconstruction of the former East Germany, this is not entirely surprising, but it does seem to be a lost opportunity, especially for cross-national comparisons.

Kassel-Wilhelmshöhe

The following sections detail the development effects observed during a site visit to the Kassel-Wilhelmshöhe ICE station in January 1992. Of the 11 cities served by the ICE upon its introduction in June 1991, this is the only completely new intercity train station. It is also the first new station to be built in a German city since shortly after WWII. It is here that the preliminary development effects of high-speed rail are most readily observable. The remaining ICE stops are at long-established stations in the center of major urban centers. No development effects are as yet observable at these stations.

Background

Kassel is located on Germany's longest new high-speed line segment, the Hannover-Würzburg section. This section forms a new north-south axis in the German high-speed rail system, supplementing the traditional north-south line running through Hamburg-Bremen-Düsseldorf-Frankfurt-Stuttgart. Although Kassel is located in the middle of Germany latitudinally, it was located very close to the border of what was previously East Germany when the decision was made in the early 1970s to route the new line there. At that time, its 213,000 residents were served by only two intercity trains per day, both of which called on the main train station located in the center of the city (Nose: 134; Klotz, 1987). With the reunification of Germany in 1990, Kassel has again become a centrally located city, making the decision to locate an ICE station there a fortuitous one for the Deutsche Bundesbahn, and especially for Kassel.

The station was perceived as a great economic opportunity for the city, enabling it to be integrated with the rest of Germany and Europe via up to 100 hourly ICE and IC trains per day. By ICE, Kassel-Wilhelmshöhe is now less than one hour from Hannover, 1½ hours from Frankfurt, 2 hours and 10 minutes from Hamburg, and 2 hours and 45 minutes from Stuttgart (Deutsche Bundesbahn, 1991: 48, 74, 76, 116). These times, combined with the station's centrality within the city, are expected to provide a strong development impulse near the station and in Kassel as a whole. Specifically, the station is expected to improve the ability of the city to attract industrial and service firms, and in addition to improve the image and, possibly, the funding of its university and government agencies (Bergholter, 1991: 24; Klotz, 1987).

Planning

Although the city views the new station as an excellent stimulus to the community, officials perceive it as both an opportunity and a threat. These uncertainties can be narrowed down to three questions. First, is it possible to build a multi-modal terminal that serves not only intercity passengers, but also regional and local passengers; that facilitates transfer between them and intra-urban transit; and that is compatible with the existing site characteristics (Bergholter, 1991: 25)? Based on the design and layout of the facilities and the observation of passengers using the station, one would have to answer in the affirmative.

Second, is it possible to control speculation and conversion around the station, even in the face of high demand for office, hotel, and retail space? The strong demarcation of growth and non-growth areas in city development plans is expected to help control this. According to Bergholter, though, almost all available space in the city already had firm development plans at the time of his writing (ibid.).

Third, is there a role for the old main train station in the city center? The city wants to strengthen regional transportation links to the city center and turn it into a regional service center (ibid.: 26). Although the city center station still receives local train service and some regional trains, and is connected to the Kassel-Wilhelmshöhe station via bus, tram, and train, one has to wonder if it will not simply be left behind as development occurs around the new station.

The city has three ongoing programs which it would like to couple with the new station: the upgrading of the university to a top scientific and industrial research center, along with the integration of the university with the city's growth plans; revitalization of the inner-center and the re-establishment of its role as city-center; and general plans and policies to improve the quality of life and standard of living in Kassel. The station is also thought to provide an opportunity to channel growth that is occurring in the western part of the city (Bergholter, 1991: 24).

