Empresa de Ferrocarriles Suburbanos S.A. (FESUB)

Santiago Commuter Rail Study

FINAL REPORT

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with

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Section I.

EXECUTIVE SUMMARY

A. Purpose of This Report

An international team, consisting of Parsons Brinckerhoff International, Inc. (PBI), R. L. Banks & Associates, Inc. (RLBA), and Consultores de Ingeniería Ltda. (CDI) was retained by Ferrocarriles Suburbanos S.A. (FESUB), a subsidiary of Empresa de los Ferrocarriles del Estado (EFE), in April, 1997, to perform the following tasks:

- Evaluate the current suburban rail operations in Chile.
- Determine the economic and operational feasibility of achieving a privatized, high quality commuter rail operation for the Santiago Metropolitan Area.
- If such an operation is considered feasible, recommend an implementation plan.
- In the implementation plan, provide a specific outline of the economic and operational requirements.

This report describes the current suburban rail system in the greater Santiago area, presents recommendations for service improvements, and specifies methods whereby the improved service can be initiated and operated through a private operator.

B. Findings and Recommendations

1. The Railroad

The railroad in the Santiago region was originally constructed to high standards. It was fully capable of supporting freight, intercity passenger, and suburban commuter services. Ample yards and shops were provided. Suitable interlockings, stations, and branches supported the operation. Train movements were controlled by automatic block signals. Other characteristics included 1676 mm gauge track, and electrification at 3,000 volts DC through an overhead catenary system.

Since World War II, the railroad has not benefited from any investment. Therefore, technological upgrades, such as modern rolling stock and supervisory train control, are absent. In addition, the fixed plant has deteriorated. Along with this deterioration, service has declined significantly, in both frequency and quality.

This degradation in the railroad has occurred during a period when competing modes of transport have markedly improved. These modes include express highway, long-haul and suburban bus, and rail rapid transit. In addition, automobile ownership is increasing as the general economic level of the country improves.

A major factor in Chile's economic growth has been the government's initiatives toward privatization and achievement of the efficiencies of a free-market economy. These initiatives have provided a climate supportive of rapid economic expansion. More importantly from the perspective of this report, a result of these initiatives has been an increase in the public's perception of the high level of performance of all modes of transport except the railroad. In fact, the public seems

to have lowered its perception of the quality and level of service which the commuter railroad can provide.

Appreciation of this public perception is critical to the recommendations contained in this report. Thus, while the public continues to ride trains, the railroad as a mode is not perceived as one that can compare and compete favorably with others. This perception persists in spite of the cheaper fare and faster trip time the railroad provides between Santiago and Rancagua.

However, the inferior level and quality of commuter rail service is not because the competing modes are inherently superior. Rather, it derives from the comparison of modes of modern design and operation to a railroad that has been allowed to become technologically obsolete and poorly maintained.

EFE, in conjunction with the government, is beginning to change the public's perception, through critical investments and pursuit of a series of organizational and economic initiatives. The subsidiary organizations of FESUB, Metro Regional de Valpariso (MERVAL), and the Real Estate Organization were established with a high degree of autonomy. The railroad freight operation was privatized, and the groundwork has been laid to privatize the intercity passenger operations.

EFE also has made limited capital investments for such items as new commuter rail rolling stock and track improvements. These initiatives are commendable, and have served to maintain the railroad system at a minimum level of operability. However, a more strategic and comprehensive approach is required for the suburban rail service to succeed as an important element in the overall transportation network of the metropolitan Santiago area.

2. Observations Regarding Suburban Service

This study is based on observations made by the team during site visits and interviews. The following items are included in these observations.

- The railroad was originally planned and designed to provide for a high degree of compatibility between freight, intercity, and suburban passenger service. Its configuration enabled high levels of service for each type of operation.
- The railroad was originally constructed to high standards. However, it has seen only minimal technological improvement since construction. Furthermore, it has suffered from many years of deferred maintenance and asset divestiture.
- The suburban passenger service offered as of September 1, 1997, does not provide an accurate picture of the utility that can be gained from the commuter rail mode. The danger in this is that the current commuter rail operation will be perceived as the best that can be provided in terms of service level and quality.

- The current condition of the commuter rail operation has implications for all aspects of this study. For example, the current service provides virtually no basis for establishing the minimum service quality of a privatized system. Indeed, the competing Tour Bus provides the benchmark that a privatized commuter rail could achieve.
- The current commuter rail ridership cannot be used as an accurate predictor of the potential rush hour ridership. This is because ridership has diminished due to extremely long intervals between trains during the busiest travel periods, and because of poor on-time performance. For the same reasons, the potential modal split between bus, rail, and private automobile cannot be determined.
- The population growth of metropolitan Santiago has been coupled with high levels of motor vehicle traffic congestion. The growth and vehicle congestion have been channeled into narrow corridors formed by the mountain ranges. These patterns emphasize the clear benefits which could result from a modern commuter rail system for the region.
- Increasing motor vehicle congestion is worsening an already severe air pollution problem.
- Population growth and vehicle congestion are at levels where a rebirth of the commuter rail system should not be gained at the expense of other modes. Indeed, commuter rail should be viewed as one component of a balanced, multi-faceted passenger transportation system, including Metro rail, long-haul and suburban bus, intercity rail, private automobile and taxis, bicycles, and even travel on foot.
- The existing EFE network, including the lines to Tiltil and Melipilla which currently offer no passenger service, represents an irreplaceable asset. These are continuous rights of way not now being used efficiently for the movement of people.
- Time is of the essence, due to the continuing decapitalization of the railroad, and the current initiatives to privatize the rail freight and intercity passenger services.

3. Path Forward

As a result of this study, the PBI team has determined that it is feasible to develop an efficient commuter service on the existing rights of way. In fact, the team recommends that FESUB be improved and expanded, with this being accomplished through privatization. A private concessionaire should be sought to rehabilitate the system, and then to operate service at specified levels for a defined period of time.

This approach appears to be economically viable, provided government interest and support exists. The required government interest is in two forms:

First, a one-time capital investment. This would be used to restore and improve the fixed plant and rolling stock to the point where commuter rail can provide reliable service, comparable to competing modes. The private operator then would be required to adhere to specific service standards, with measurable levels of frequency, amenities, performance, and quality.

Second, an ongoing sharing of revenue "risk" with the private operator. This would be through some form of government support, such as the purchase of a pre-determined number of tickets, to be used to encourage patronage.

This two-pronged approach, described in more detail in Section IV of this report, has the following benefits:

- Attracting private operators, through an equitable sharing of revenue risk. This is a critical factor. The lack of available data regarding the elasticity of commuter rail ridership casts doubt on whether accurate demand forecasting can be performed. Given this uncertainty, in the absence of risk-sharing, private operators would be discouraged from bidding.
- The government will receive an indispensable service. Therefore, the risk-sharing should not be considered as a subsidy, since the government's purchased transportation could support public policy in other areas, such as industrial development, housing, real estate development, or air pollution abatement. This approach is consistent with governmental and social policy in Chile.
- The operator will be provided with a substantial incentive to achieve efficiency and to control costs. This incentive derives from the measurable service goals that must be met, in exchange for the provision of a functional rail system and an equitable sharing of risk with regard to travel demand.

The necessary rehabilitation and improvements to the rail system should involve the application of readily available technology, so that the required design work is technically straightforward, and can be completed quickly. Consequently, the "Path Forward" is recommended to be:

- Retain a professional services firm to prepare the Conceptual Design and a Build-Operate-Maintain (BOM) tender. This firm would also coordinate the suburban privatization with the intercity passenger and freight operations, and with the activities of the Real Estate organization.
- Define the required level of rehabilitation and improvements in the BOM tender. The tender would also require the contractor to state a firm price for carrying the conceptual design to completion, and for implementation of the capital rehabilitation and improvements necessary to operate an efficient, and ultimately profitable, service.
- Require the preparation of a business plan for the second part of the BOM tender. While the first part of the tender focused on capital investment, the second part will cover the operation of the suburban commuter rail service

within the greater Santiago region. This part of the tender will specify defined target dates for the progressive expansion of the system, the support required from the government, and the financial goals leading to the payment of a premium to the government as the service succeeds. The overall tender will require coordination with the freight and intercity passenger railroads and the Real Estate business (Nueva Via). The content of the tender is outlined in Section IV of this report.

