Chapter 5
METHODOLOGY—SYSTEM REQUIREMENTS AND PERFORMANCE

This chapter presents the methodologies and specific assumptions for the analysis of system requirements and performance of the HSGT cases. The four main analytical components are capital investments, travel demand and revenues, operating and maintenance (O&M) expenses, and ancillary activities.

CAPITAL INVESTMENTS

Building on the system design assumptions outlined in Chapter 4, the capital investment requirements for an HSGT case fall into four broad categories:

1. Initial investment in fixed plant;
2. Initial investment in vehicles;
3. Continuing investment in vehicles; and
4. Continuing investment in fixed plant

Initial Investments

Initial investments include all fixed plant, rolling stock, and related equipment and facilities necessary to operate and maintain the HSGT system at its inception.

Initial Fixed Plant Costs

Initial fixed plant requirements for Accelerail cases came primarily from a review of track charts and other secondary sources.[1] For New HSR and Maglev, the new rights-of-way were superimposed on geographic information system maps. In both cases, the research led to application of standard unit costs to the identified quantities and types of work.

Major components of initial fixed plant costs, together with key assumptions and procedures governing the costing effort, are summarized below.

Right-of-way purchase and preparation costs figured into the estimates for New HSR and Maglev because they involve new right-of-way. Such costs entered into Accelerail estimates only for curve realignments outside the existing right-of-way.

[1] The scope of the capital costing effort did not allow for the illustrative corridors to undergo on-site inspection especially for this study.

Realignments were treated as follows:

Technology:	**Accelerail 90**	**Accelerail 110, 125, 150**	**New HSR**	**Maglev**
Treatment:	No realignments outside right-of-way	Modest realignments, where feasible and requiring no extraordinary construction or relocations	Does not apply—new rights-of-way[2]	

Track capacity additions (applies to Accelerail only). New sidings, turnouts, crossovers, double track sections, and reverse-signaling provisions were specified for existing freight railroads, in order to accommodate—without adverse impact—freight train frequencies one-fifth greater than those of today, along with projected HSGT trains.

New track construction (New HSR and Maglev). New HSR track was assumed to be constructed to world-class (e.g., French, German, or Japanese) standards for 200 mph permanent way. Maglev guideway reflected the system design concept for U.S. Maglev as described in the report on the National Maglev Initiative (NMI), with some design modifications based on subsequent research and made in consultation with such NMI participants as the U.S. Army Corps of Engineers. Both New HSR and Maglev were assumed to be essentially double-tracked in the Northeast and California[3] corridors, but lower prospective traffic densities in most other corridors permitted the frequent use of single track with long passing sidings.

Track structure improvements. Accelerail 150 options assumed a rebuilding of the track to standards approaching those of New HSR, including concrete ties. The other Accelerail options presupposed that—

- The freight railroads would be in a state of good repair at the inception of HSGT projects—in particular, the existing rail would be suitable for the higher speeds;
- The HSGT project would "line and surface" (bring to strict geometric tolerances) all mainline track;
- Ties, other track materials, and ballast would be selectively renewed, at a rate requisite to the speed level;
- Track undercutting, ballast cleaning, and drainage improvements would occur for Accelerail 110 and 125; and

[2] Brief segments of New HSR, primarily in approaches to large cities, would make use of existing railroad rights-of-way and were treated (in this and analogous design issues) similarly to higher-speed Accelerail options.
[3] Los Angeles—Bay Area segment only.

- The condition of the track upon completion of the upgrading would be consistently maintained thereafter.[4]

Train control systems. New HSR and Maglev would have all-new, state-of-the-art train control systems. The Accelerail options were estimated with train control systems providing speed and authority enforcement.

The train control systems for Accelerail will necessitate that freight railroads' locomotives be equipped with cab displays. These retrofits were estimated based on each railroad's fleet size and its route-mileage: the shorter the railroad, the higher the percentage of locomotives assumed to require cab displays. (See Table 5-1.) As discussed in Chapter 4, any remaining differences over the extent and responsibility for locomotive modifications would be left to negotiations between the railroad and other Accelerail partners.

Table 5-1
Assumed Percent of Freight Locomotives Retrofitted with Cab Displays by Railroad Size

Total Route-Miles of the Freight Railroad	Percent of Freight Railroad's Locomotives Assumed To Be Retrofitted
0—2,000	100%
2,001—5,000	75%
5,001—10,000	50%
10,001—15,000	25%
15,001 and above	15%

As added safety precautions for the mixed-use Accelerail environment, the estimates also included shifted load detectors and additional electrically locked switches.