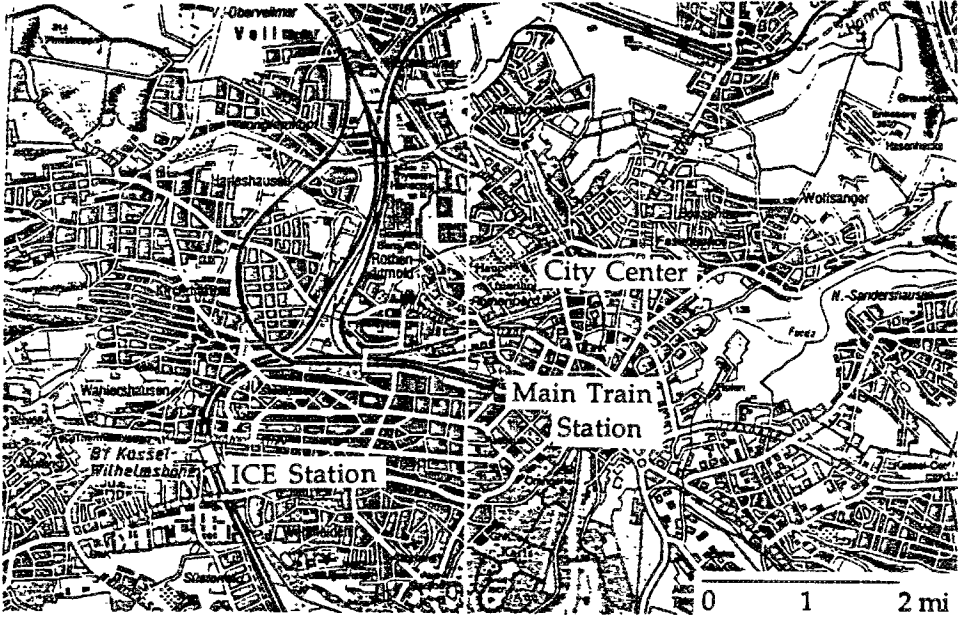
Location and Design

The city originally wanted the new intercity train station to be built underneath the existing station in the city center. However, this soon proved to be prohibitively expensive and the site was shifted to a small local passenger and freight train station approximately 2.2 miles (3.5 km) to the west of the city center (Figure 4.2) (Klotz, 1991: 40-41). The new station is located on the Wilhelmshöhe Allee, a wide street running east-west and dating from the Baroque era. Because it links the urban city center with a growing residential area and a nearby large park to the west, the street carries high levels of automobile, streetcar, and bus traffic (Bergholter, 1991: 24).

The station itself has an innovative and distinct architectural design (Figure 4.3). Located on a bridge that crosses the railroad tracks, its most distinctive feature is the large canopy that extends out from the front of the station lobby to cover the four light-rail stops, seven bus stops, 15 taxi stands, and the kiss-and-ride stop. Although temporary drop-off/pick-up automobile park-

Figure 4-2

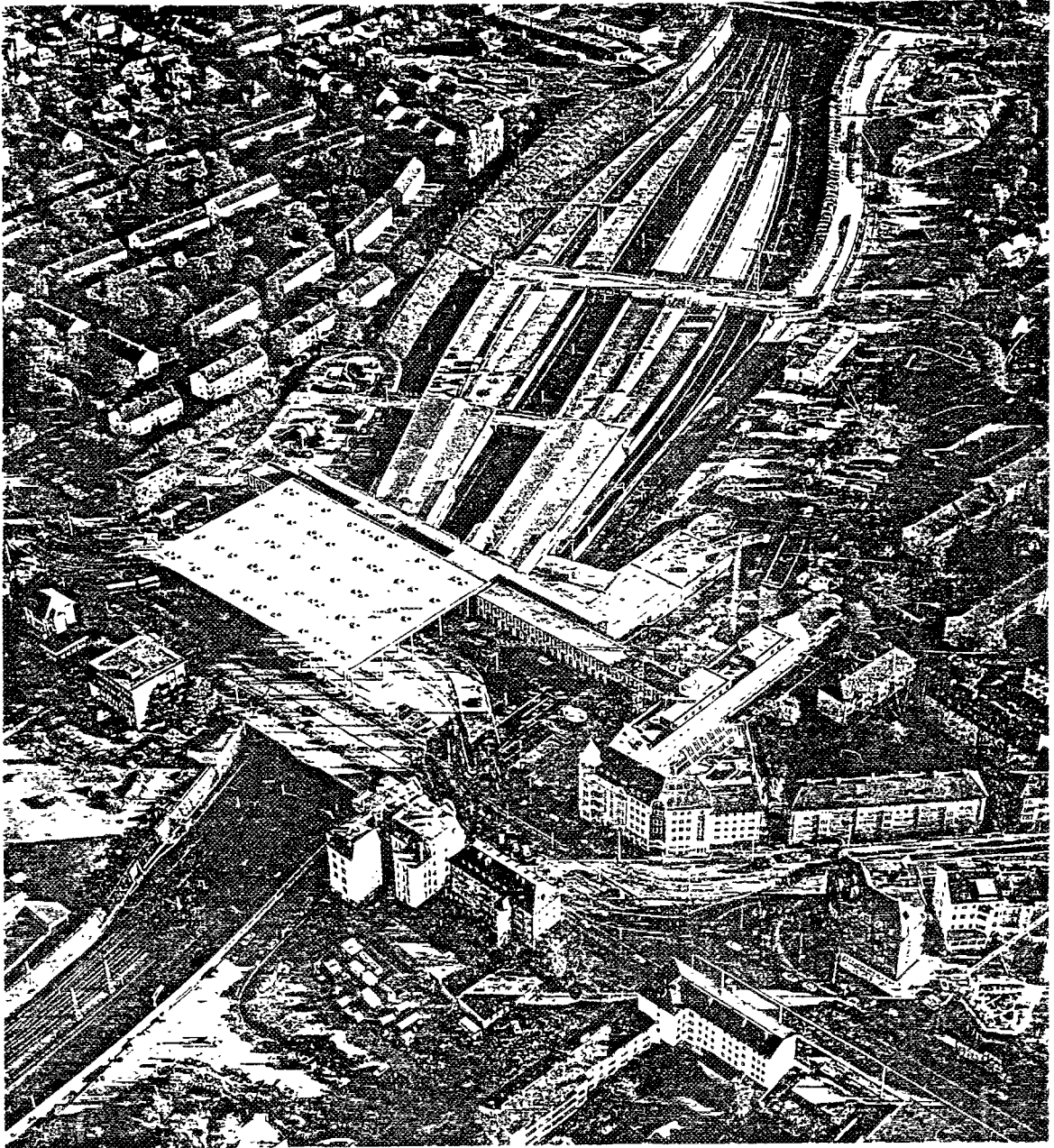
Kassel-Wilhelmshöhe ICE Station Location