Section II

BACKGROUND

A. Project History and Methods

1. Overview

The Project Team was led by Parsons Brinckerhoff International, Inc. (PBI). Key individuals from offices in Buenos Aires, Argentina; Newark, New Jersey; and Washington, DC, participated. PBI managed the project, and performed tasks related to evaluation of systems, rail operations, and requirements for rail improvements and rehabilitation.

R. L. Banks & Associates, Inc. (RLBA), was a strategic partner. Headquartered in Washington, DC, the firm evaluated the viability of the proposed privatization from the business perspective. This evaluation included assessments of potential demand, and competition with other transport modes.

Consultores de Ingeniería Ltda. (CDI), headquartered in Santiago, performed several key roles. The firm acted as local liaison, provided assessments of other transport modes and local land use issues, and assisted in the evaluation of the current state of the FESUB infrastructure and rolling stock.

Initial site visits occurred in March and April, 1997, and an interim report was submitted in early September, 1997. The interim report provided an initial assessment of the railroad's fixed plant, rolling stock, and operations. It also suggested that privatization could be accomplished with government support, including significant initial capital investment.

Team members again visited the railroad, September 27 to October 1, 1997. The purpose of this visit primarily was to inspect the newly-arrived Spanish trainsets and to discuss the direction the study was proceeding. On September 30, a presentation was made to Executive and Senior EFE staff. Thereafter, team members met to discuss findings, and to finalize plans for the format and delivery schedule of the final report.

2. Investigative Approach

Data required to achieve project goals ranged from very specific technical information, to the very general. The specific information included such things as the condition of the railroad's signal system, and its service schedule and fares. The general included the general state of Santiago's economy and the government's overall economic philosophy. There were three primary sources of information.

a. Interviews

Detailed interviews were conducted by team members with responsible officials of EFE. The officials represented a variety of departments, including marketing, engineering, transportation, and planning. Interviews were also conducted with government officials, the former head of FESUB, and officials of Nueva Via and Tour Bus.

b. Site Visits

Visits were made to each line. Walking inspections were conducted on a selective basis. Particular attention was given to Alameda Terminal, the locomotive shops, Rancagua Station and Interlocking, Talagante and Tiltil, and the Alameda Tunnel. Observations of peak and off-peak operations were made at different locations. Rides were taken in both the coaches and cabs of trains in passenger service, and on one of the new Spanish trainsets.

c. Data and Statistics

Information was provided by EFE regarding schedules, on-time performance, failure analysis, and ridership. While EFE was helpful in providing some of the required data, certain key information was not available, such as track charts and maintenance histories. Data were also unavailable for planning-related matters, such as ridership elasticities in comparison to fares and trip times. Miscellaneous and more general data were obtained from general discussions, publicly-available maps, and print articles concerning business activity in Chile.

B. Organization of the Report

The structure of this report reflects the task listings in the Request for Proposals. Section III addresses each of these, with the exception of Task N, Proposed Tender. The task that pertains to the actual proposed tender is addressed in Section IV, where a specific outline of a BOM tender package is presented.

C. Current Status

1. Economic Philosophy in Chile

Chile was under the direction of an elected Socialist government led by Salvador Allende, during the period 1970 to 1973. During this period, the economy was highly centralized, under government control. Major businesses operated under State direction. As a result, the Chilean economy nearly collapsed.

The return to an elected government in 1989 has resulted in an economic rebirth in Chile. Indeed, the orientation to a private economy exceeds that of most West European and North American economies.

In Chile, business structures are developed for privatization of segments of the economy where public operation is accepted as a "necessary evil" by other free-market economies. This includes such segments as urban transit and suburban freeways.

In North America, passenger rail operations are generally considered to require an operating subsidy. Operating and management efficiencies are aimed at reducing the amount of this subsidy. Recent arrangements have led to contracting these services to private operators, who assume operational responsibility on a "for profit" basis. While gaining efficiencies, this approach has not totally eliminated the need for government support to urban passenger rail.

In developing the recommendations for Santiago, the PBI team has been sensitive to Chile's economic philosophy. Consequently, a proposal is made for a business tender which avoids the continuing payment of an "operating subsidy" (defined as "continuing cash payments"). Instead, the government would provide capital funds, then purchase transportation services on an annual basis, at a pre-determined level.

2. The Railroad

a. General Description

(1). The railroad from which FESUB was established was previously operated by the State Railways (EFE) as part of Via Sur, which provided commuter and intercity passenger service between Santiago and Puerto Montt. The overall railway operations, freight and passenger, had been characterized by widespread service and high employment.

(2). In 1978, the government established a requirement that EFE eliminate its need for a state operating subsidy. At the same time, EFE was granted commercial freedom to set its own rates, and to recruit or dispense with labor. The operating subsidy, along with assistance for servicing internal and external debts, was terminated in 1979. In the aftermath of this, EFE undertook drastic rationalization of its overall operations. Some 500 km of route were closed, and employment fell from a peak of 28,000 in 1973 to 9,500. It was in this climate that FESUB was established, mimicking what EFE had done in the Valpariso area with the creation of MERVAL in 1987.

(3). With the loss of operating and debt-servicing subsidies, the passenger railways have not been able to earn enough money to be self-sustaining. This has led to their decapitalization.

The decapitalization of the suburban rail system has occurred in two forms. The first consists of the selling of property. For example, parcels of land adjacent to stations and former yards have been sold. This has not appeared to impact current operations directly, but may impact the potential for growth or for capturing new revenue from joint development.

The second form of decapitalization involves deterioration of the fixed plant and rolling stock, in some cases to the point where they are no longer functional. For example, the signal system is no longer completely functional in some areas. The older MU trainsets are another example. Five sets were observed in the train yard in an out-of-service condition.

b. MERVAL, FESUB and Other EFE Agencies

The suburban commuter service had been perceived by EFE as one requiring particular organizational focus. To this end, in its 1987 reorganization EFE created a semi-autonomous operating unit for passenger service in the greater Valpariso area. This unit was named the Metro Regional de Valpariso railway

(MERVAL), and provides passenger service between Valpariso and Limache. MERVAL has achieved a reasonable level of success. FESUB, which was created in MERVAL's image, has failed to meet similar expectations. Therefore, the decision was made to consider full privatization of FESUB.

The other business activity that must be considered is the former Real Estate unit of EFE. It is currently being reorganized as an independent, for-profit corporation, Nueva Via . The transfer of EFE's real estate assets to this new company must be accomplished without adversely impacting the railroad, either operationally or from a business perspective.

When interviewed, officials of Nueva Via stated that prior to privatization, the impact of a particular real estate project on the railroad was one of the criteria for its evaluation. However, they also stated that under privatization, this would not be the case. They said they would participate in joint development with the railroad. However, the ramifications of such a basic change in business philosophy require further consideration from a public policy perspective.

c. Tenders and Privatization

The formulation of a business and operating strategy for the Santiago commuter service must be done within the context of the other privatization efforts. Also, the historical evolution of the FESUB organization must be considered.

Freight service has already been privatized, and is now provided by FEPASA. It is in the process of being converted to full diesel operation. "Through freight" service is provided between Rancagua and Tiltil on the north-south line, and local freight service to Talagante and beyond on the west line. Although it shares mainline trackage with the passenger services, FEPASA has separate yard and maintenance facilities.

