TRANSPORT RESEARCH INSTITUTE

North-South Rail Link

Review of the Intercity Ridership Analysis

February 2002

EXECUTIVE SUMMARY

Transport Research Institute Limited performed an independent review of the intercity (Amtrak) ridership portion of the Draft Environmental Impact Statement/ Report/ Major Investment Study of the North-South Rail Link project in Boston dated November 3, 1997.

The six-point summary of conclusions are as follows :

1. The study under review assumed that there would be no increase in auto congestion by the year 2020. With a more reasonable assumption that automobile use will double by 2020, the forecast ridership would increase by about 12%.

2. The traffic volume survey should have been based on specific, punctual and dedicated origin-destination surveys despite budget constraints. Ridership forecasts are uncertain because they are based on 1995 traffic that was not observed but computerized in 1995. The travel database for 1995 is unacceptable for an investment grade ridership study.

3. A change of locomotive to diesel engine at Woburn station, eliminating the passenger train transfer would increase the expected level of ridership by 340,000 passengers per year in 2020.

4. Were the projected growth at Logan to continue at the expected rate, about 10% of Logan access would be by rail, which is still very low compared to the 35% reached in London and 20% in Paris in the year 2000.

5. The level of induced demand is quite low.

6. In our opinion, intercity ridership will be between 1,170,000 and 1,290,000 in 2020. The North-South Rail Link will increase ridership by about 14.5% over the No-Build alternative.

QUALIFICATIONS OF TRANSPORT RESEARCH INSTITUTE, LONDON

The Transport Research Institute (TRI), based in London, is an independent firm specializing in ridership projections. The Transport Research Institute provides consulting services in transportation project planning and financial management and is particularly active in developing, testing and implementing state of the art planning tools in the transportation industry. TRI consists in experts from several universities who have a broad range of skills and expertise in all aspects of project planning in the railway, highway and air industries.

The author of this review is Andres Lopez Pita, Professor, University Polytechnic of Barcelona, Spain. He was assisted and advised by Olivier Picq, Railway Economist and Jean-Pierre Arduin, Railway Transport Researcher.

Andres Lopez Pita graduated with a Ph D in civil engineering and worked for more than twenty years with the Spanish Railroads (RENFE). He is professor of transport economics at the University Polytechnic of Barcelona. Andres Lopez Pita is a member of different expert working groups within the International Union of Railways (UIC). He is also a member of the Consultancy Committee of the Pan-American Railroad Association and a member of the Board of Directors of the Spanish Railroads. He is the author of more than two hundred publications on railroads.

Olivier PICQ graduated with a Ph D in transport economics and MBA in statistics. Through his work as consultant, he has gained an in-depth knowledge of carrying out traffic forecasts, preparing forecasting methods and tools, planing rail operations for high-speed rail projects and management of engineering projects. He also acquired a thorough theoretical and practical grounding in all fields of the high-speed rail operation (routing, operating-center management and customer relations). He gained extensive experience in the marketing and distribution of railways product in Europe and USA. From 1995 to 1999, he was responsible of the investment-grade ridership and revenue undertaken by the Florida Department of Transportation for the implementation of a high-speed rail network between Miami, Orlando and Tampa. He was also involved in the Quebec-Toronto and Texas triangle high-speed rail projects in North America.

Jean-Pierre Arduin graduated with a mining and civil engineering degree and a MBA in statistics and economics. Working with the French Railroads at the New Infrastructures and High-Speed Rail Department, he was in charge of all the studies of high-speed intercity corridors in Europe and involved in rail feasibility studies in Asia, North and South America and Australia. He studied the major rail infrastructure projects in North America : Quebec City-Toronto, Montreal-New York, the Texas Triangle, San Francisco-Los Angeles, Los Angeles-Las Vegas, and Miami-Orlando-Tampa. After more than twenty-five years of experience in the economics of high-speed railroads, he is internationally well known in transport planning, rail institutional aspects, ridership forecasts, project financing and transport infrastructure fees and privatization.

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I. Objectives of the Intercity Ridership Review

A- Brief description of the North-South Rail Link Project

The North-South Rail Link would provide a rail connection, in tunnel, between South Station and North Station in Boston, Massachusetts, extending the National Rail Transportation Corporation (Amtrak) Northeast Corridor rail service from Washington D.C., New York City and Providence, Rhode Island, through to New Hampshire and Portland, Maine.

B- Scope of Transport Research Institute's Independent Review

The Transport Research Institute was asked to review the intercity ridership portion of the Draft Environmental Impact Statement/ Report/ Major Investment Study of the North-South Rail Link project in Boston. This review is limited to the intercity (Amtrak) segment of ridership projections and to the Rail Link to access Logan airport. The Transport Research Institute did not review any of the material pertaining to commuter rail or other MBTA operations; these projections were considered separately in the North-South Rail Link Study, and are excluded from our scope.

The objective of this Review is to evaluate the overall forecasting process and the assumptions used by the firms that developed ridership for the North-South Rail Link, in order to assess the reasonableness of the forecasts.