Source: Klotz, 1991.

Figure 4-3

Kassel-Wilhelmshöhe ICE Station and Environs



Source: Langer, 1991.

ing is allowed in front of the station, regular parking is located either behind the station, above the train platforms, or underground to the west. Tour bus parking is available to the east of the station. Transit and automobile passengers have no more than a five-minute walk to the platforms. The platforms are reached by long ramps extending down from the station lobby, and by stairs and elevators from the parking lot above the platforms. ICE, IC, regional, and local train service is provided from the four platforms.

Development

Because the station has been in operation for less than one year, it is difficult to observe development effects, and, unfortunately, DB is not monitoring development activity in the area around the station (Lange, 1992). However, the Kassel Industrie und Handelskammer (an industrial and trade organization similar to a chamber of commerce) reports that a general increase in demand for all types of space has taken place, including retail, service, hotel, residential, and raw land. Some specific effects that have been noted are: a 20 percent increase in rents for area office space, to \$13.38/sq ft/year (DM 240/sq m/year); the construction of a new hotel near the station; the development of a large parcel behind the station, which is expected to serve mainly service industry firms requiring access to the ICE; and little demand for manufacturing uses in the area (Frei, 1992).²

A brief visit to the station and a cursory land use survey around it produced similar findings. The design of the station is innovative, highlighted by the architectural qualities and details, which are effective at creating a sleek and polished image. DB sought this image for the ICE, in part as a signal to development in the area, although it does sometimes seem a little out of place with the current development in the area. The station itself has the usual array of small retail shops, restaurants, and cafes catering to travelers, as well as information and ticketing facilities, and railway offices. In addition, it has a fairly large retail/drug store, estimated to be 5,000 sq ft (465 sq m).