At this time, EFE is moving ahead with privatization of the intercity passenger rail operations. This service operates from Alameda Terminal over the mainline to points south of Rancagua. It uses electric multiple unit trains (EMUs), as well as conventional coaches pulled by electric locomotives. Approximately 13 daily trains are operated each way, including a long-distance Auto Train. Maintenance facilities and yards are shared with the suburban commuter passenger service. At least one daily suburban train (to San Bernardo) uses intercity equipment. Operation at Alameda Terminal is completely integrated between the intercity and the suburban services, except for ticket sales. Ticket sales are conducted from two separate offices. Each office sells only its own tickets. Ticket prices are based on separate intercity and commuter tariffs.

In formulating each of the individual tenders, it will be necessary to maintain a strategic overview. This perspective will include the need to describe

specifically the operational and financial interfaces between each separate organization. This interfacing is addressed in Section IV of this report.

Tenders and privatization currently completed, in progress, or proposed include:

- Freight.
- Intercity passenger.
- Suburban passenger (FESUB).
- MERVAL
- Nueva Via (real estate).

Note that a "total" or strategic overview of these privatizations is essential.

d. Suburban Operation

The existing Santiago suburban commuter operation is not representative of a true commuter service. The intervals (headways) between trains during rush hours are too great for the service to be useful to large numbers of travelers. This is the result of a shortage of operational rolling stock, and of limitations of the signal system.

Travel demand for the Rancagua Line cannot be directly extrapolated from current patronage to predict ridership for a refurbished, quality service. This is because current ridership is artificially depressed due to the operating limitations discussed above.

3. Transportation in Santiago

Santiago, as well as Chile as a whole, has benefited economically from the government's policy of privatization of businesses. The Santiago urban area is growing along with its economy, as people are attracted to the area by the availability of jobs.

However, with urban growth comes the associated problems of land use, traffic congestion, and air pollution. This is true everywhere, and Santiago is no exception. But Santiago does have the unique problem of its topography. The mountain ranges have forced urban growth into narrow corridors, thus concentrating the associated problems.

Travel demand is perceived to be strong for all modes, public and private. Highways, buses, and the Metro are well-utilized. Even FESUB's services attract more ridership than would be expected, given the quality of service.

EFE and the government possess a great asset and a *potential* tool for helping to address the greater Santiago area's urban growth problems. It is the suburban commuter rail system. The rail system goes where the growth is occurring. But its *potential* for attracting large numbers of riders from pollution-causing, "land-eating" highway modes must be realized, and every effort made to accomplish it.

Section III.

FINDINGS BY TASKS

Summary

The Santiago Commuter Rail Study included fourteen specific Tasks. Task N, the task that pertains to the actual proposed tender, is addressed in Section IV, where a specific outline of a BOM tender package is presented.

A "mini" report has been prepared for each of the remaining thirteen Tasks, as follows:

- Task A - Conceptual Framework;
- Task B - Economic Performance Technical Policy/Conditions;
- Task C - Conceptual Government Monitoring Organization;
- Task D - Compatibility Requirements;
- Task E - Safety Requirements and Equipment Standards;
- Task F - Maintenance Requirements;
- Task G - Maintenance Facilities;
- Task H - Rolling Stock Performance;
- Task I - Criteria and Control Procedures to Measure Performance;
- Task J - Reconcile Market Demand Data; Analyze Economic Impact;
- Task K - Financial Scheme for Implementation;
- Task L - Technical, Legal, Economic, and Institutional Conditions; Plan for Participation of Private Sector; Policy and Legislative Issues; and
- Task M - Fare Structures and Collections Systems.

Collectively, the Tasks establish the rationale and the framework for the Proposed Tenders, which are set forth in Section IV.

Task A

CONCEPTUAL FRAMEWORK

Requirements

Investigate and define the process to implement a restructuring of FESUB services. Review existing documents and overall conditions, review foreign experience with similar structures, identify conceptual framework, analyze alternatives, and provide recommendations.

Overview

EFE continues to search for answers to find a successful framework for implementing a restructuring of the operations, maintenance, upgrading, and expansion of commuter rail service in Santiago.

The Parsons Brinckerhoff International (PBI) consultant team has been told that Chile does not wish to subsidize the commuter rail concession, but that both the Chilean government and EFE recognize that fare receipts alone from a revitalized commuter rail operation may not cover operating costs.

Therefore, the Chilean government has proposed that the Santiago commuter rail system, presently being operated by FESUB, be privatized. The objective of the privatization is to reap the benefits of private sector business motivation and efficiencies.

The form of the commuter rail concession, and its relationship to the other components of EFE, have not been decided. Some at EFE have firm beliefs regarding the functions, such as train dispatching and maintenance of way, that should be an integral part of a commuter rail service, and be performed by the commuter rail concessionaire. Others within EFE have opposing views. The functions to be performed by others, i.e., by other concessionaires or EFE, is one of the recommendations PBI has been tasked to produce. PBI is to assess the options and present them to EFE. EFE, in turn, will make the decisions necessary for overall acceptance of the privatization concept.

Another requirement of the study was to present the benefits of suburban rail improvement, in order to make the advantages clear to Chile's decision-makers, and to the public.

This task was made especially difficult because it was represented to the PBI team by members of key independent planning groups that the government has little confidence that successful privatization of commuter rail service can be accomplished.

Because of these potentially conflicting issues and uncertainties concerning the conceptual framework, the PBI team presented a letter to the client, EFE/FESUB, recommending a modest reorientation of the study. The letter was dated May 9, 1997. Another reason for the proposed reorientation was the absence of certain critical data needed to develop appropriate criteria. Given the lack of this data, only a broader and more generalized report, based on worldwide criteria, could be developed.

Therefore, it was agreed upon by EFE/FESUB that the study would focus on the development of three mutually compatible recommendations:

- A broadly construed organizational structure for provision of a successful suburban commuter rail service.

- A structure, within the government, to exercise regulatory oversight, especially with respect to safety issues.
- A conceptual framework for a draft tender package that could be used to elicit responses from the private sector. The main criterion of the tender package would be to provide the biggest benefit for the citizens of Chile, ensured by suitable regulatory oversight.

In consideration of this reorientation, the study team recommended, and EFE/FESUB agreed, that an interim report would be submitted. The purpose of the interim report would be to advance the process to develop the commuter rail structure, the government oversight structure, and the tender outline consistent with an approach acceptable to EFE.

The interim draft report was submitted prior to a presentation on September 30, 1997. EFE expressed its reactions and opinions. In accordance with these responses, the PBI team has completed the study and this report.

Discussion

A viable railroad infrastructure exists, but with much of it deteriorated and in a state of disrepair. There is considerable evidence to indicate that there are genuine opportunities for significant improvements to the operation. At present, only the line to Rancagua provides suburban rail passenger service. This service is of poor quality and limited frequency. It is important to note that the intervals between peak-hour commuter trains are excessively long.

A frame of reference for approximating potential ridership demand on the Rancagua rail line can be taken by comparing present and past FESUB commuter rail riding patterns, and by examining what has taken place in Buenos Aires, Argentina, following privatization. Demand can also be approximated from the experience of the Santiago Tour Bus service on the limited-access highways (freeways) in the same travel corridor. Express buses operate on one- to two-minute frequencies (headways).

Ridership demand for commuter rail service can also be estimated for the Maipu rail travel corridor. Even though commuter rail service is not currently provided in this corridor, its population growth and traffic congestion, coupled with a poor highway system, represent strong rail travel demand factors.

The Tiltil rail corridor traverses undeveloped country. However, local experts predict that high growth will occur because of the corridor's suitability for heavy industry, together with the resultant influx of jobs. Not so certain, though, is whether this growth will translate into demand for commuter rail service.

Another significant factor is derived from the worldwide experience of the PBI team. Implementation of a modern, efficient rail transportation system will generate significant travel demand. This is especially the case as the service area develops with suburban and satellite towns.