This independent review provides some comments about the forecasting procedures and gives a fair opinion about the work that has been done. This review modifies some forecasting assumptions in the interest of producing the most likely set of forecasts.

This analysis includes the evaluation of data sources, assumptions, modeling systems, the application of these systems, and the forecasts of ridership. The reasonableness of the ridership forecasts means that the data are from reliable sources, assumptions are credible, the models are state of the art, the application of the models is appropriate, and the forecasts are credible.

C- Conclusions of the TEMS Report

Transportation Economics and Management Systems, Inc. (TEMS) is the firm responsible for the intercity demand forecasting activities relative to the North-South Rail Link.

TRI reviewed ridership estimates that were produced in 1998 for the North-South Rail Link in Boston under different scenarios. The following table shows the ridership estimates produced. Depending on the assumptions used regarding the frequency of rail service and the auto congestion level, approximately 6.5 to 9.9 million passengers[1] would ride the intercity (Amtrak) rail services during the year 2020 for the Build Alternative consisting of a rail tunnel connecting North and South Stations, a distance of about one mile. This represents an increase of 600,000 to 950,000 passengers over the No-Build option. This table was derived from information found in exhibits 5.1, 5.2, 5.3 and 5.4 of TEMS Report.

(one-way trips)	No-Build Option		Build Option	
Number of riders	(17 roundtrips)	(26 roundtrips)	(17 roundtrips)	(26 roundtrips)
Auto Uncongestioned Scenario	5,848,605	6,568,516	6,463,416	7,273,976
Auto Congestioned Scenario	8,014,107	8,954,706	8,846,647	9,904,430

Source : TEMS Report

II. The Review Process

A- The Forecasting Firms

TRI recognizes that Transportation Economics and Management Systems, Inc. (TEMS) is comprised of qualified industry representatives with substantial experience in intercity rail data collection, demand modeling, and ridership forecasting. The demand forecasting team, in particular, is lead by professionals with substantial experience in forecasting the impact of introducing intercity (Amtrak) rail systems in North-America and abroad. Qualifications comprising the demand forecasting team's experience include :

- Conducting travel surveys
- Developing modeling techniques

[1] One-way annual trips

- Preparing long-term economic scenarios
- Forecasting the impact of new rail systems on intercity travel demand
- Performing sensitivity analyses of key variables

The rail ridership estimates for Logan Airport were produced by the Central Transportation Planning Staff (CTPS).

The forecasting work performed and the final report delivered are indicative of highly experience transportation professionals. Consequently TRI was satisfied with the level of professionalism, expertise and skill applied in the completion of the intercity ridership forecasts for the North-South Rail Link.

B- Information Available for Review

The following reports were provided to the review Consultant:

- *Technical Report No. 4, "Ridership Methodology and Forecasting Study"*, North South Rail Link Project, February 1998
- *North South Rail Link, Intercity Rail ridership and Revenue Forecasts*, prepared by Transportation Economics and Management Systems, Inc. (TEMS), October 1997

In addition to these written reports, we were provided with additional information (interim notes, memorandum, minutes of meetings, …) which facilitated our work.

C- Review of Major Areas of Investigation

The review process we performed addressed seven major areas of investigation including:

1. Transportation Network

Transportation data for public mode services (fares, travel time, frequency of service, access to terminal, …) and automobile (travel time and auto costs) have to be gathered to support the ridership process. The reliability of these data is a key point in regards of the credibility of the forecasts.

2. Socio-Economic Data

Socio-economic current data and long-term forecasts were collected from the most reliable sources. Future total demand growth is driven by socio-economic factors such as population, employment and income. The reliability of these data is another key point in regards to the credibility of the forecasts.

3. Surveys and Travel Database

Travel data was gathered to support the forecasting process. Two types of data were collected. The first was a collect of available information to define the characteristics of existing (1995) travels within the Northeast corridor. The second (stated preference data) was collected through a travel survey to investigate how travelers would react to the availability of the planned rail transportation improvements as a traveling alternative. Both data collections were reviewed relative to their potential for introducing bias or error into ridership forecasts.

4. Forecasting Assumptions

Travel demand forecasting requires making assumptions regarding many variables that are input in the forecasting process. The assumptions made in the ridership forecasts for the North-South Rail Link were reviewed for reasonableness and consistency was checked.

5. Forecasting Methodology

The ridership forecasts for the North-South Rail Link have been derived from the use of various models. The structural form of the models were reviewed and considered as generally acceptable forecasting techniques for reasonably estimating current demands.

6. Ridership Forecasts Results

Rail traffic forecasts were analyzed for the two considered scenarios:

- The "No-Build" case considers all the planned infrastructure improvement up to 2020, and gives the intercity rail ridership forecasts without the implementation of the North-South Rail Link,
- The "Build" case assesses the impact of the implementation of the North-South Rail Link on the intercity rail ridership in 2020.