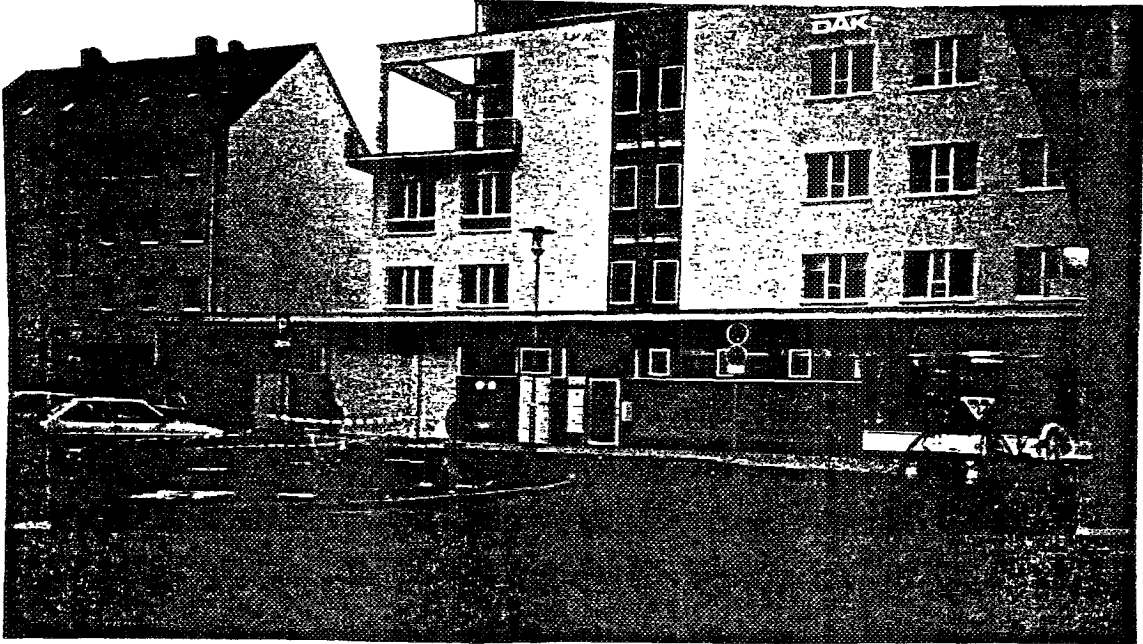
Attached to the west of the station by a covered walkway is a large building containing several diverse uses (Figure 4.4). Towards the back on the ground floor is a grocery store estimated to be 4,000 sq ft (370 sq m). Above this are four stories of offices for a number of electronics, communications, financing, and business management firms, estimated at 21,000 sq ft (1,950 sq m). Towards the front on the ground and second floors is a mix of cafes, restaurants, retail stores, and a hotel, with an estimated total of 30,000 sq ft (2,800 sq m). The building continues along parallel to Wilhelmshöhe Allee for about 100 feet, then turns up a neighboring street, where it has ground-floor retail stores and a mix of offices for lawyers, doctors, and business management above. The remaining buildings on that street are strictly residential.

²Prices calculated using an exchange rate of \$1=1.66 German Marks (New York Times, 1992).

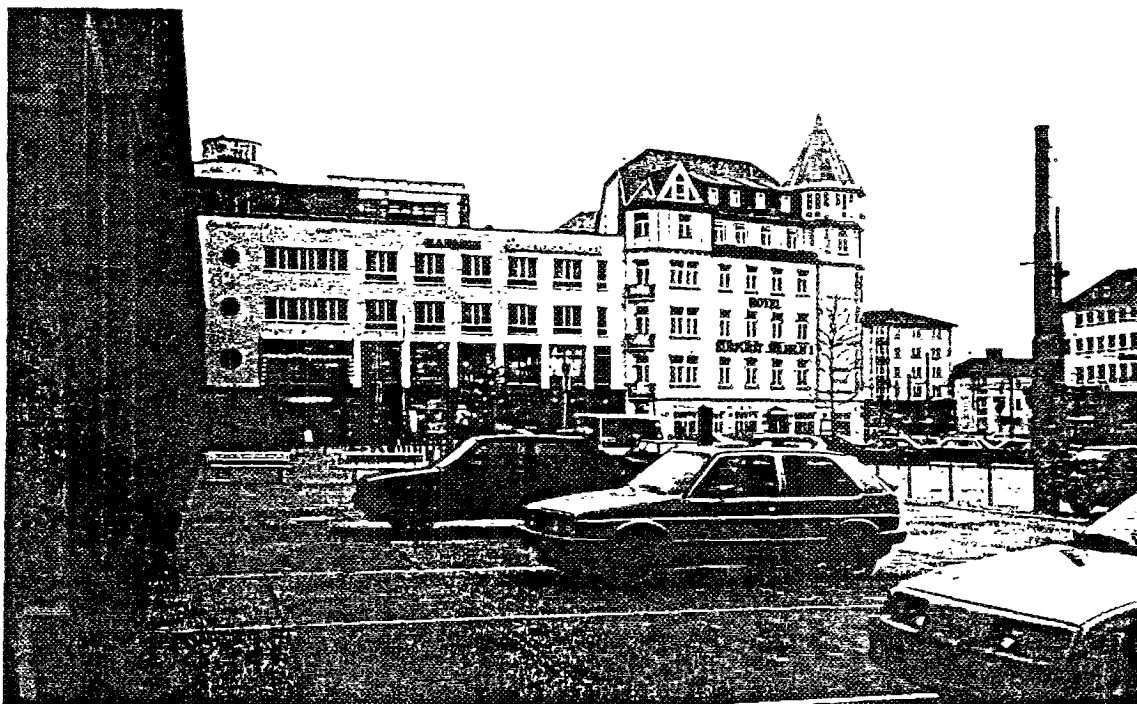
Figure 4-4

Development Complex at West End of Station

Offices and Ground-Floor Retail Stores (behind station, looking southwest)