There is more to be considered in the implementation of a modern, suburban commuter rail system for the greater Santiago area than potential ridership. Sociological, economic,

and environmental benefits resulting from implementation of efficient commuter rail systems have been demonstrated in cities throughout the world with growth constraints similar to Santiago's. Whether the growth is constrained by water, land formations, or land use policies, the benefits accrue. One need only consider the Borough of Manhattan in the City of New York to realize the positive economic, social, and environmental impacts of modern, efficient commuter rail service. New York City could not have remained the business and financial center that it is without effective commuter rail service.

Findings

The metropolitan Santiago area has a need for a high quality suburban rail service. This need can be demonstrated from several perspectives: travel demand, economic, social, and environmental.

The commuter railroad infrastructure already in place and the related real estate assets constitute virtually irreplaceable resources. They should be exploited for benefit of the public and the government.

Current commuter rail service neither offers nor represents the quality of modern, efficient suburban rail passenger service. Nor does the existing service enable the potential for societal benefits inherent in modern commuter rail operations to be realized.

Because the quality and level of service are so poor, it is inappropriate to attempt to predict patronage, costs, or benefits of improved suburban commuter rail service from present experience.

In Section IV of the study team's report, a business arrangement for privatizing the Santiago commuter rail service has been identified and described in detail. The arrangement describes how the existing rail network can be returned to a state of good repair, upgraded, and operated efficiently. The business arrangement also candidly discusses the economic reality of passenger transport.

Task B

ECONOMIC PERFORMANCE TECHNICAL POLICY/CONDITIONS

Requirement

Develop conceptual policy and/or conditions related to the economic performance of the services, with the objective of covering operating costs as a minimum.

Overview

The axiom that "objectives must be measurable to be attainable" suggests that what is not measured probably will not be attained. Thus the study team's initial objective in approaching this task was first to examine measures of economic performance for the current service, then to identify policy and/or conditions which would foster the best possible economic performance and, finally, to quantify (measure) that potential performance.

The study team requested an estimate or accounting of the commuter service's economic performance. That information was not able to be provided, in part because FESUB never became a truly autonomous commuter rail operator with separate funds or its own financial/accounting system. (It was indicated that a commuter service budget, both planned and actual or attained, does exist; however the team has not seen such a document.)

Irrespective of ownership or control, the economic performance of commuter rail systems are almost always closely monitored and measured, whether they are independent entities or components of government-operated, national freight and passenger rail systems. Since public funds are usually involved, determining the economics of suburban rail service is generally part of a larger political budgeting process as taxpayers and their governments seek to understand the costs of various government services, in order to make informed resource allocation decisions. Changing the prevailing institutional arrangements to a sponsor-contractor relationship also tends to increase the importance given to economic performance measurement, as both the sponsor and the contractor attempt to verify the contractor's service and cost performance.

Privatization adds still another motive for improved measurement of economic performance: the contractor's profit incentive. The contractor must understand its proposed and actual cost structure and expected performance in order to submit an informed, competitive bid and then to turn its proposal into reality. The responsibility for economic performance measurement and the inherent financial risks of operating are in large measure, but not completely, transferred to prospective contractors during the bidding process, as they seek to project their future operating performance and construct bids accordingly. Government economic regulators will also need periodic relevant reports to assess contractor compliance and fulfillment of policy objectives.

The study team recognizes that there may have been little historical need to account separately for the economic performance of various components of EFE's operations. Nevertheless, the absence of any application of cost tracking or allocation techniques denies managers the ability to assess the cost of operating inputs, such as labor, material, and electricity, against outputs like trains operated, train-kilometers, or passenger-kilometers. It also precludes use of other than total financial performance as a factor in EFE's internal decisions, or in setting broad transportation policy at the federal level. (It is neither surprising nor unusual that commuter service operating costs are not segregated from other EFE expenditures, since the deficit for all services is made up by the same entity. Similarly, prior

to privatization, commuter losses incurred by Argentina's Ferrocarriles Argentinos were not accurately calculated.)

- **Present Economic Performance**

Absent requested information about commuter service operating costs from EFE, the study team nevertheless was able to draw some conclusions about the magnitude of the annual deficit. The conclusions were based upon information in the study "Estimacion de Resultados Operationales del Metrotren a Rancagua", along with data from EFE's "Annuario Estadistico 1995", Metrotren schedules, observations, interviews, and other sources. While detailed estimates have not been produced, it is clear that farebox revenues (742 million pesos in 1996) do not cover even the directly assignable costs such as electric power, train crews, stations, and equipment cleaning and maintenance. The deficit would be even greater if an appropriate portion of non-operating staff costs in the Gerencia de Pasajeros, along with other expenses, materials and purchased services, were properly allocated.

- **Economic Performance of Other Commuter Services**

Economic performance of commuter rail services varies widely from city to city, even from line to line. This may be attributed to a number of operational, economic and historic factors. Some commuter routes are owned by the sponsoring public entity, and thus no access fee is paid. Others operate on trackage owned by private sector freight railroads, and access fees alone can be U.S. $10.00 or more per train-mile. (This is in addition to the cost of capital invested in expenditures for condition or capacity improvements, which may be necessary upon service initiation, contract renewal, or upon other extraordinary events.) Labor arrangements, and the time and context in which those arrangements evolved, also have important cost implications. The length of time that a service has been offered affects land use and passenger volumes, which also are related to total urban area and corridor population levels.

In addition to conveying some sense of the magnitude and variance of commuter rail costs, the following three tables demonstrate that there are many measures of economic performance, and that they sometimes provide seemingly contradictory information. For example, Virginia Railway Express (VRE) has the higher cost per train-mile in the first table, but by far the lowest subsidy per rider in the third table. It also should be recognized that some measures focus on operating efficiency (such as cost per train-mile), and others focus on service efficiency (such as cost per passenger-mile). The distinction is that train-miles and car-miles are operational outputs that are more closely related to operating costs than are service outputs, such as passenger-miles or subsidy per passenger-mile, which are influenced by fare structure, overall travel demand and transportation options.

- **Annual Operating Costs: Selected North American Commuter Services**

As an indicator of order of magnitude, annual operating costs of two North American commuter services are presented in the following table. Metrotren operating statistics also are presented to give an indication of the comparative scale of the three services. VRE[1] and

[1] Virginia Railway Express is a commuter rail service linking Washington, DC, with Fredericksburg and Manassas (lines to each) in Northern Virginia.

Metrotren are of similar scale. VRE proposes to operate 26 trains per weekday on two routes in FY 1999, while Metrotren operated 22 trains per weekday on one route. Because VRE operates on weekdays only, Metrotren's annual train-kilometers exceed VRE's. Maryland Area Rail Commuter (MARC)[2] service operates approximately three times the volume of trains and train-miles as VRE and Metrotren.

Operating Costs
Selected North American Commuter Services

	MARC (Maryland Mass Transit Administration) FY 1996	Virginia Railway Express FY 1999 (Proposed)	Metrotren (EFE) 1997
Trains Operated[a]	76	26	22
Daily Train-Miles	3,969	1,208	1,082
Annual Train-Miles	1.012 Million	0.302 Million	0.400 Million
Annual Operating Budget	$31.4 Million	$18.8 Million	Unknown
Cost per Train-Mile	$30.98	$62.14	Unknown

a 365 days annually by Metrotren; 313 days by the U.S. operators.

Sources: MARC statistics, FY 1996; VRE Preliminary Budget for FY 1999; RLBA estimates of Metrotren operations based upon Metrotren schedules.

The average cost per train-mile of the two services shown above is U.S. $46.52. Applied to Metrotren's annual train miles, this would imply that a North American service of similar scale might have an annual operating budget in the range of U.S. $15 million. While such a projection for Rancagua-Alameda service is admittedly highly imprecise, it does suggest a potential order of magnitude.

- **Cost per Passenger: North American Commuter Services**

Service characteristics can have a major impact upon how a service compares under various performance measures. For example, a service with a large proportion of its riders living at a long distance from the primary destination may report a low cost per passenger-mile, but a relatively high cost per passenger, with similar contrasts in cost per train-mile and cost per train. Nonetheless, some conclusions may be drawn from an examination of cost per passenger on major U.S. commuter rail systems (see following table). On six of ten systems, the cost per passenger is between U.S. $7.16 and 7.98, a variance of only 11 percent. Of the four remaining systems, two are above this range in terms of cost per rider and two are below.