Electrification. New HSR and Maglev lines would be fully electrified. The Accelerail 125 and 150 electrified cases were assumed to have modern, unobtrusive, European-style electrification systems similar to that approved for installation between New Haven and Boston.[5] Electric propulsion was treated as an "overlay" for cost estimating because the same alignments were used as in the nonelectrified cases. The overlay consists of adding the required power supply system (substations) and delivery system (catenary) to the candidate rail corridor, and providing the modifications to the signal systems and clearances required to accommodate electrification.

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[4] The costs of such a program were indeed charged against each case—see below under O&M expenses.
[5] Federal Railroad Administration, *Record of Decision—Final Environmental Impact Statement/Report and 4(f) Statement—Northeast Corridor Improvement Project Electrification—New Haven, Connecticut to Boston, Massachusetts,* May 1995.

Grade Crossings and Fencing. New HSR and Maglev would have no highway/railroad grade crossings. Treatment of crossings on Accelerail lines adhered strictly to the Department's Action Plan for Highway-Rail Crossing Safety[6] and assumed improvements for public and private crossings that suit the planned operating speed over each crossing, rather than the top speed of the technology. The distribution of crossings by treatment at each operating speed level appears in Table 5-2.

Table 5-2
Assumed Treatment of Grade Crossings

Operating speed over crossing (mph)		Percentage of crossings	Percentage of crossings at each speed level improved by—			
From	To	retaining existing warning levels	Installing or upgrading flasher-gate systems	Providing positive barriers against intrusion	Separating	Closing
PUBLIC CROSSINGS						
0	79	65%	10%			25%
80	110		65%		10%	25%
111	125			50%	25%	25%
126	and up				75%	25%
PRIVATE CROSSINGS						
0	79	75%				25%
80	110		60%			40%
111	125			30%	30%	40%
126	and up				60%	40%

The New HSR and Maglev options were assumed to be completely fenced, for protection both of the railroad and of would-be trespassers. Fencing was installed in the Accelerail cases at a coverage rate that was dependent on the maximum speed operated over each segment.

Station treatments differed as between newly built and existing facilities:

- Each **new station**—built from scratch on New HSR or Maglev lines or added to Accelerail systems—was sized, and its high-level platform and track requirements were established, to accommodate its estimated volume of traffic for the Year 2020 (midpoint of the planning period).

[6] Federal Railroad Administration, Federal Highway Administration, Federal Transit Administration, National Highway Traffic Safety Administration, *Rail-Highway Crossing Safety Action Plan Support Proposals*, June 13, 1994, pp. 28-30.

Costs were developed on a per-square-foot basis reflecting similar construction.

- **Existing Accelerail stations** were assumed to be already adequately sized. High-level platforms, however, were estimated and charged to each case.

Other fixed facilities included:

- Maintenance-of-way bases (sited at regular intervals)[7];
- Storage yards (based on fleet size in each case); and
- Equipment maintenance/repair and service/inspection facilities. Each corridor (or group of corridors considered together) was assumed to have one maintenance/repair shop. In addition, each corridor **over 150 miles in length** was estimated to have a service/inspection facility at both endpoints.[8,9]

Contingency and Program Management. The following percentage markups of project cost provided an allowance for contingencies, design, and construction management:

	Upgrading of Existing Railroads (Mainly Accelerail)	**New Construction (Mainly Maglev and New HSR); also Accelerail electrification**
Contingencies	20%	25%
Design/construction management	10%	16%
Total allowance	30%	41%

Initial Vehicles

The required number of initial trainsets for a particular HSGT system[10] was determined to satisfy its estimated demand and service itineraries as of the year 2000, and through the early years of corridor development. Several factors influenced the number of trainsets required including forecast passenger demand, trip times, equipment turn times, and

[7] Lease costs for related movable equipment, both railborne (e.g. tamper) and highway (e.g. utility cranes, crew cab trucks), are included in operating and maintenance expenses.
[8] Up-to-date Amtrak maintenance/repair/service/inspection shops already exist at Washington and Boston, and non-Maglev corridors terminating in either of those two cities benefited from a consequent reduction in capital costs.
[9] Corridors less than 150 miles long (of which this report contains only one example, California South) were assumed to require only one service/inspection facility.
[10] See Chapter 4 for trainset composition.

maintenance cycling. The cost of a locomotive varied with technology and was determined based on recent procurements and estimates for development when necessary.