Offices, Hotel, Restaurant, Cafes (in front of station looking west)



Wilhelmshöhe Allee itself is a four-lane street with light-rail tracks running up the middle and wide sidewalks. Continuing west from the station, it is bordered by four- to six-story buildings, most of which are entirely retail or a mix of ground-floor retail and offices (Figure 4.5). Several, however, have ground-floor retail with residences above. Most of these uses appear to be continuation of existing uses. Only one new building was noted within one-half kilometer west of the station, an architecturally innovative building (similar to the station) with ground-floor retail and cafes, and two to three stories of what appeared to be residences above, estimated at a total of 30,000 sq ft (2,800 sq m). Although partially occupied, in late 1992 it was still in the process of being painted and finished internally.

Across from the station, to the west of the tracks, are several five-story buildings with ground-floor retail and offices above. A completely new building is under construction directly across from the station, to the east of the tracks. It is a five-story building with 6,900 sq ft (640 sq m) of ground-floor retail space, and 28,500 sq ft (2,640 sq m) of office space. It is bordered by another building with a similar mix of uses. To the northeast of the station is a large government building that appears to be undergoing renovations.

The remaining property within a one-mile radius of the station is primarily residential, with one large exception. To the southwest of the station, bordering the parking above the train platforms, is the large parcel (approximately 500 ft [150 m] wide and 2,500 ft [760 m] long) that Frei (1992) referred to as being under development for offices (Figure 4.6). Needless to say, development of such a large piece of property will have a substantial effect on the local property market and business location. It is the clearest evidence to date that the ICE station has had an effect on development in the area.

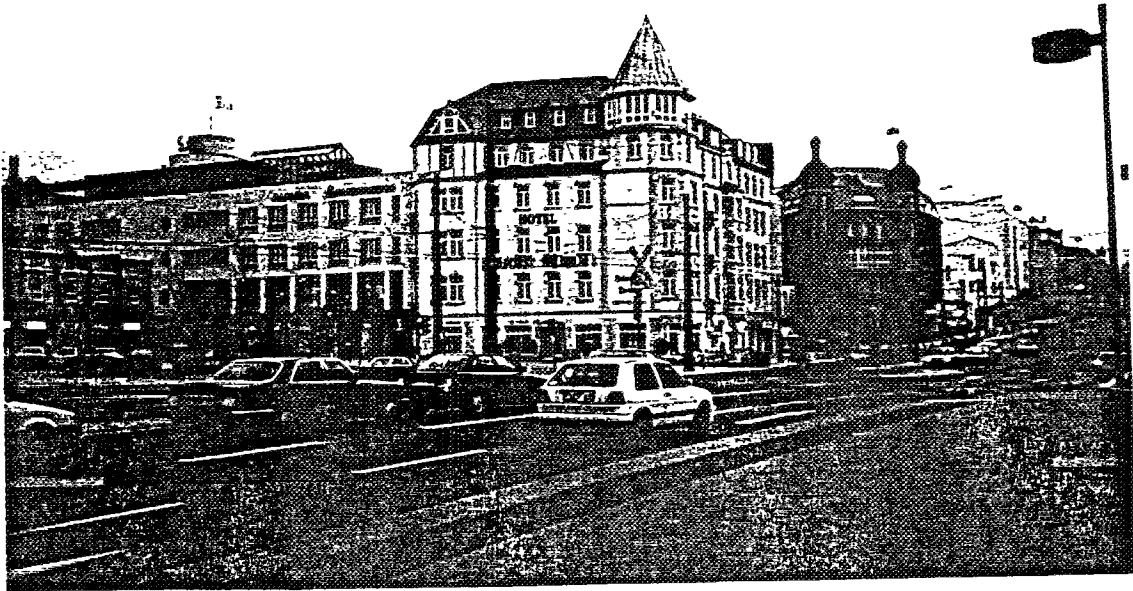
Summary

The Kassel-Wilhelmshöhe station provides an opportunity to observe the development effects of high-speed rail at a new intercity station location, although the ICE has been operating for less than a year. Demand for office, hotel, and retail space around the station has significantly increased (as evidenced by a 20 percent rent increase for retail space), and a large parcel bordering the station is being developed and is expected to serve information/service sector firms requiring access to the ICE. However, the question of the ICE's impact on the existing city center remains unanswered, and there is no available information on value capture.