[2] MARC is the State of Maryland's commuter rail service.

Operating Expense per Passenger Selected U.S. Commuter Railroads Fiscal Year 1997	
Commuter Rail Agency	**FY 97 Operating Expense per Passenger (U.S. $)**
Orange County (Los Angeles)	9.56
Metro North (New York City)	8.57
SEPTA (Philadelphia)	7.98
Tri-County Commuter Rail (Florida)	7.82
New Jersey Transit	7.74
Caltrain (San Francisco)	7.70
Long Island Rail Road (NewYork City)	7.41
Virginia Railway Express (Washington)	7.16
METRA (Chicago)	5.12
MBTA (Boston)	4.69

Source: MARC

The average cost per passenger for all ten commuter services is $7.38. The average of the middle six closely-grouped services is $7.64. While it would not be appropriate to use these figures as predictors of the performance of a new service, they do indicate that North American services demonstrate a reasonably tight range of expected performance in terms of cost per passenger.

- **Additional Performance Measures: North American Commuter Services**

Yet another set of commuter rail economic performance measures is displayed below. Note that while some performance indicators vary significantly, O&M cost per passenger-mile is very closely grouped.

Performance Measures				
	VRE	**Tri-County**	**Metrolink**	**3 System Average**
Annual O&M Costs ($ mil)	11.82	20.89	42.90	
Annual Ridership (mil)	1.80	2.91	4.60	
Annual Revenue (mil)	7.49	5.18	11.00	
Vehicle-Miles (mil)	0.97	2.47	3.03	
Performance Indicators				
Annual O&M Cost/Rider ($)	6.57	7.17	9.33	7.69
Annual Subsidy/Rider ($)	2.41	5.39	6.93	4.91
Fare Box Recovery Ratio	63.3%	24.8%	25.6%	37.9%
O&M Cost/Veh-Mile ($)	12.20	8.46	14.18	11.61
O&M Cost/Passenger-Mile ($)	0.22	0.22	0.25	0.23
Passenger-Miles/Veh-Mile	59.75	39.41	57.32	52.16
Revenue/Veh-Mile ($)	7.73	2.10	3.64	4.49

Notes: Tri-County is a commuter rail service in South Florida. Metrolink is the popular name for Southern California Regional Rail Authority (SCRRA).

Sources: "Gertler, Peter, & Kutrosky, David. Progression or Regression: A Case Study for Commuter Rail In the San Francisco Bay Area", January 7-11, 1996, Transportation Research Board Annual Meeting; RLBA.

- **Economic Performance of a Privatized Service**

A projection of the potential economic performance of a privatized commuter service is necessary to shed some light on the financial impacts and responsibilities resulting from a change in service provider. The currently operating Alameda-Rancagua service represents an economic performance model. When service is implemented on other lines, to project operating results the operator would apply similar cost factors. Actual financial performance would depend upon terms negotiated with the government. Lacking budget information from EFE, the bidder must make projections relying upon the information provided by the government in the bid package, as well as the bidder's own experience.

Since the form and arrangements of commuter service privatization are still being developed, it should be remembered that optimum economic performance will require a "best case". In a "best case", the commuter operator is free to act as a business, making decisions about

service, equipment, staffing and investment accordingly. It is assumed that the operator will be required to maintain base service levels negotiated with the government for implementation once new equipment is ready for service. These service levels are assumed herein to be represented by the present Metrotren schedule, and that proposed in the study "Estimacion de Resultados Operationales del Metrotren a Rancagua".

- **Opportunities for Improved Economic Performance**

Acquisition of newer equipment and establishment of a continuing equipment maintenance program, along with similar upgrade and maintenance of the physical plant, will present an excellent opportunity to improve economic performance. Likewise, innovative new services and fare policies could have positive impacts upon ridership and revenues. In addition, a new operator, free to develop new operating methods and engage in commercial ventures, could expect to improve economic performance significantly.

Each competing prospective contractor will propose unique combinations of cost reductions and revenue enhancements, with different priorities among specific initiatives and with varying expected results. The government could ask bidders to consider cost/revenue initiatives beyond those contained in their several initial bids. Or, for example, the government could work with the selected contractor to encourage additional measures to improve financial performance. Many such measures are identified in a June, 1997, paper entitled "Lessons Learned in Transit Efficiencies, Revenue Generation and Cost Reduction", published by the Center for Urban Transportation Research of the University of South Florida. That paper categorized opportunities as follows:

> Positive Opportunism - actions by transit agencies to take advantage of their existing, unique resources such as facilities, staff, and public visibility.
>
> Partnerships - agreements or joint ventures related to providing new or custom services for private sector firms or other public agencies.
>
> Cooperation - working with other agencies to carry out existing functions in more efficient ways.
>
> Service Planning, Marketing or Delivery Methods - developing new ways of providing service which improve efficiency.
>
> Improved Management of Resources - changing processes and organizational roles and structures, including procurement and contracting practices.

Opportunities could be described or organized in many other ways. The important message is that a nimble, private sector operator will have a wide variety of ways to improve economic performance. Bidders should identify and explore these opportunities during their due diligence evaluation[3] and should reflect them in their proposals.

[3] "Due diligence" is the investigation of risk factors which prudence demands be executed prior to putting a significant amount of money into a business.

- **Prospective Contractors Are Responsible for Predicting Future Performance**

Information on the economic performance of the present commuter service, however informative it might be, has only partial relevance to a new, completely restructured service. Therefore it is not essential information for prospective contract operators. It is incumbent upon the bidders to conduct a due diligence assessment, and to project the expected economic performance of their planned service. Past economic performance of the EFE-operated service is not critical information, since all aspects of the operation are subject to alteration by the contractor. Similarly, projections of economic performance included in earlier studies of potential service expansions or upgrades would be of limited application to privatized, contractor-operated services.

EFE and the government must furnish accurate ridership and revenue figures to prospective bidders. Additionally they must provide a service history that sets forth the service schedule and performance quality associated with historic ridership and revenues, as well as current maintenance arrangements for both plant and equipment. This information will provide bidders with two things: First, a basis for developing ridership and revenue estimates related to proposed service. Second, when combined with operating cost estimates, each bidder would have the capability of estimating projected economic performance.

Findings

The study team's first important finding with respect to economic performance is that, according to officials interviewed, the commuter service's operating costs are not specifically determined within EFE's operating budget, or otherwise made known to EFE managers. Thus, although commuter revenues are separately counted, it is impossible to measure the service's performance in terms of actual operating costs, increase or decrease in operating costs, or in terms of cost per passenger, passenger-kilometer, or other unit of output.

Next, and equally important, it is clear to the team from preliminary estimates that the present commuter service requires government funding support, and may well continue to require such support even after infrastructure and equipment improvements and the introduction of private sector management and practices. Development of realistic tendering arrangements should so recognize.

The third important finding is that it is the responsibility of each prospective contractor to project future performance under the service and operating plans envisioned. The government's responsibility is to provide a clear, complete and comprehensive description of the services it wishes to be provided. This is of vital importance to a successful contracting process. Bidders must have a clear understanding of the service levels that are required (expressed in capacity per peak hour per peak direction, or other parameters), as well as the expected standards of quality and any seasonal variations. Likewise, the physical plant and equipment to be provided by the government, expected minimum compensation, and the associated financial terms must be spelled out clearly. The government also is responsible to provide the most accurate possible information concerning past ridership and revenues, service patterns, and quality. Once those standards are conveyed, it is the bidder's responsibility to plan its proposed operations, estimate ridership and revenues, and calculate the resulting economic performance.