The cost of a passenger car depended largely on its interior configurations (e.g., coach, coach-café) and reflected recent procurements and the number of cars ordered.

Initial base costs ranged from $10 million per trainset for Accelerail 90 consists ($38,000 per seat) up to nearly $20 million per trainset for New HSR ($52,000 per seat). The estimated base cost for Maglev vehicles was approximately $12 million per two-car trainset ($80,000 per seat).

Continuing Investments

Continuing investments included all expenditures, other than annually recurring O&M expenses, that would be incurred after the inception of HSGT service for fixed plant, rolling stock, and related equipment and facilities. These ongoing investments would be necessary to maintain the high degree of operational reliability and service quality that would keep HSGT service marketable and commercially viable.

Continuing Vehicle Investments

Continuing investments in vehicles included the following items, for which the analysis projected expenditures in the specific years of incurrence:

- **Fleet expansion.** The number of required trainsets would increase over the study period (2000 —2040) with increases in demand. These additional trains were assumed to be purchased in the middle of each planning decade, or in some cases less frequently, in order to accommodate growth. In general, fleet expansion equipment orders would be for fewer units than the initial order.
- **Fleet replacement**. Assumed fleet life would be 20 years, at which time vehicles would be replaced in kind.
- **Fleet overhauls** were assumed to occur on a mileage-driven basis that would differ by technology, with work performed by outside contractors.

Equipment overhauls and equipment purchases, either to expand service or to replace older equipment, were treated as continuing investments in the year in which they would occur.

Continuing Fixed Facility Investments

For New HSR and any new construction under Accelerail options, the periodic replacement of major track and electric traction components ("program" track maintenance) was ascribed to particular years based on expected life cycles of the components.[11]

Continuing Investments for Maglev

For Maglev, continuing investments included fleet replacements and expansions only; vehicle overhauls and fixed facility program maintenance were subsumed in operating expenses.

Areas of Uncertainty in Capital Cost Projections

Beyond the requirement for intensive, site-specific engineering work as a prerequisite to implementing any HSGT corridor, two areas of uncertainty characterize the capital cost projections and emphasize the need for further detailed study of individual corridors.

Safety is a fundamental mission of the Department, and ongoing safety research and experience periodically necessitate reexamination and augmentation of the FRA's railroad safety standards. To the extent that new safety regulations and guidelines impose costs not addressed in this report, the initial investment requirements will increase over the levels projected herein. On the other hand, the FRA's Next Generation High-Speed Rail program is actively pursuing opportunities for technological developments that would enhance safety, lower capital and operating costs, and improve system performance. The net financial effect of all these ongoing activities is not susceptible to estimation at this time, nor is it included in the capital cost contingency factors.

TRAVEL DEMAND AND REVENUES

This section describes the methodology underlying the demand and revenue projections for each case.

Overview

The broad outlines of the demand methodology, as applied to each case, are as follows:

[11] For Accelerail options in general, this study did not determine the installation dates of the freight railroads' track components, and "program" maintenance was treated as a separate, annualized element of maintenance-of-way expense.

Step 1: In the **absence** of HSGT, **project the likely traffic of the existing modes** for all city-pair markets in the forecast years.

- Air
- Auto
- Bus
- Conventional rail

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Step 2: Apply **diversion models** to each existing mode to develop the likely traffic levels contributed by that mode to an HSGT system.

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Step 3: Based on the proportions of diversion from other modes, develop **induced demands** for HSGT.

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Step 4: HSGT demand is the total of **diverted** plus **induced** demand, summed across all city pair markets served by the case.

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Step 5: HSGT passenger transportation revenue is the product of the demand times the assumed fares (separately calculated for business- and nonbusiness-purpose trips).

Step 1: Project Existing Modes Without HSGT

Air and auto projections made use of regression equations, while bus and rail projections incorporated a simple annual percentage increase assumption from a 1993 base, within the range established for auto and air.

Air Projections

A regression equation related air volumes in 1979, 1983, 1988, and 1993[12] to fares, distances, population, and per capita income. On the basis of this equation, assumed fares,

[12]Taken from the 10 percent sample of actual tickets sold by large airlines as compiled by the Research and Special Programs Administration (RSPA) of the Department. Minor adjustments were made to account for missing commuter airline trips and a small undercount. Base year traffic was extrapolated from the 10 percent sample for that year. For comparison purposes, actual total commuter airline trips for a city pair were obtained from RSPA. Given a situation when the extrapolated traffic for a city-pair appeared high/low in comparison with the actual commuter trips, an adjustment was made to the base traffic. The effects of such adjustments added 2.2 percent to total air traffic. All trip totals were then increased by 1.5 percent (3.7% -2.2%) to account

and applicable BEA population and income forecasts,[13] the model then developed air passenger growth factors for each city-pair market. Application of these growth factors to 1993 actual data yielded the presumed air traffic for the forecast years.