Figure 4-5

Development Along Wilhelmshöhe Allee West of Station

(Looking west)



(Looking east toward station)



Figure 4-6

Parcel Under Development Behind Station

(Looking south)



5. IMPLICATIONS FOR CALIFORNIA

High-Speed Rail System

The CalSpeed research group at the Institute of Urban and Regional Development, University of California at Berkeley, has developed a detailed proposal for a high-speed rail system in California (Hall et al., 1992). This system is designed primarily to serve the Los Angeles Consolidated Metro Area and the San Francisco Bay Area (Figure 5.1). According to the 1990 Census, these areas have a combined population of approximately 20.5 million (Table 5.1). In addition, the system would serve the next group of medium-size metropolitan areas, those with populations of 0.4-2.5 million, including San Diego (2.5 million), Bakersfield (0.54 million), Fresno (0.67 million), Stockton (0.48 million), and Sacramento (1.5 million).

The CalSpeed high-speed rail system is based on steel-wheel-on-rail trains capable of speeds up to 200 mph (322 kmh). It would be able to achieve approximately the following express travel times from Los Angeles: Bakersfield, 0:50; Fresno, 1:20; San Jose, 2:05; Sacramento, 2:30; and San Francisco, 2:55.

Anticipated Development Effects

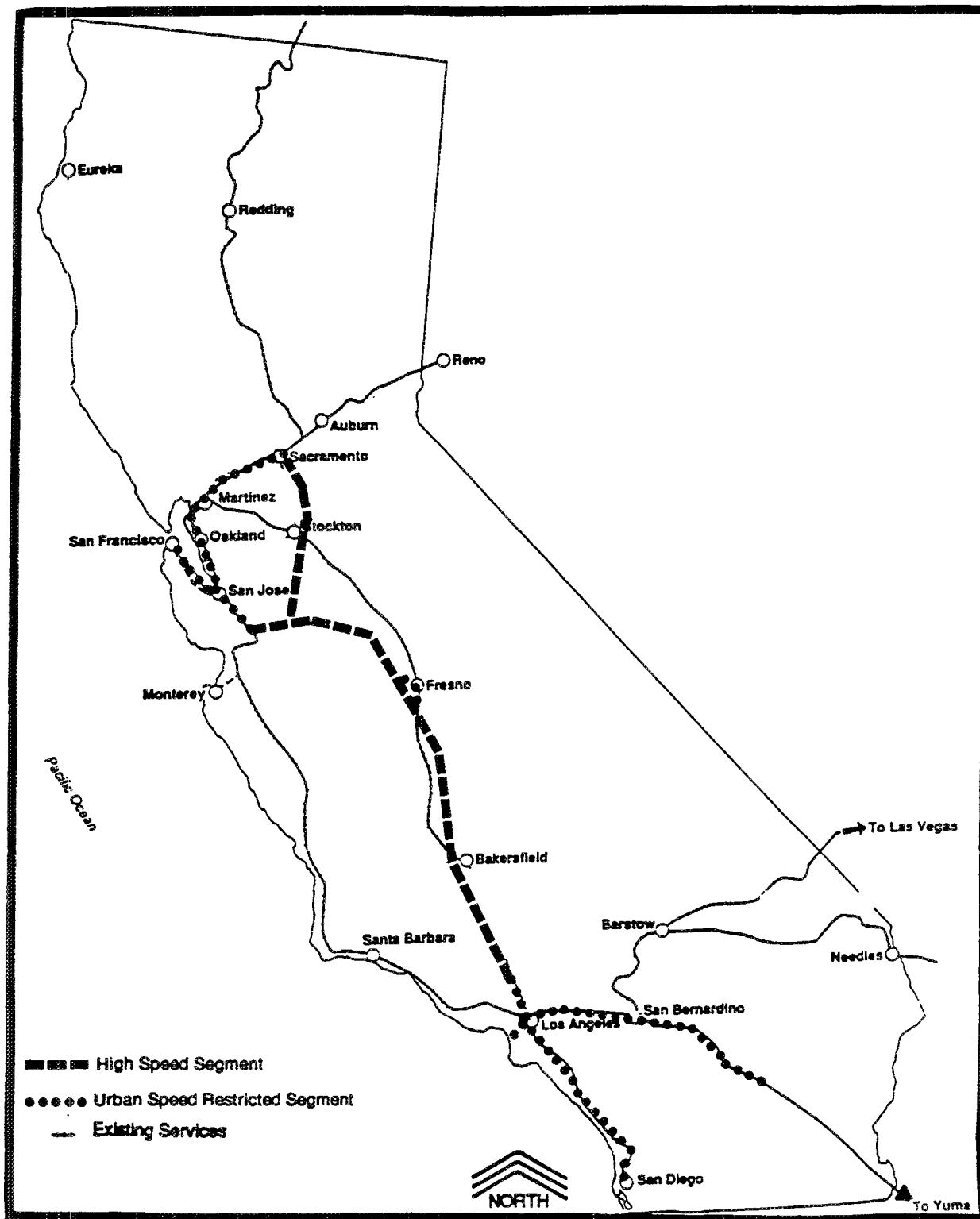
As a review of high-speed rail systems in Japan, France, and Germany, has indicated, the development effects of high-speed rail are highly variable and depend on a range of factors, making it difficult, without detailed analysis, to specify development effects by location. However, a number of general statements about the potential development effects of a high-speed rail system in California are possible.