In other words, the government's bid package should be structured to appeal to prospective bidders from a business risk perspective. The prospective bidder should recognize that if a bid is made, two factors will come into play. First will be the lump sum initial costs for rehabilitation and improvements. Second will be the operating and maintenance (O&M) costs. These O&M costs will be founded in part on the bid offering of a set amount of government interest payments based on a specified amount of purchased transportation. The purchased transportation is for fares, so this payment actually represents an equivalent number of riders the bidder is obligated to carry.

The bidder's anticipated profit and loss then becomes a function of two sets of variables: the income from and cost to transport the riders whose fares have been paid by the government, plus the income from and cost to transport any additional riders generated by the bidder's marketing efforts. As the bidder controls both sets of variables, the risk is "known".

Task C

CONCEPTUAL GOVERNMENT MONITORING ORGANIZATION

Requirement

Develop and propose a conceptual government monitoring organization which is modular and flexible, and responsible for the enforcement of technical and commercial performance parameters as well as system safety and institutional issues.

Overview

Chile's decision to turn over the operation of commuter railroads to the private sector carries with it the requirement to oversee compliance with the terms of the agreement(s) consummated between government and concessionaire. For example, the agreement will probably contain requirements regarding the provision of minimum service levels (such as number and consist of trains, as well as on-time performance); for maintenance of government property; and for expenditure of government funds (provided for capital rehabilitation projects). The government monitoring organization (GMO) must protect the public's interest by enforcing contract provisions.

With even higher public priority, the GMO should prescribe and enforce railroad safety standards, including those related to joint operations (freight, intercity passenger and commuter rail service) on the rail corridors used in common by those services.

The development of a government monitoring organization necessarily depends upon its responsibilities. These responsibilities depend upon what responsibilities, or functions, are assigned to the concession and included in the commuter rail tender package.

Implementation of the privatization of Santiago's commuter rail service will require due care and attention. The objectives should be: (1) that the "new service" will be seen by the public as a welcome improvement and convenience; and (2) that the new service will be managed and operated with efficiency and economy from the viewpoint of Chilean taxpayers. Both objectives must obtain if the new service is to be a success: customers must be attracted, and the taxpayers must get their money's worth.

The study team favors a relatively lean, competitive, market-driven, open-to-creative-ideas mentality in the GMO, to match what is expected in the contractor. A survey of new-start regional/commuter passenger rail operations in the United States confirms the advisability of a small GMO, staffed by professionals who understand the business. The small GMO would depend upon backup assistance from existing capabilities within the government of Chile, for example, for legal assistance or audit.

Passenger Railroad Functions

The study team recommends that the commuter rail concession include all or most functions which are normally associated with operating a railroad. Thus, the contractor will be able better to control the service. The contractor should control: train movement; crewing and scheduling; dispatch of all trains that use the commuter rail lines and of electric traction power; maintenance of the track and related infrastructure and rolling stock; and performance of all passenger service functions including marketing.

Normal passenger railroad functions are listed below.

a. Maintenance of Way

   Track

   Signals/Communications

   Power Supply

b. Maintenance of Equipment

   Cars and Locomotives

   Cleaning

   Supervision and Inspection

   Maintenance and Rehabilitation

   Maintenance of Facilities

c. Transportation

   Operating Crews

   Traffic Control

   Propulsion (power to move the train)

d. Passenger Services

   Marketing/Ticketing

   Stations

   On-Board Amenities

e. General and Administrative

   Management/Administration

   Safety

   Insurance

The study team learned that EFE was considering including maintenance of infrastructure in another concession. The team believes there are arguments for an arrangement in which the commuter rail contractor, having executed the infrastructure capital improvements required to upgrade and integrate the commuter rail service, is responsible for maintaining that infrastructure, within commuter rail territory. If the contractor that prepares the capital investment plan realizes that over 20 years it will be responsible to maintain that infrastructure, that contractor is more likely to perform the infrastructure upgrade job properly. This very approach has been taken in the case of the new Hudson-Bergen Light Rail Transit Line, now under construction in New Jersey, USA.

The study team believes it is of special importance that the contractor dispatch all trains within commuter rail territory. First, commuter trains will use the corridor far more than any other traffic. Second, commuter service should have priority over other traffic, including intercity passenger, if it is to carry out its function properly. This approach has

been followed in North America by, among others, the Metro North commuter rail service in the New York City metropolitan area.

Government Monitoring Organization (GMO) Duties

Safety is the primary oversight responsibility appropriate for the GMO. This includes at a minimum the prescription of safety-related standards, and a reporting system with regard to inspections and accidents.

The GMO should monitor and administer the agreement with the contractor, insuring compliance with the terms of the agreement. Where the tender has specified minimum levels of service (number of trains per day, train make-up, on-time arrival, etc.), the contractor's performance should be monitored. If included in the contract, the GMO should monitor efficiency-related or financial performance measures (for example, farebox recovery ratio). The Task I portion of this report contains a discussion and conclusions with regard to performance measurement.

Assuming the concession includes construction and rehabilitation responsibilities using government of Chile capital funding, reporting requirements should include accounting for the expenditure of those funds, and reporting the results attained. This funding could be substantial, as it will include, for example, upgrading the Santiago-Rancagua corridor for improved commuter train operations, and rehabilitation of the Melipilla and Tiltil corridors and start-up of passenger service. The GMO should insure that government funds are used in accord with legislated purposes.

The GMO should also monitor the "government interest" in the commuter railroad, as that term is defined in Section IV of this report.

GMO Oversight with Regard to All Railroad Operations

In a larger sense, it may be appropriate and logical to organize a single GMO to oversee all privatization concessions, not only in the Santiago area, but nationwide. This would include all railroad safety functions in Chile. It was indicated to the study team, in interviews conducted in Santiago in 1997, that the need is foreseen for a GMO to exercise rail monitoring, safety, and economic regulatory functions over the restructured Chilean rail industry.

In former years, EFE controlled and operated all railroads in Chile. Now a private concession operates Chile's rail freight service. EFE performs maintenance and dispatching on Class 1 lines, and Ferrocarriles del Pacífico, S.A., (FEPASA) maintains and dispatches Class 2 lines. The plan to privatize Santiago's commuter rail service underlines the need for an oversight and regulatory organization to: (1) coordinate operations of disparate railroad entities, to ensure that the government is earning appropriate returns (or avoiding deficits) on the investment in its railroad facilities; (2) establish rules for the operation of one railroad on another's lines; and (3) in particular, to establish and enforce safety requirements common to all.

Regulation of U.S. Railroads

It may be helpful in this regard to describe briefly the roles of the three bodies which oversee the United States railroad industry: the Association of American Railroads (AAR),[1] the Federal Railroad Administration (FRA),[2] and the Surface Transportation Board (STB)[3].

Among other things, it is the AAR's role to develop and administer rules governing the movement of, compensation for, and operation of railcars among the common carrier railroads. This may or may not be an issue in Chile. The STB's rail regulatory functions have application to economic issues such as rates, service, and rail company mergers, which are either not pertinent in Chile, or which will be delegated to the successful private concessionaire. The concessionaire will owe its success, in part, to the establishment of rates and service that reflect desired public policy. The FRA regulates rail safety, an issue that applies in any country.

A fourth entity, the American Railway Engineering & Maintenance Association (AREMA), produces and revises the Manual for Railway Engineering. This Manual contains recommended standards with regard to engineering, design, and construction of the fixed plant of railways for the American railroad industry. AREMA was formerly a component of the AAR, but now is an independent professional organization.

In the United States, railroad safety is a subject addressed by Federal law (currently the Federal Railroad Safety Act of 1970, as amended). The law is administered by the U.S. Secretary of Transportation, through regulations issued by the FRA. These regulations establish rail safety rules and standards. In addition, the FRA monitors the railroads' inspections and other activities to insure compliance with the regulations.

U.S. rail safety regulations include track safety standards, freight and passenger[4] car safety standards, operating rules, radio standards and procedures, railroad accident and incident reporting and investigation, locomotive safety standards, grade crossing signal system safety, and other subjects.