7. Reasonableness of the Forecasts

Sensitivity tests to the key assumptions were reviewed and helped to determine if the model reacted according to observed travelers behavior.

The "reasonableness" of the forecasts implies that the forecasts are credible in terms of current practice and realistic in terms of underlying assumptions.

III. Transportation Network

A- Intercity Line-Haul Travel Times, Service Frequencies and Out-of-Pocket Costs

The network data regarding the public mode services (fares, travel time, frequency of service, access to terminal, …) and automobile costs were collected from the most reliable sources. Automobile travel times were computed according to two scenarios : uncongestioned and congestioned highways.

Procedures and assumptions to adapt the network database to the zone system have been found highly acceptable and consistent with the procedures and assumptions used in the industry.

B- Future Transportation Network Development

Planned infrastructure investment projects in the public transportation network and for highways have been part of the study. The impact of these projects after future completion is incorporated in the forecasts.

It should be noted that there is no major highway project planned along the corridor that could absorb all the increasing use of automobile. As a result highway congestion is very likely to increase significantly by 2020, and the congested highway scenario should be considered as the “Central Case” scenario. On the contrary, the Central Case scenario considered in the final report is the uncongested or “free flow highway” case. This TRI review finds the “Central Case” forecasts contained in the final report to be very conservative in regards to this highway congestion assumption.

IV. Demographic/Socio-Economic Data

The socio-economic data (population, employment and household income) as well as their long-term projections have been derived from the most reliable sources :

- *1990 Census of Population and Housing*
- *Bureau of Economic Analysis Regional Projections to 2045*

Procedures and assumptions to adapt the socio-economic database to the zone system have been found highly acceptable and consistent with the procedures and assumptions used in the industry.

V. Survey Data Collection

A- Overview of the Data Collection Strategy

Stated preference surveys are used to collect information describing how respondents think they would react to a new, previously not experienced, situation. This type of survey was conducted as part of the data collection activity leading to the preparation of the North-South Rail Link ridership forecasts. Respondents were asked to report whether they would switch travel modes for the trip that was intercepted under a range of rail service characteristic alternatives. These data were used to structure the TEMS mode choice model.

The collection of stated preference data presents unique challenges to demand forecasters. First, people are asked to describe their reaction to a mode with which they have no first hand experience. Secondly people are asked to answer today on their future behavior, up to 25 years later, which is introducing a bias in the forecasts as far as a lot of extraneous factors that the travelers are not aware of yet can modify their planned behavior during such a period of time. Despite these potential shortcomings, the collection and use of stated preference data has become standard practice in the evaluation of new transportation modes.

B- Summary of Stated Preference Data Collection Results

2,032 surveys were undertaken. After TEMS conducted analyses of the data intending to identify illogical response patterns, the number of valid questionnaires has been reduced to 1,369. The use of this stated preference survey is to derive the value of time, the value of access, the value of interchange, and the value of frequency by trip purpose and mode of transport. As a final result, the stated preference survey provides a logical set of values. The values of interchange are of particular importance in this study. These values have been determined with a lower number of surveys (750 valid answers). The result is that the interchange is perceived as a major obstacle to travel : the value of interchange is ranging between $44 to $80 per hour above the value of travel time depending the travel mode and the trip purpose. The burden of the interchange is more important for non-business passengers, family and senior citizens travelling with heavy baggage than for business passengers. Moreover the interchange is perceived by the rail users as a hardship with values of time for interchange reaching high records.

VI. Travel Database Development

A- Zone System

The travel corridor is segmented into geographic sub-areas of sufficient details to represent adequately the travel time and cost differences between competing modes. The zone system consisting of 141 geographical zones appears to be large enough to use disaggregated travel demand models and to derive reliable ridership figures by rail stations, and covers efficiently all states in the Northeast corridor.

B- Market Segmentation

The TEMS study splits the overall market into different components, market segments, having different travel objectives and observed behavior patterns. These procedures are critical to the preparation of reliable forecasts and are consistent with standard practice.

C- Intercity Travel Volumes

Different sources of data were used to assemble the intercity travel demand database :

- **For Air traffic volumes** *: Origin-Destination Survey of Airline Passenger traffic, Air Transport Association of America,*
- **For Bus traffic volumes** : *no traffic data available,*
- **For Auto traffic volumes** : *Central Transportation Planning Staff (CTPS) and Boston-Portland rail study ("Ridership and Revenue Forecasts : Restoration of Passenger Rail Service in the Boston-Portland Corridor", 1993),*
- **For Rail traffic volumes** : *Amtrak ticket count information.*

All the available sources are providing aggregated traffic flows, and trip allocation models were used to allocate trips by zones and trip purposes. The structure of the models used to derive the ridership estimates for the North-South Rail Link requires this allocation of the total trips to the 141 zones and two trip purposes. Nonetheless, this procedure is subject to uncertainty and may introduce a very high bias in the forecasting process. As a result, the total number of trips derived from very reliable sources such as Air Transport Association of America and Amtrak certainly reflects the current total demand very well but the disaggregation by zones and trip purposes may prove to be very far from the reality of 1995.