1. The current recession will reduce all development effects, from the regional to station level. The importance of the economy for development to occur has been repeatedly highlighted in the preceding sections. However, considering the amount of time necessary to plan and construct such a system, the state will probably be well on the way to recovery by the time operations begin. In fact, according to one theory, infrastructure investments at the scale of a high-speed rail system may be required for economic recovery.

According to the Center for the Continuing Study of the California Economy (1992), California will add an additional three million jobs and six million residents during the 1990s, increases of approximately 20 percent each, despite the fact that the recession is more severe in California than in the rest of the nation. Although the state will experience numerical growth, prosperity and quality of life may suffer if the state does not take action to increase investment by the public and private sectors in education, production facilities, research and development, and infrastructure (ibid.: 3).

Figure 5-1

California High-Speed Rail Network (Proposed)



Source: Hall et al., 1992.

Table 5.1**California Population by Region, 1980-2000 (000s)**

	<u>1980⁽¹⁾</u>	<u>1990⁽¹⁾</u>	<u>2000⁽²⁾</u>	<u>Annual Growth</u>		<u>Growth Rate</u>	
				<u>1980- 1990</u>	<u>1990- 2000</u>	<u>1980- 1990</u>	<u>1990- 2000</u>
Los Angeles Basin	11,589.9	14,640.8	17,197.3	305.1	255.7	2.4%	1.6%
San Francisco Bay Area	5,179.8	6,023.6	6,901.0	84.4	87.7	1.5%	1.4%
San Diego Region	1,861.8	2,498.0	3,218.7	65.6	72.1	3.0%	2.6%
Sacramento Region	1,099.8	1,481.0	1,941.2	38.1	46.0	2.0%	2.7%
Rest of State	3,948.6	5,166.6	6,423.6	121.8	125.7	2.7%	2.2%
California	23,679.9	29,760.0	35,681.7	608.0	592.2	2.3%	1.8%

Note: ⁽¹⁾ Census data.

⁽²⁾ Estimated by CCSCE.

Source: Center for the Continuing Study of the California Economy, 1991.

2. A high-speed rail system would increase population and employment growth rates in the regions it serves above the statewide average. Actually, according to the Center for the Continuing Study of the California Economy (1992), the regions that such a system would serve have been and will continue to be the fastest-growing in the state. The Center divides the state into economic regions similar to those identified by the CalSpeed study (Figure 5.2). In the 1980s, the Sacramento and San Diego regions led the state in population growth rates, and they will do so again in the 1990s, followed closely by the San Joaquin Valley, which dominates growth in the "Rest of State" group (Table 5.2). The Los Angeles Basin and San Francisco Bay Areas will grow more slowly, but will still account for 60 percent of the state's absolute population gain during the next decade. The situation for employment growth is similar, although the "Rest of State" group experienced below average job growth during the 1980s. This trend is expected to reverse as employment growth in the major regions spills out into the San Joaquin Valley. These trends are likely to continue into the following decade.