Dispatching, Rolling Stock Reliability

In addition to contract compliance and railroad safety, the GMO may have an appropriate role in dispatching and rolling stock reliability issues. Given the probability of service by one operator over another's tracks, dispatching standards, to establish priorities, would be

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[1] The Association of American Railroads (AAR) is an entity comprised of its individual members. It is responsible for matters requiring common efforts to facilitate railroad industry contributions to the national transportation policy as set forth in Federal law. The AAR represents the railroads in appropriate cases before the courts, administrative tribunals, Congressional committees, and other government bodies.

[2] The Federal Railroad Administration (FRA) is the component of the U.S. Department of Transportation responsible to implement certain Federal railroad law, in particular that pertaining to railroad safety.

[3] The Surface Transportation Board (STB) is the successor to the Interstate Commerce Commission. It has various Federal regulatory functions, including those related to the common carrier obligation of railroads.

[4] Formerly, passenger equipment standards were developed by the AAR and adopted by carriers as recommended practice. Currently, the FRA is developing passenger equipment standards that will carry legal requirements.

appropriate. Minimum rolling stock reliability standards, and/or penalties for breakdown in another concessionaire's territory, should be established for locomotives, cars, and diesel or electric multiple units (DMUs/EMUs).

Qualification/Certification of Engineers/Dispatchers

To assure common understanding of the operating and safety rules as well as an appropriate level of training and proficiency, it is common practice to qualify or certify engineers (mecanistas) and dispatchers. This practice will be even more important where two or more operators or contractors move equipment in the same railroad territory.

Resolution of Disputes

Finally, resolution of disputes between concessionaires (contractors), as well as resolution of disputes between contractor and government, would be addressed by the GMO. The method for resolution of disputes should be prescribed in the contract.

Findings

Chile is evolving from a system in which there was only one railroad operator to one in which there will be several. The study team recommends that a GMO should, at least in all territory where two or more operators/contractors are present, establish and monitor compliance with common standards in regard to safety, operating rules, service quality, and rolling stock interchange and reliability. Indeed, compliance with these standards should be a part of any contract with a commuter rail concessionaire.

With specific regard to the commuter rail concession contract, the GMO should be organized to monitor compliance with contract terms, most importantly:

safety;

accountability with regard to government funds;

service quality;

efficiency and cost effectiveness; and

resolution of disputes.

A discussion of safety, service quality and efficiency is contained in Task I, Criteria and Control Procedures to Measure Performance.

No specific recommendation will be attempted with regard to the number and types of personnel required to staff a GMO. Such a determination will depend on what portion of Chile's rail system the GMO will supervise.

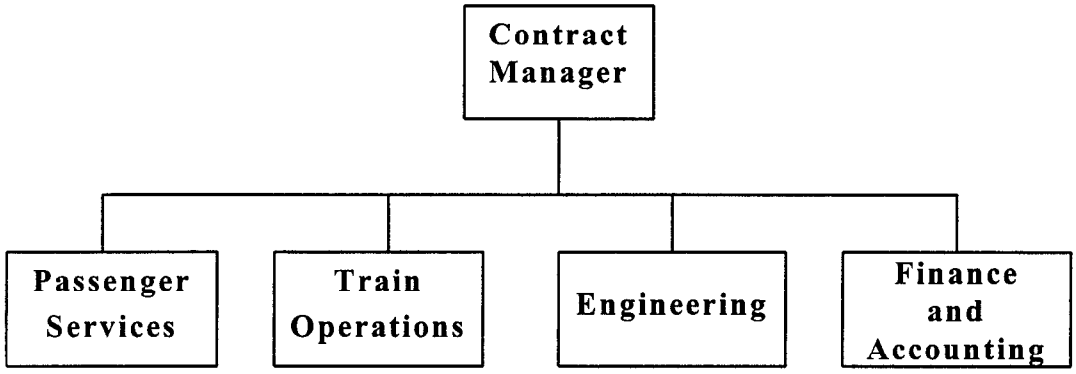
An independent, stand-alone GMO, charged with the responsibility of overseeing the Santiago commuter rail contractor, would require a small staff led by a contract manager and consisting of an engineer, an operations and safety specialist, a cost analyst, an accountant, and a lawyer, to protect the public interest and monitor the contractor's compliance with the contract.

It is recommended that the functions on the simple organizational chart at Figure 1 be embraced by the GMO. The contract manager would have overall responsibility for

FIGURE 1

Organizational Chart

Stand-Alone Government Monitoring Organization



supervision of the commuter rail contractor. The GMO would ensure protection of the government's interests, monitor the expenditure of government funds, and supervise compliance with contract's provisions. Assistant Contract Managers could cover the areas of safety, passenger services, train operations, engineering, and finance and accounting.

Safety responsibilities would include monitoring of compliance with and enforcement of the safety standards, including the performance of audits. Receipt of injury and accident reports would be another responsibility.

Passenger Services responsibilities would include public relations, coordination of commuter rail services with other modes (Metro, bus, intercity), marketing, and the efficiency performance measurement areas described in Task I (revenues, operating cost, farebox recovery, etc.).

Train Operations would monitor service quality, including those performance measurement areas described in Task I, such as on-time performance and equipment availability.

Engineering would encompass review of performance and cost effectiveness of expenditure in respect of maintenance of way (including track, signals, communications and electrical power distribution), maintenance of government equipment, and capital rehabilitation of the commuter rail system.

Finance and Accounting would be responsible for monitoring the prudent and honest expenditure of government funds, as well as assessing returns on (or deficits from) those funds, and would coordinate with Passenger Services with regard to the efficiency performance control measures.

Because of its experience and familiarity with Chile's overall railroad operations, the PBI study team recommends that the GMO function be assumed by a restructured EFE. To perform the role of GMO, EFE should divest itself of any direct operating or engineering responsibilities in connection with all privatized railroads, to avoid any potential conflict of interest in its role as overseer.

Task D

COMPATIBILITY REQUIREMENTS

Requirements

Analyze compatibility requirements for other related activities, including operation of freight and intercity passenger services, infrastructure maintenance and train dispatching. Identity and any potential conflicts, and provide mitigating solutions.

Overview

The rail infrastructure in the Santiago region was well designed for compatible operations among passenger (intercity and commuter) and freight operations. The infrastructure now must be updated and restored to a state of good repair. Major capital investments will be needed to expand service to Melipilla and Tiltil, if such expansion is desirable.

The existing signal system is only partly functioning, and at present does not have the capability to govern an intensified commuter rail system. The system should be replaced by a centralized dispatching system, including reverse signaling. This improvement is needed to provide for safe, reliable and flexible operations.

A decision with regard to responsibility for train dispatching on the commuter rail lines is required. Since commuter rail will have the majority of train movements on the tracks it uses, and since on-time performance for daily workers is most critical in attracting additional riders, the study team recommends that dispatching responsibility for all operations - intercity passenger, freight, and commuter rail - be assigned to the commuter rail operator in the shared territories.

Findings

The original railroad was constructed to provide a high level of compatibility between all three services (suburban, freight, intercity). This compatibility is evidenced by track layout, interlocking configuration, and yard and station locations, all of which were developed to support three services concurrently.

Fortunately, sufficient infrastructure remains under EFE's control to support these operations if appropriate rehabilitation and improvements are accomplished, and if the tender packages for each of these three services are properly designed and coordinated.

From an engineering perspective, the key to future compatibility with a presumably higher train density is an improved signal and traffic control system. The Traffic Control System should include a full, modern supervisory control system. The original signal system was not so equipped. A modern supervisory control system would allow the efficient management of all three services, with signalized operation in either direction on both main tracks. It would also permit control of all signals and switches within suburban commuter rail territory from a single location.

The recommended signal and train control system would provide the operational flexibility necessary to efficiently operate multiple types and numbers of trains. For example, it would enable trains to be operated around track blockages. It would also permit trains to be scheduled to overtake and pass other trains on the two track mainline.