Regarding the auto traffic and bus traffic, it seems that the traffic flows have been totally generated both in terms of number of trips and spatial distribution.

This procedure consisting of generating the traffic volumes and/or allocating the number of trips brings a serious uncertainty in the results of the ridership study. This decision of generating the database, rather than conducting an origin-destination survey, was certainly based on budget and/or time constraints. Nevertheless an origin-destination surveys, even limited to a small amount of origin-destinations, would have given a better image of the travel market in 1995, and would be the only way to validate/invalidate the results of the generation/allocation modeling procedures.

VII. Forecasting Assumptions

Future event forecasting, by its very nature, includes a level of uncertainty. Assumptions made regarding factors affecting overall travel demand and the utilization of the North-South Rail Link may or may not actually come to pass. Demand forecasters attempt to make reasonable assumptions in these areas using the “best” information available at the time the forecasts are prepared.

We reviewed and concurred with most of the assumptions used in the forecasting of the overall travel demand in the corridor and in the share of total demand that would be attracted to the North-South Rail Link.

A- Assumptions regarding Socio-Economics

The assumptions regarding population, employment and income growth appear to be taken from the best available sources of information. These economic growth forecasts should be achievable over the 25-year forecasting period and may prove to be conservative if the economic expansion in the Northeast Corridor continues at current observed rates, which is not considered in the forecasts.

B- Assumptions regarding Railway Service

Assumptions used to describe the travel time and access/egress time appear to be reasonable. It should be noted that the forecast reports indicate that two scenarios were developed concerning the frequency of service of the future railway service. The level of railway service to be provided should be considered by taking into account the train operation constraints (through the tunnel, and at some critical points along the corridors), the availability of the rolling stock to

accommodate passenger trains, and the operating and maintenance costs generated by the running of extra trains. A cost-benefit analysis should have been done and would have given answers to the best frequency scenario. This adjustment would tend to slightly impact the North-South Rail Link ridership but would definitively improve the overall economics of the rail project.

Moreover, the future railway service as it has been planned still requires a train interchange at Woburn station through a cross-platform for passengers traveling from/to North of Woburn, Maine and New England. TRI highly recommends to evaluate the feasibility of providing through trains by the addition of a diesel traction at Woburn station. The change of train is and will increasingly be perceived as a very important hardship, and is undoubtedly a strong railway traffic decreasing factor. Knowing both that the values of railway interchange revealed by the Stated Preference survey are high and that the impact of the elimination of the first interchange at South station on the rail traffic is important, the elimination of the second remaining interchange should also noticeably increase rail traffic to/from North of Woburn.

C- Assumptions regarding Feeder Services

Assumptions were also made regarding the access mode to rail intercity passenger services. The ridership estimates show that the planned feeder services to intercity (Amtrak) rail passenger services will be used by a large number of travelers. Should this feeder service not be made available, or available at a decreased level of service, then a significant reduction in the North-South Rail Link usage should be expected.

D- Assumptions regarding Air Fares

Assumptions regarding the air fare are always a sensitive issue. The TEMS forecasters have chosen to adopt a no-change policy and to keep the air fares at current levels for the long term period. TRI concurs with this approach but a sensitivity test regarding how a variation of air fares impacts the North-South Rail Link ridership forecasts is clearly needed to evaluate the robustness of the forecasts. Such a test has not been presented in the reports.

E- Assumptions regarding Auto Congestion

It is very clear that the uncongested scenario is unlikely to happen, taking into consideration the skyrocketing use of automobile and the absence of any new major road project to absorb all the increase of auto traffic. The congested

scenario with an annual growth in travel time of 3% in urban areas and 1.5% in rural areas seems very likely to happen. This in turn would increase North-South Rail Link ridership by about 12% in the TEMS study.

VIII. Forecasting Models & Ridership Forecasts

A- Overview

The methodology used by TEMS to perform the ridership forecasts is analyzed in the following sub-sections of this report. TRI has confidence in the TEMS model structure and validation tests contained in the forecast reports.

We found the methodology used to be state of the art.

However, it is the use of the modal share model as a sequence of binary choices which is not convincing. The modal share should be modeled as a whole choice between the available modes of transport, and not, as a sequence of binary choice *Public Transport/Private Transport*, then *Air Transport/Ground Transport*, then *Rail Transport/Bus Transport*. The structure of the modal choice constitutes the most critical point of the methodology analysis.

The model of total demand then the model of modal share are successively examined. The models have been found correctly calibrated and suitable for reliable forecasts.

B- Total Travel Demand Model

The Compass@ model used by TEMS is a multi-modal demand model comprised of two sub-models:

- The total travel demand model, that is used to estimate both the natural growth of the total market and the level of induced demand;
- The modal share model, that is used to determine the proportion of travelers changing modes of transport.

The following paragraph analyzes the total travel demand model.