A high-speed rail system would reinforce this growth and channel it within regions to cities with stations, which would then have significant advantages in accessibility over their neighbors and be in a better position to attract growth. Once this point was recognized, competition for a high-speed rail station would probably be fierce between cities within a region.

3. Employment growth rates will be highest in those regions with large concentrations of information-related economic activities and centers of higher education. The information-related sector is the fastest-growing sector of the economy, accounting for one million new basic jobs

Figure 5-2

Major Economic Regions of California



Source: Center for the Continuing Study of the California Economy, 1992.

Table 5.2

California Employment by Region, 1979-2000 (000s)

	<u>1980⁽¹⁾</u>	<u>1990⁽¹⁾</u>	<u>2000⁽²⁾</u>	<u>Annual Growth</u>		<u>Growth Rate</u>	
				<u>1980-1990</u>	<u>1990-2000</u>	<u>1980-1990</u>	<u>1990-2000</u>
Los Angeles	5,445.7	6,917.2	8,485.8	147.1	142.6	2.4%	1.9%
San Francisco Bay Area	2,574.9	3,210.5	3,824.8	63.6	55.8	2.2%	1.6%
San Diego Region	716.2	1,073.0	1,449.4	35.7	34.2	4.1%	2.8%
Sacramento Region	462.6	663.6	912.6	20.1	22.6	3.7%	2.9%
Rest of State	1,732.6	2,174.6	2,748.7	44.2	52.2	2.3%	2.2%
California	10,932.0	14,038.9	17,421.0	310.7	307.5	2.5%	2.0%

Note: ⁽¹⁾ California Employment Development Dept.

⁽²⁾ Estimated by CCSCE.

Source: Center for the Continuing Study of the California Economy, 1991.

(exporting products/services outside of California) during the period 1979-89, approximately 85 percent of total basic job growth in the state. During the period 1989-2000, this sector is expected to provide approximately 0.8 million new basic jobs, over 90 percent of the new basic jobs in California (Center for the Continuing Study of the California Economy, 1991: Reg 16). The majority of these types of jobs will be found in the Los Angeles Basin and San Francisco Bay Area, thereby further reinforcing their economic advantages in these sectors. However, this effect will be mitigated somewhat by the dispersion of "back-office" information-related activities out of these two regions to others where there are lower land and labor costs.

4. Increases in employment and economic activity in the accommodation, retail, and wholesale sectors would be dispersed across the system. However, regional activities would concentrate in cities with stations.

5. Ridership would be poor at stations without adequate transportation network connections, specifically an urban rail link directly to the local city center. Given that systems already exist or are under construction in the Los Angeles Basin, the San Francisco Bay Area, San Diego, and Sacramento, it would be possible to connect high-speed rail to these systems. These connections would likely increase ridership on both the local and high-speed rail networks and increase development around the stations.

6. Land value premiums on the order of 20 percent might occur around stations if adequate transportation infrastructure were provided and development were supported by public agencies.

Recommendations

On the basis of the aforementioned anticipated development effects, two recommendations are made.

1. The state agency responsible for development of a state high-speed rail system must take an active role in developing the area around stations. This can be done by establishing a development authority within that agency and giving it three fundamental powers: the ability to buy and sell property; the ability to develop its property; and the ability to enter into development agreements with local public agencies and private developers. This agency must also coordinate and facilitate development done by local public agencies and private developers, and provide adequate staff and funding for such activities.

2. The state agency responsible for the development of a high-speed rail network must work closely with local transportation authorities to guarantee that adequate road and transit connections are provided to high-speed rail stations. This is especially true for local rail systems, so that high-speed rail stations can be easily accessible and can allow passengers to transfer smoothly between modes. This may require the provision of funding to assist local agencies in making connections to high-speed rail stations.

These recommendations are made on the basis of the observed development effects of high-speed rail and related rail systems. For better or worse, the State of California has little control over the regional scale population and employment growth effects which a high-speed rail system will generate. However, in the process of developing such a system, the state will have to purchase property for high-speed rail lines and stations. This will give the state the opportunity to improve the development that takes place around stations, ensure adequate transportation linkages, and capitalize on land value increases that the stations and related development generate. Failure to do so will not only result in a loss of possible revenue to support the development of high-speed rail facilities, but a loss of ridership. The latter is especially critical for the long-term success of a high-speed rail system.

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