Auto Projections

No solid data base currently exists for auto traffic on a city-pair basis. Therefore, on the basis of observations of auto trips in 55 markets from previous detailed corridor studies, a model was developed to estimate existing and future auto traffic in 50- to 500-mile city-pair markets. The model calculates auto trips for any year as a function of—

- the combined personal income of the two cities;
- the distance separating the cities;
- the potential of one of the cities, due to its recreational infrastructure, to attract a high number of tourists; and
- whether or not competing, frequently operated rail service exists between the cities.

Conventional Rail Projections

"Conventional rail" means passenger train service of the type and frequency operated by Amtrak in the early 1990s. Amtrak city-pair ridership statistics were adjusted to remove local traffic,[14] then projected through the study period by applying the growth rates described in Chapter 4.

Bus Projections

Since the bus companies do not publish their city-pair ridership, the study estimated 1993 bus traffic from bus route frequencies, an average seat capacity of 45, and an assumed average load factor of 50 percent for corridor-type services.[15] A gravity model then estimated the number of bus passengers traveling to and from all city pairs (stops) within a route,[16] thus providing a base for forecasts.

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for the remainder of the ticket sample's shortage compared to Federal Aviation Administration enplanement data.

[13] See Chapter 4 for underlying assumptions and BEA forecasts.

[14] I.e., within CMSAs or MSAs and less than 50 miles; see Chapter 4.

[15] Thus a 45 seat bus is assumed to have 22.5 passengers, and this is multiplied by the bus frequency between the route endpoints. The 50 percent average load factor is based on a conversation with a bus industry expert.

[16] The gravity model calculates the number of intermediate stop passengers by using as explanatory variables the population and income for the "stop" areas (cities) and the distance between the stops.

Step 2: Apply Diversion Models

A set of diversion models—one for each mode and trip purpose—estimated the percentage of trips in each city-pair that HSGT would attract were it available. In this discussion, the "donor mode" is one of the existing modes as projected for the future, and the HSGT option is the recipient mode.

Each diversion model considers pairwise comparisons of the utility of HSGT versus that of the existing mode, as seen by business and nonbusiness travelers. If the perceived utilities are equal, then HSGT attracts 50 percent of the donor mode's passengers.

The diversion model equations include, as independent variables, the fares, trip times, and frequencies of the paired, competing modes. The coefficients used in these linear combinations depend on the donor mode and trip purpose; represent the relative value that travelers, who are using that mode for that purpose, attach to the attribute, e. g., "value of time"; and reflect structured interviews in which travelers expressed preferences between their habitual mode and alternatives characterized according to these attributes.

There are separate equations for business and nonbusiness trip purposes for each of the following five donor modes, for a total of ten[17] equations in all:

1. **Local air trips within a corridor ("Air O/D")—**the actual trip endpoints are both in the corridor
2. **Transfer air trips ("Air Transfer")—**the trip within the corridor forms part of a longer air trip
3. **Auto**
4. **Conventional Rail**[18]
5. **Bus**

For each donor mode and trip purpose, these equations calculate future market share percentages for HSGT by city pair. These percentages, when applied to the base trips projected by donor mode and trip purpose in the absence of HSGT, yield the ridership diverted to HSGT. Total HSGT ridership in a corridor thus aggregates the diverted ridership in all markets from all donor modes and trip purposes.

[17] Actually, the air and auto modes are further disaggregated, making a total of 16 equations.
[18] In markets where significant conventional rail service already exists, adjustments are made to account for trips which have already diverted to the existing rail service.