1. Model specification (Functional form and Data)

$$T_{ijp} = e^{\beta_{0p}} \ (SE_{ijp})^{\beta_{1p}} \ e^{\beta_{2p} U_{ijp}}$$

T_{ijp}, being the number of trips between the zones i and j for the trip purpose p

SE_{ijp}, being the socio - economic variables for the zones i and j for the trip purpose p

U_{ijp}, being the total utility of the transportation system for zones i and j for the trip purpose p

β_{1p} being the elasticity of the number of trips to socio - economic variables for the trip purpose p

β_{2p} being the elasticity of the number of trips to the total utility of the trip for the trip purpose p

β_{0p} being an adjustment constant for the trip purpose p to be calibrated with the linear regression technique.

The total travel demand model has the following functional form:

The functional form of the model is classical.

The explanatory socio-economic variables are broken down by trip purpose:

- Employment and annual household income for business purpose;
- Population and annual household income for non-business purpose.

The travel utility is a function of the generalized costs of the modes of travel :

$$GC_{ijp} = TT_{ijm} + \frac{TC_{ijpm}}{VOT_{mp}} + \frac{VOF_{mp} \times OH}{VOT_{mp} \times F_{ijm}}$$

TT_{ijm} being the travel time between zones i and j for mode m,

TC_{ijpm} being the travel cost between zones i and j for mode m and trip purpose p,

VOT_{mp} being the value of time for mode m and trip purpose p,

VOF_{mp} being the value of frequency for mode m and trip purpose p

OH being the operating hours,

F_{ijm} being the frequency of departures between zones i and j for mode m ,

In the Compass@ TEMS model, the generalized cost of transport is expressed in time units (minutes) rather than in cost (dollars). This specification although unusual is nevertheless acceptable, and has no influence on the capability of the model to derive reliable ridership estimates.

2. Model Parameters (Estimation Method, Interpretation and Reasonableness)

The coefficients are estimated by using the linear regression techniques:

$$\ln(T_{ijp}) = \beta_{0p} + \beta_{1p} \ln(SE_{ijp}) + \beta_{2p}(U_{ijp})$$

$$U_{ijp} = f(GC_{ijp})$$

GC_{ijp} being the generalized cost of travel between zones i and j for the trip purpose p

The elasticities have generally accepted values.

The statistics of Student found in the TEMS Report are quite high which shows the statistical robustness of the values of the parameters. The incremental form of the total demand model is used to estimate the total travel demand. There is no particular objection to use the pivot point method.

The procedure used relates travel growth to growth in population or employment and income. It assumes that the transportation level of service changes between the base year and the No-Build/Build scenarios.

The procedure used is consistent with accepted standard practice, and produces confident estimated growth rates to be applied to the base year travel volumes.

3. Growth Rate Forecasts

As a result of the application of the model, the total demand grows at the average rate of 1.8% per year which is quite low considering the observed growth in the travel demand in the corridor during the past years. This moderate growth rate in the total demand reflects the conservatism of the economic growth assumptions. It should be noticed that the structure of the model applies the same natural growth rate to all the modes, which is quite unlikely.

4. Induced Travels

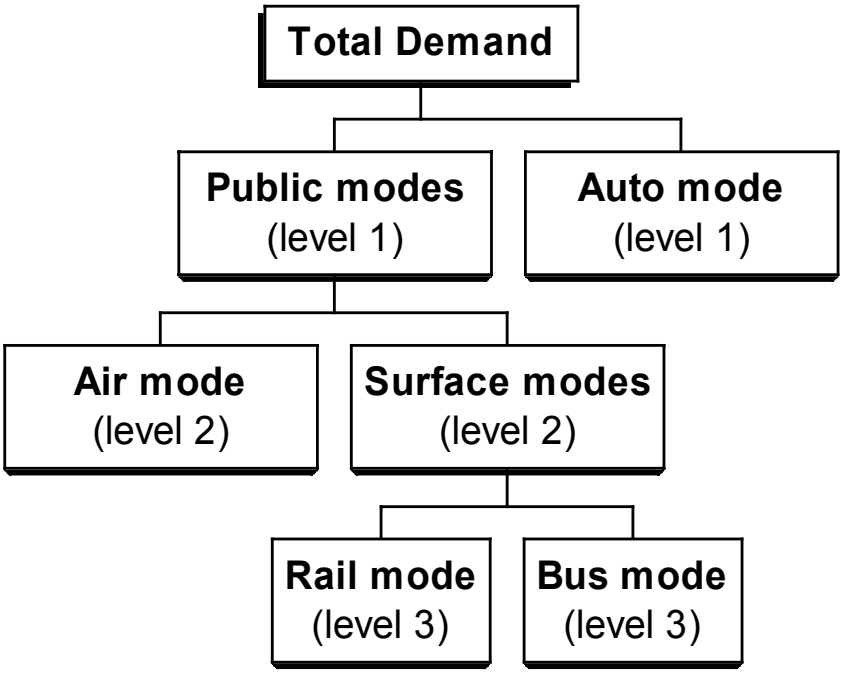
Induced travel is comprised of trips that are made because there is a rail improvement in the corridor and that would not have been made in the corridor if the rail improvement did not exist. The Consultant uses the total demand growth model to derive the induced demand through a component describing

the available transportation system as measured by the utility function. Changing the transportation system by providing better rail service results in a higher total travel demand when applying this model. It is this additional demand that forms the rail induced demand.

C- Mode Share Model

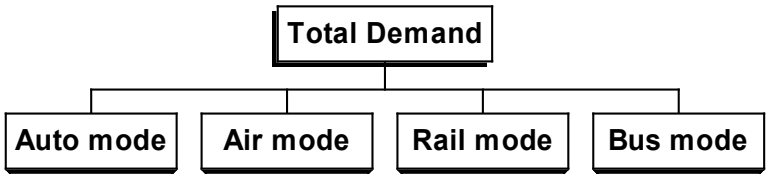
1. Overview

The Compass@ mode split model uses a nested logit structure. Three levels of binary choice were calibrated.



The methodology is acceptable but the way the modal choice is structured in a sequential way has not been proved to be the one that most closely reflects the observed behavior of the traveler. Moreover nested logit models may prove to be very difficult to calibrate when some available modes of transport have relatively a low market share, which is the case for the bus and rail modes along the Northeast Corridor. In practice, this type of model may not allocate all the traffic to all the transportation modes that are available to the traveler. As a result, it would have been interesting to proceed also with a logit type model where the traveler makes a unique choice between different alternatives of travel as illustrated hereafter. This different structure of the logit model could have been used to verify the robustness of the results, and the experience has

shown that the logit models with direct allocation share (one level model) are very effective.



2. Model Specification

The binary logit model is used with this equation :

$$P_{ijmp} = \frac{e^{U_{ijmp/\rho}}}{e^{U_{ijmp/\rho}} + e^{U_{ijnp/\rho}}}$$

P_{ijmp}, being the percentage of trips between the zones i and j by the mode m for the trip purpose p,

$U_{ijmp/p}$, being the utility function of modes m for the trip purpose p,

$U_{ijnp/p}$, being the utility function of modes n for the trip purpose p,

ρ, being the nested coefficient.

The utility is inclusive as the log-sum definition is used :

$$U_{surface} = \ln(e^{Urail} + e^{Ubus})$$

We totally agree with the description of the nested logit model.

The incremental form of the modal split model was used to estimate the market share for a specific mode of transport.

3. Model Parameters

The three levels are correctly calibrated and we concur with the set of parameters given even if we do not have the description of all the calibration process.

4. Validation and Sensitivity Tests

TEMS presents a very in-depth analysis of the coefficients found in the current study and other coefficients derived from other corridors. It is clear that both models are correctly calibrated and are suitable for ridership forecasts.

It should be noticed that the sensitivity tests were performed only for socio-economic variables. It would have been of great interest to know how the model reacts with a variation of other extraneous factors such as rail and air fares and rail travel times.

D- Intercity Ridership forecasts

1. The No-Build Scenario

The rail ridership and market share sharply increases in the No-Build scenario because of:

- The seeding of the Boston-Portland service,
- The rail improvement between New York and Boston.

The following table is an estimate of the different factors generating rail traffic between the base situation (1995) to the No-Build case (2020) with high frequency and uncongested highway. This table was derived from exhibits 2.12, 2.13, 5.1 and from information found in page 5-1 of TEMS Report.

Rail traffic	
Year 1995 – Base case without the Boston-Portland service	1,985,409 Trips
Year 1995 – Base case with the "seeding" of the Boston-Portland service *	2,401,190 Trips
Year 2020 – Reference case with the natural growth of the market	3,734,734 Trips
Year 2020 - No Build case taking into account rail improvement South of Boston only – Scenario high frequency – Uncongested highway	6,568,516 Trips

* The "seeding" of the Boston-Portland service generates a rail intercity ridership of 415,000 trips in 1995.

The effect of the rail improvement between New York and Boston, (without the completion of the North-South Rail Link project) is about 2,833,000 extra trips in 2020, whose 2,625,000 trips are diverted from other modes and 208,000 are

induced. 10% of air trips (971,000 passengers) and 17% of bus trips (473,000 passengers) are diverted to railway services. Only 0.7% of auto trips (1,182,000 passengers) are diverted to the improved railway service.

In case of the *No Build* scenario the induced demand accounts for 7 to 8 per cent of the increase in rail traffic.

2. The Build Scenario

The Build scenario evaluates the impact of the North-South Rail Link : the Rail Link is constructed between the North and South stations, the electrification of the rail service is extended from South station to Woburn, and trains do not stop at North station. In the case of the uncongested scenario with high frequency service, the increase in ridership is 705,000 riders. 214,000 are diverted from air, 137,000 diverted from bus and 318,000 diverted from automobile. Induced trips amount to 37,000 passengers which accounts for 5% of the increase in rail ridership.