Step 3: Develop Induced Demand

Induced demand, which is totally new demand for travel created by the introduction of a new travel option, generates controversy owing to the paucity of corroborative historical data, roadblocks to defining and quantifying such demand even where data exist, and methodological difficulties.[19]

Probable cause exists, however, for allowing for a modicum of induced demand in this analysis. Studies of the effects of introducing totally new transport capabilities (the jet in transatlantic travel, major additions to highway networks) suggest that up to 70 to 80 percent of demand can be termed "induced." More germane to HSGT, estimates of demand induced by Shinkansen lines in Japan range from 6 to 28 percent of total travel; the French National Railways claims that as of 1984, 16 percent of the traffic on the Paris-Lyon TGV line was induced.[20]

When Southwest Airlines entered the Baltimore/Washington—Cleveland market, its 81 percent fare cut caused traffic between all three Washington area airports and Cleveland to grow by 173 percent over the previous year's traffic. Determining how much of that was induced—**trips that would never have occurred without the "new service"**—exemplifies the problems bedeviling all induced demand projections. First, there would have been natural traffic growth due to improved national and local business conditions. Second, traffic would have been diverted from other airports—conceivably, even from as far away as Richmond, Harrisburg, Philadelphia, and New York. Third, the new fare (averaging $31) can be cheaper per mile than the perceived cost of driving assumed in this study, so that considerable auto traffic might have been diverted between very large catchment areas surrounding the two origins and destinations.[21] Only the residual, which cannot be readily calculated based on available data and techniques, would truly constitute induced demand.

Table 5-3 shows the importance of induced demand in several HSGT corridor studies. Following the precedent set by the more cautious of those studies as well as transit

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[19] As the World Bank's railway advisor puts it:

> Beware of induced demand. Logically, if an entirely new option is available, at least some demand will occur that is entirely new and would only exist with the new mode. Common sense (unlike some models) suggests that, if all else is held constant, little new demand would actually result. Clearly, models that predict significant levels of induced demand must bear the burden of proof.—Louis S. Thompson, "Trapped in the Forecast: An Economic Field of Dreams," *Transportation Research News 165*, March-April 1993.

[20] Boon, Jones and Associates, Kingston, Ontario, *Induced Demand: Case Histories*, for National Maglev Initiative.

[21] To illustrate these last two factors: Baltimore-Washington International Airport—now a low-fare Mecca due to the presence of Southwest Airlines—in 1995 registered a growth of 114 percent in passengers originating in the District of Columbia, almost 90 percent from Virginia, and 80 percent from Southern Pennsylvania, according to the Baltimore Metropolitan Council.

Table 5-3
Induced Demand in Other Corridor Studies[22]

L.A.—Las Vegas:	48%	New York—Montreal:	17%
Florida:	40%	Texas Triangle:	10%[23]
Pennsylvania:	None	Ohio:	6.8—7.6%
Detroit—Chicago:	10%	National Maglev Initiative	10% (baseline option)

industry experience, [24] this analysis assumed that **induced demand will equate to ten percent or less of the diverted traffic,** as detailed in Table 5-4.

Table 5-4
Assumptions on Induced Demand

Donor Mode	Induced HSGT Traffic as a Percentage of Traffic Diverted from Donor Mode
Air O/D	10%
Air Transfer	25% of 10%, or 2.5 percent
Auto	10%
Conventional Rail	At 50% diversion rates and above, a graduated scale of diversion starting at 0% and reaching 10% at the 100% diversion level

Steps 4 and 5: Total Demand and Transportation Revenue

The total HSGT travel for each case in each forecast year equates to the sum, across all city-pair markets in the corridor, of—

- Ridership diverted from each donor mode, by trip purpose, plus
- Induced ridership, expressed as a percentage markup over diverted traffic by donor mode and trip purpose.

Likewise, the passenger transportation revenue for each case summarizes, across all city-pairs—

- Diverted plus induced business-purpose trips, times the assumed HSGT business fare, plus

[22] Source: *In Pursuit of Speed***,** Transportation Research Board, Washington: 1991, p. 105; *Final Report on the National Maglev Initiative,* p. 3-4.
[23] This was for the initial Texas work. Subsequent efforts used a more complex method.
[24] Retrospectives on urban transit ridership (derived from reported information on selected systems) before and after the introduction of light or heavy rail to bus-only corridors show the following results, in terms of the ratios of induced to diverted travel:

- BART Transbay (1975): **12%**
- Euclid Line, San Diego Trolley (1987): **7%**
- MARTA East-West Line (1980): **17%**
- WMATA Van Ness Extension (1984): **13%**

- Diverted plus induced nonbusiness trips, times the assumed HSGT nonbusiness fare.

Passenger transportation revenue, plus income from ancillary activities, equals system revenues for each case.

OPERATING AND MAINTENANCE EXPENSES

The O&M expense model constituted a build-up costing approach. It analyzed the entire HSGT operation into major functions (e.g., transportation), subfunctions (e.g., train movement), and activities (e.g., train operators) so as to identify and estimate all the work elements necessary to conduct and perpetuate passenger transportation service. The objective was to develop a total O&M expense for each case by adding detailed estimates up a complex hierarchy. Table 5-5 exemplifies the output of the model and shows the expense hierarchy at its highest levels of aggregation.