The forecasts are in the good range both for the No-Build and Build scenarios. The diversion rates from the existing modes are realistic : the air and bus modes being the most affected in terms of proportion of their travelers switching to rail services and the auto being very marginally affected by rail services. Nevertheless, it should be noted that the level of induced demand is quite low, especially in the Build scenario with only 37,000 induced trips.

E- Logan Airport Ridership Forecasts

The access to Logan Airport by Public Transportation would be significantly improved by the North-South Rail Link. The data and the modeling approach that support the rail ridership forecasts were thoroughly reviewed in order to give a fair opinion on the work done for assessing the impact of the North-South Rail Link on Logan Airport. The rail ridership results for Logan Airport were also analyzed then compared to other airports having a similar rail connection in Europe.

1. Database for the Logan Airport Analysis

The Central Transportation Planning Staff (CTPS) built the Boston Metropolitan Regional Transportation model. This model is well known and very frequently used to prepare the traffic forecasts in the area of Boston. The model incorporates the regional highway system, the commuter rail system, the rapid transit system, the local and express bus services and the water shuttle services.

The model is based on data provided by the Massachusetts Transportation agencies, and on specific diaries including 3,900 households in the Metropolitan Boston Region. The household travel survey and the commuter rail survey from 1991 were also used.

It should be noticed that the data seem to be very detailed for the Metropolitan Boston region and provide a very good database for people living/working in the Metropolitan Boston area but are not so well representative of people living/working outside the Metropolitan area.

2. The Modeling Approach for the Logan Airport Analysis

There is very little indication given in the reports about the modeling approach used to derive ridership forecasts for the Logan Airport. It seems that there is no specific model to estimate the rail traffic in connection with Logan Airport. We found that portions of the forecast modeling approach and procedures were not documented in the reports, and we could not complete our review of the procedures used for the rail ridership estimates for Logan Airport.

3. Ridership Forecasts for the Rail Link to access Logan Airport

Forecasts for passengers using rail services to access Logan Airport, derived from Table 3.3-1 of the MBTA Regional Ridership chapter, are shown in the table hereafter:

(daily traffic)	**Base case (1995)**	**No-Build case (2020)**	**Build case (2020)**	
			3 stations	*2 stations*
MBTA Logan Airport trips	4,500	11,900	13,250	13,700
Regional Rail	150	1,525	2,850	3,300

The rail forecasts for the Build case shows an expected rail traffic increase of 2,675 passengers in the three-station option and 3,575 passengers in the two-station option. It corresponds to an increase in rail ridership of 20% over the No-build case for the three-station option and 26% for the two-station option.

In 2000, about 26 million passengers were using Logan Airport. According to official Logan Airport forecasts, air traffic is expected to grow at an average annual rate of 3.3% reaching 37 million passengers in the year 2010. Air traffic would increase to 51 million passengers in 2020 if the same growth forecast for the 2000-2010 period is continued during the 2010-2020 period. As a result, the market share of public transportation to access Logan Airport would nearly double in 2020 increasing from 5.5% in 1999 to about 10% in 2020. The net

impact of the North-South Rail Link is a gain of 1% to 2% in the market share of public transportation. It is the TRI's opinion that this impact is quite low and the effect of the North-South Rail Link outside the Boston Metropolitan area is underestimated.

4. Comparison with Other Air-Rail Connections

The connection of a Metropolitan area and its airport by rail transportation has proved to improve dramatically the convenience of the airport access in several European cities. In London, both the Heathrow Express and the regional commuter rail link connect Heathrow Airport to the Metropolitan area in 30 to 55 minutes. In Paris, Charles-de-Gaulle airport is also connected to the center of Paris by a regional commuter rail in 30 minutes. The market share for the rail transportation has reached 35% in London and 20% in Paris in 2000. In regards to these experiences, the market share forecast for the Logan Airport connection appears very low taking into account the heavy auto traffic expected by 2020.

5. Conclusions

The forecasts for Logan Airport are quite conservative. Recognizing the importance of a rail connection for the future of Logan Airport, we recommend developing a specific and dedicated model for the airport link based on a traffic database extended to regions outside the Boston Metropolitan area. The North-South Rail Link connection should be able to enlarge the hinterland of Logan Airport by attracting more passengers living North and South of Boston.

IX. REASONABLENESS AND AREAS OF POTENTIAL CONCERNS

The forecasts are very reasonable despite some potential concerns.

A- Areas of Potential Concerns

The major area of concern is the travel volume database set up for 1995. Every investment grade ridership study should be based on a large origin-destination survey that supports all the ridership modeling activities. The lack of an origin-destination survey in 1995 can potentially be considered as a fatal flow.

Moreover, it is our opinion that the level of induced demand may prove to have been underestimated for the Build scenario.

Other potential concerns are regarding some assumptions regarding highway congestion and rail service:

- The uncongested scenario has been preferred to the congested scenario in the final report;
- and the elimination of the interchange at Woburn station has not been considered.

B- Likelihood of the Forecasts

As far as ridership forecasts are concerned, it is a common use to determine the most likely scenario, which should be neither optimistic nor conservative. This most likely scenario should be based on a set of realistic assumptions and should constitute the Central Case forecasts.

Consequently, a revision of the assumptions concerning the auto congestion and the rail interchange at Woburn station has been made in order to derive what TRI considers to be the most likely scenario.

Under the auto congestion assumption, and according to the TEMS study, the North-South Rail Link would provide an increased ridership of 833,000 passengers in the case of 17 round trips per day and 950,000 passengers in the case of 26 round trips per day in 2020.

Also, it has been also possible after a detailed exam of the ridership structure and the generalized costs to estimate roughly what could be the impact of the elimination of the rail interchange at Woburn station. It is likely that a direct service without train transfer at Woburn station would increase the North-South Rail Link ridership by 340,000 passengers in 2020. As a result, the Central Case estimates for the North-South Rail Link is an increase in ridership of between 1,173,000 and 1,290,000 riders in 2020. The additional impact of the North-South Rail Link is about +14.5% over the No-Build alternative.

It should be noted that these results are totally dependent of the 1995 travel database that constitutes the base of all the forecasting work. As far as the ridership forecasts for the North-South Rail Link are concerned, it is impossible to foresee how the completion of an origin-destination traffic survey, as it is recommended, may affect these results.

C- Other Relevant Experiences

This forecast increase in traffic of +14.5% for the North-South Rail Link is very reasonable in comparison to other rail projects. Several projects in Europe have planned the elimination of one or two rail interchanges:

- The Channel tunnel between London and Paris allows to operate direct intercity rail service between these two cities. The rail traffic has multiplied by 10.
- The high speed rail by-pass around Paris avoids two train interchanges in the center of Paris. The rail traffic has multiplied by 5.
- The Talgo trains between Paris and Barcelona with an automatic adjusting gauge system avoids a train transfer at the Spanish border. The rail traffic has multiplied by 1.5.

In comparison with these European experiences, it should be stressed that the forecast rail impact of the North-South Rail Link is modest.

X. CONCLUSIONS OF THE TRI REVIEW

The TRI review suggests the following comments regarding the rail ridership report done by TEMS on the intercity or Amtrak portion of the project:

- *Overall approach used*

The North South Rail Link intercity ridership study includes the conduct of a stated preference survey, the development of the state-of-the-art mathematical model, the segmentation of the travel markets, the testing of sensitivity scenarios, and the participation of a qualified peer review. The work that has been done is acceptable and reasonable. The overall approach concurs with generally acceptable practices with a major exception of the development of the traffic volume database. The traffic volume database should have been based on specific, punctual and dedicated origin-destination surveys despite budget constraints.

- *Forecasts validity*

The mathematical models, the main assumptions and the forecast procedures are considered acceptable.

- *Ridership Uncertainty*

The ridership forecasts presented in the North South Rail Link report are primarily based on 1995 traffic movements that were partly generated then fully allocated within the zoning system and the trip purpose segmentation. This procedure brings an uncertainty into the forecasts. It is very difficult to say that the forecasts are likely to happen because the final estimates depend on 1995 broken down traffic flows, by trip purposes and micro-zones, that were not in fact observed in 1995. It is difficult to say in which proportion and to which extent, positive or negative, the uncertainty relative to the 1995 base year database would affect the forecasts.

- *Reasonableness of the forecast*

Some other findings could affect the ridership forecasts:

(i) Level of Auto congestion : the scenario retained as “Central Case” does not take into account any increase in auto congestion. This assumption is very conservative because the use of automobile is expected to double up to 2020. No major highway infrastructure project is planned in the Northeast corridor to relieve all the highway traffic. It is very likely that the increased auto congestion scenario as developed in the TEMS study would increase the expected level of intercity rail ridership by about 12%.

(ii) Rail interchange at North Station : the remaining rail interchange at Woburn for passengers going (or coming from) north of Boston is a serious obstacle for attracting rail ridership. Experience derived from North America and Europe shows that a rail interchange cuts rail ridership dramatically, and passengers are more and more reluctant to use so inconvenient rail services. The expected level of rail ridership would be increased by 340,000 passengers in 2020 by adding a diesel engine locomotive, thereby providing through service for passengers at Woburn station.

- *Conclusions and recommendations*

(i) Doing a dedicated, punctual and specific origin-destination survey that would validate/invalidate the 1995 traffic volume data base would address our main concern.

(ii) The revised assumptions in terms of auto congestion and through service at Woburn station should yield increased ridership. As a whole, the increase in intercity ridership with the completion of the North-South Rail Link tunnel may prove to be in the range between 1.2 and 1.3

million passengers for the year 2020 with the assumption the 1995 travel database has been well generated and allocated, the additional impact of the North-South Rail Link being about +14.5% over the No-Build alternative.