To accomplish this, the model incorporated a series of linked spreadsheets, comprising an ordered set of cost-estimating relationships (CERs), to project O&M expenses for a broad spectrum of HSGT systems. This method resulted in a set of CERs with the flexibility to estimate costs based on:

- the technology being modeled;
- the service operated—frequency, top speeds, and other characteristics;
- the physical characteristics of the infrastructure over which the service is operated;
- the ownership and operational responsibility for the infrastructure; and
- the management philosophy applied to develop the HSGT organization.

Within that characterization, the expense estimates assumed the continuation of existing rail passenger industry wage rates, ratios of supervisory and support personnel to on-site primary workers, and spans of control. The expenses do, however, reflect the efficiencies inherent in high-volume, high-frequency, high-speed operations with new equipment, new or refurbished infrastructures, and enhanced customer service levels.

Maglev’s uniqueness necessitated careful consideration in the development of the operating expense model. Not only does the technology depart from the steel-wheel-on-steel-rail norm of the other options, but no example of revenue intercity corridor service yet exists anywhere in the world. Therefore, the Maglev O&M expense estimates incorporated specialized CERs for such technology-specific functions as maintenance of equipment and maintenance of way, while such other functions as stations and train crews received the same treatment as for Accelerail and New HSR.

Table 5-5: Example of O&M Model Output for a Typical Case[25]
(Year 2020; Amounts in Dollars)

Account Number	Description	Labor Costs	Energy	Other Materials	Purchased Services	Total O&M Expense
1000	**MAINTENANCE OF WAY**	**606,855**	**0**	**44,449**	**5,410,681**	**6,061,985**
1200	Permanent way maintenance - Inspection and Repair	383,323	0	6,881	2,154,047	2,544,251
1300	Permanent way program maintenance	2,837	0	23,917	2,878,329	2,905,083
1400	Major structures maintenance	0	0	0	70,409	70,409
1600	Electric traction maintenance	0	0	0	0	0
1800	Signals and communications maintenance	117,138	0	9,725	306,121	432,985
1900	M-O-W facilities operating overhead and maintenance	103,558	0	3,926	1,775	109,259
2000	**MAINTENANCE OF EQUIPMENT**	**4,587,429**	**7,149**	**782,296**	**4,297,848**	**9,674,722**
2300	Short turnaround cleaning	0	3,805	94,182	937,114	1,035,101
2500	Service and inspection	40,371	3,344	253,183	2,725,370	3,022,267
2700	Maintenance and repair	4,223,812	0	418,993	0	4,642,806
2900	M-O-E buildings operating overhead and maintenance	323,245	0	15,938	635,365	974,548
3000	**TRANSPORTATION**	**11,833,937**	**4,250,808**	**11,050**	**1,791,560**	**17,887,354**
3300	Superintendence and dispatching	335,454	0	11,050	1,791,560	2,138,064
3500	Train movement	10,513,055	4,215,619	0	0	14,728,674
3700	Yard operations	985,428	35,189	0	0	1,020,617
3900	Transportation facilities operating overhead and maintenance	0	0	0	0	0
4000	**PASSENGER TRAFFIC AND SERVICES**	**8,181,371**	**0**	**437,365**	**11,508,978**	**20,127,714**
4200	Marketing, service design, and pricing	1,834,621	0	263,589	0	2,098,210
4300	Information, reservations, and ticketing	921,054	0	15,084	9,111,166	10,047,303
4500	Baggage services	65,557	0	280	0	65,837
4600	Station operations and maintenance	0	0	0	185,676	185,676
4800	On-board services	4,077,521	0	116,163	2,212,137	6,405,821
4900	Station overhead	1,282,617	0	42,250	0	1,324,867
5000	**GENERAL AND ADMINISTRATIVE**	**6,343,603**	**0**	**690,569**	**11,540,683**	**18,574,855**
5200	General and administrative management	3,582,502	0	145,392	0	3,727,894
5300	Personnel	590,146	0	17,940	0	608,086
5400	Procurement	667,122	0	21,450	0	688,572
5500	Financial management	1,038,717	0	38,476	425,608	1,502,801
5600	Security	280,708	0	461,189	4,552,157	5,294,054
5700	Insurance and liability	184,408	0	6,122	5,845,109	6,035,639
5800	Taxes	0	0	0	0	0
5900	G&A facility operating overheads and maintenance	0	0	0	717,808	717,808
TOTAL		**31,553,194**	**4,257,957**	**1,965,730**	**34,549,750**	**72,326,631**

[25] "Tenant" Paradigm. **This table is provided for insight into the overall workings of the model rather than for the sake of the individual numbers.** A "zero" (or very small amount) in a cell does not necessarily mean the item is missing from (or underestimated in) the calculation. For instance, many energy costs are included in "purchased services" and certain overheads are dealt with elsewhere in the model than in the "overhead" accounts (1900, 2900, etc.).

The following assumptions underlie the operating expenses for this study.

Maintenance of Way

Incremental costing. In Accelerail cases[26] involving intercity passenger operations over a freight railroad landlord, the expense model estimated the freight railroad's track maintenance expenses both "with" and "without" the superimposed passenger service and assumed that the passenger operator would pay for the increment[27] as a "purchased service." Since the scope of the study did not allow for detailed engineering inspection of the existing routes, the model assumed a generic freight railroad based on typical conditions for principal main lines in the U.S. and calculated the baseline expenses ("without" HSGT) accordingly. The generic freight railroad was assumed always to be in good repair—i.e., with no deferred maintenance at any time. The assumed standards for the improved railroad ("with" HSGT) varied with the technological option and the assumed capital investments.

HSGT as Landlord. Where the HSGT operator would be the landlord, having freight or commuter tenants, this study assumed that the HSGT landlord would recover, with neither deficit, surplus, nor management fee, all incremental costs occasioned by the presence of tenant services (e.g., for track maintenance due to the presence of freight).[28] An HSGT landlord situation only occurred where an intercity right-of-way currently belongs to Amtrak—specifically, in the Northeast Corridor and in a portion of the Chicago—Detroit corridor.

Maintenance of Equipment

The assumed nature and frequency of equipment maintenance tasks governed the related O&M expenses. Table 5-6 summarizes these cycles for the Accelerail and New HSR options.

Transportation

Incremental costing. Wherever intercity passenger operations would take place over a line owned by a freight railroad, the expense model estimated, and charged to the HSGT system, the incremental transportation superintendence and dispatching expenses to be borne by the railroad landlord.

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[26] Also in New HSR cases to the extent that they rely on existing railroads for access to city centers.
[27] Plus a 20 percent management fee on direct labor and three percent on materials.
[28] To the extent the HSGT landlord can exact payment from its tenant(s) of a portion of its fixed overhead costs, the landlord's operating results will improve over those shown here. Conversely, to the extent the tenant's payment to the HSGT landlord falls short of full incremental costs, the HSGT operator's results will suffer.

Table 5-6
Equipment Maintenance Cycles for Steel-Wheel Options

Equipment Maintenance Task	Assumed Frequency
Interior cleaning	Each trip turnaround, in stations; daily at service/inspection facility for more time-consuming work
Exterior cleaning	Daily
Service and inspection	Each trip turnaround, in stations; daily at service/inspection facility for more time-consuming work
Periodic maintenance and repair	60-day and 6-month cycles, based on the nature of the required work
Running repairs	As needed
Overhauls	Every 1.5 million miles of revenue service

Trainset crew sizing. Consistent with emerging arrangements at Amtrak stations, ticket control was assumed to be by means of a farecard-type system at stations, all of which would have high-level platforms allowing easy access to trains. Nevertheless, the study assigned a three-person trainset crew—one operator ("engineer"), one conductor, and one customer service representative[29]—to all trains of six cars or less. This is in addition to personnel operating cafés (see under "On-Board Service," below).

In the rare instances[30] in which traffic densities called for trains with seven cars or more, the model added a second customer service representative (for a total of four trainset crew members) to assist the greater number of passengers.[31]

Passenger Traffic and Services

Information, reservations, and ticketing assumptions include:

- All trains will be space-controlled: while the HSGT operator will not require **advance** reservations, it will sell tickets only up to the seating capacity of each train.
- Twenty percent of passengers will arrive at the station without an **advance** reservation.
- Of the advance-reserving passengers, about one-third will reserve and purchase through travel agents at a ten percent commission, while two-

[29] Customer service representatives are accounted for under "passenger traffic and services/on-board services."
[30] E.g., in the Northeast Corridor New HSR case.
[31] This approximates the train crew-to-passenger ratios of the French National Railways for its TGV services.

thirds will reserve and purchase through the HSGT operator's own system.

Baggage service. In keeping with the precedent set by Amtrak's Metroliners and VIA's Canadian corridor services, the HSGT system was assumed to offer no checked baggage service. The relatively short distances involved, the availability of ample luggage storage space on trains, and the high capital and operating costs of checked baggage service called for this assumption. The model did allow for platform attendants to assist passengers needing assistance with their hand luggage, and rental luggage carts would be available.

On-board services. The study assumed that food and soft-drink service would occur at no direct cost[32] to, and with no revenue production for, the HSGT operator. This could be accomplished by developing a labor/management partnership to streamline Amtrak's existing staffing and commissary arrangements, by contracting out the cafés, by selectively raising prices, or by other means.

General and Administrative Expenses

Insurance and liability. Expenses for insurance and liability reflected the experience of airlines, commuter rail operators, and Amtrak on a per-passenger mile basis, adjusted for both speed and the overall scale of the corridor operation.[33]

Taxes. As described in Chapter 4, the O&M expense projections do not include property or income tax payments in view of the private/public partnership arrangement underlying the HSGT project.[34]

ANCILLARY ACTIVITIES

Intercity passenger carriers typically engage in activities that are ancillary to the basic movement of people, that enhance the quality of service, that are typically priced on a pay-as-you-go basis, and that often yield profits. This study modeled these ancillary activities and included them in the system requirements and performance of the cases. Depending on the case, the total income from ancillary activities amounted to between three and ten percent of system revenues.

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[32] The HSGT operator would absorb the cost of the revenue transportation space lost due to provision of cafés.
[33] The model typically returns costs of one to two cents per passenger-mile for this activity.
[34] The precise tax arrangements and implications will, of course, require further study and negotiation during the development of individual corridor partnerships.

Categories of Ancillary Activities

For purposes of this report ancillary activities fall into three categories: passenger-, commerce-, and facility-dependent activities. These categories are defined as follows:

Passenger-dependent activities involve the purchase of optional goods and services by passengers above and beyond the fares they pay for intercity transportation. These revenues relate directly to the number of passengers carried. In addition to services and conveniences for travelers, this category also includes revenues from advertising placed in the HSGT system by other entities.

Commerce-dependent activities include use of HSGT for hauling commercial freight, especially overnight and expedited freight and mail. These revenues are affected by the volume of commerce between the cities along the right-of-way, and by competing modes for moving this traffic. For some Accelerail and New HSR systems, the passenger operator's freedom to earn some types of freight revenue may depend on negotiations with its freight railroad partners.

Facility-dependent revenues are the third component of ancillary activities. These revenues can include lease of access to right-of-way, co-development of station properties, and lease of facility space.

Analytical Treatment

The study applied four generic approaches to projecting the results of ancillary activities:

(1) In situations in which the HSGT operator would—without incurring any initial capital expenditure—receive an income stream (such as franchise fees) from a concessionaire, the projection showed an "income only" based on expected net receipts per passenger, per pound of package shipments, and the like.

(2) If the HSGT operator would need to make an initial capital investment prior to enjoying an income stream, as in the case of parking and station concessions, the projection included both "income and capital cost" in the years earned or expended. Initial investments were sized to meet year 2020 demand.

(3) If an ancillary activity's revenues would lend themselves to projection, but the recipient of those revenues (or the party responsible for their attendant expenses or capital costs) would be difficult to identify, then the analysis developed those revenues for information only and omitted them from the operating results.

(4) Facility-related activities were too site-specific for inclusion in the operating projections and received "qualitative" treatment. Nevertheless, they could theoretically provide a boost to HSGT implementation—for example, if a commercial power industry highly covets access to a specific right-of-way.

Table 5-7 summarizes the contents and treatment of each category.

Table 5-7
Overview of Ancillary Activities

Category	Includes	Treatment[35]
Passenger-dependent	• Advertising revenue • On-board alcoholic beverage service revenue • On-board phone, fax and entertainment • Station parking revenue • Station concessions revenue	• Income only • Income only • Income only • Income and capital cost • Income and capital cost
Commerce-dependent	• First-class mail; document and small parcel express • Package express • Expedited LTL	• Income only • Revenue only (for information only; no income included) • Revenue only (for information only; no income included)
Facility-dependent	• Right-of-way access for pipelines, power lines, fiber optics, air rights • Co-development • Station leases	• All qualitative

[35] In the balance of this report, ancillary income is included in system revenues, of which the ancillary portion is typically between three and ten percent. Ancillary capital costs are included in infrastructure investments.