In order to preserve the ability to provide the required flexibility and support for a modernized, expanded suburban commuter rail operation, it is recommend that a

moratorium be imposed on the disposal of potentially critical property. One example of such property is at Rancagua, where a new layup yard will be required for overnight storage and inspection of rolling stock.

A number of other items warrant scrutiny before final tender packages are prepared for the separation and privatization of services. Improper structuring of the tenders in these areas could adversely impact compatibility. These include:

- Use of the single track tunnel through downtown Santiago connecting the north and south lines. This 2 km, electrified tunnel is the freight mainline through Santiago. All passenger trains from the north will be required to operate through this tunnel to reach the Alameda Central Station. The tunnel's track capacity could be the limiting factor on the density of service on the north line. However, the combined traffic density of freight and passenger trains is not likely to reach the tunnel's capacity in the foreseeable future, if it is efficiently controlled from a centralized traffic control center.
- Joint use of passenger rolling stock maintenance shops by intercity and suburban services. This must be carefully considered, since it would be uneconomic to duplicate such facilities. The intercity and suburban locomotives, EMUs (electric multiple unit trainsets), and coaches are currently maintained at a combined location. Although erection of a separate EMU shop is in progress, this new structure is contiguous with the main passenger shop, and is within the EFE passenger service complex. Careful structuring of the tender package will be required to provide the most economical and operationally feasible approach to commuter and intercity passenger locomotive and car maintenance. The maintenance of freight cars and locomotives is easily separated, since these facilities are at a different location than are the passenger shops. No attempt should be made to combine passenger and freight rolling stock maintenance facilities.
- Actions by the Real Estate organization and improvements at Rancagua. An ample passenger station supported by a small yard exists at Rancagua. However, because of equipment shortages, train sets are not stored overnight and serviced there. Time and money are wasted moving the empty equipment back to Santiago, and then back to Rancagua for the inbound morning schedule. Under an improved service scenario, a small storage yard with coach cleaning and minor repair capability should be established at Rancagua. In addition, a large parking lot for commuters traveling from beyond Rancagua is recommended.
- Stations require improvement. This is an investment and business issue which can be separated from the commuter service or the revenue used to support it. Therefore it is not a compatibility issue, since the rail passenger services can be made to operate efficiently with the existing stations. Some additional stations might be warranted as suburban traffic and highway congestion grow.

Prior to selling any more real estate, an inventory of land which is presently available should be made. These lands then should not be obligated to other use until the integrated rail privatization plan is complete. While Rancagua provides one example of the possible

need of land to support commuter rail service improvements, other locations with potentially useful real estate also require evaluation.

It can be seen that the design of the intercity passenger tender contracts and the existing freight contract - as well as understandings involving the Real Estate organization - are critical to maintaining compatibility between the three services.

Task E

SAFETY REQUIREMENTS AND EQUIPMENT STANDARDS

Requirements

Define safety requirements and develop standards for equipment operations and maintenance.

Overview

Safety is the key element in any successful passenger rail operation. Regardless of how high the level and quality of service, an operation that is unsafe will not be used by the public.

As important as the actual safety of the operation is its *perceived* safety. The public will not use the train if they perceive it is unsafe, based on accounts of accidents in the print or broadcast newsmedia. Passengers will not continue to use the train if they see and "sense", on an ongoing basis, things that cause concern or fear. Such "things" could be an extremely rough ride, "strange" noises while the train is moving, uncorrected physical hazards on station platforms, rough train handling, carelessness on the part of crew members, etc.

All railroads publicly proclaim that safety is a primary concern. But only the railroads that actually *work hard* to provide a safe operation achieve it. This work is a never-ending, often repetitive process.

The railroad operations safety process has its origins in the design and provision of safe track and structures, signals and train control systems, communications systems, rolling stock, and other equipment. Upon these a structure of workable and enforceable rules, standards, and procedures must be built. These requirements should be based upon and reflect the actual facilities and equipment in use.

The safety process achieves fulfillment in two ways. First is through the management of safety. This involves the constant monitoring and enforcement of compliance with the rules, standards, and procedures, by responsible and accountable managers. Training and discipline are included in monitoring and enforcement.

It is often stated that safety on a railroad is everyone's business. This is partly true. Safety *must* be the goal of each manager, supervisor, and worker. But there should also be a dedicated unit within the organization responsible for "managing" safety. To be effective, this unit should report directly to the chief operating officer (general manager). It should also be recognized that the ultimate responsibility for the safe operation of the railroad rests with the general manager.

The second aspect of fulfilling the safety process is through ongoing review and, as required, revision of the rules, standards, and procedures. Training is also an element of reviewing and revising. Of great importance is that the rules, standards, and procedures not be developed, and then forgotten. It must be recognized that they are living documents. If they are not revised to reflect new experience, hardware, "software", and practices, they will become irrelevant. If they become irrelevant, the safety of the operation is in jeopardy.

Where safe operation exists, the rules, standards, and procedures will affect each and every element of railroad operation. Broadly speaking, these elements are the transportation and maintenance functions.

The transportation function is the actual operation of the trains. It includes train makeup, train handling, compliance with operating rules and procedures, train dispatching and movement control, hours of service and other aspects of crewmembers' fitness for duty, crewmembers' qualification and certification, safety of employees, and safety of passengers and other members of the public.

The maintenance function is the care of track, power, signals and train control systems, communications, and rolling stock. It includes track safety standards, passenger car safety standards, locomotive safety standards, passenger car and locomotive safety glazing standards, locomotive and passenger car inspection requirements, rolling stock safety appliance standards, rolling stock power brakes and drawbars standards, rear end marking device requirements for passenger trains, signal and train control systems and appliances standards, highway-rail grade crossing signal system safety, radio communications requirements, and employee safety requirements.

Railroads that consistently demonstrate safety in operations have comprehensive programs that address each aspect of the two functions. These railroads also demonstrate a "corporate culture" that focuses on the importance of safety.

It is important that one recognizes the difference between a corporate culture that truly focuses on safety, and one that only pays it "lip service" (i.e., verbalizes safety commitment, but does not practice or insist upon it).

A true corporate safety culture can exist where a railroad is allowed to practice self-regulation. However, in most cases it results from a partnership. The partnership consists of the railroad operator and an external oversight entity. The key to a successful partnership is genuine desire for and commitment to safety, by both the railroad and the overseer. This desire should be marked by an enlightened, cooperative approach to oversight. Such an approach is characterized by open communication, the absence of a "know-it-all" attitude on the part of both parties, and joint problem solving.

What must be avoided at all costs is an approach to safety oversight that will cause the railroad operator only to meet the standards set by the overseer. Too often, these are minimal standards. The goal should be an oversight approach that encourages the operator to set and attain the highest level of safety standards.

The study team believes that the oversight approach should be one that uses performance-based standards. This approach would be characterized by measurable safety requirements, or goals. Attainment of the goals should be able to be readily documented. By exceeding the goals, the railroad operator would exhibit the type of commitment to safety that is desired. As goals are surpassed, a higher level of safety performance is automatically established.

Findings

The study team has based its findings concerning the safety of the current suburban commuter rail service on interviews, train rides, and site inspections.

The study team found that current suburban commuter railroad operations are poor from a comprehensive, or systematic, safety perspective. This finding applies to both the transportation and maintenance elements of the railroad's operation.

- Transportation

The study team found that the railroad's rule book article 90 is devoted to safety. However, the team was unable to determine whether a separate safety officer or safety department exists. As noted above in the "Overview" section, there must be a dedicated entity or individual within the organization responsible for the day-to-day management of a systematic approach to safety. This individual or entity should be a direct report to the general manager. A past practice on many railroads and transit systems has been to have the safety department report to the human resources manager, or to the operations manager. This has changed. Today, it is recognized that to be most effective the safety department must report directly to the general manager, who is the one ultimately responsible for the safety of the operation. To have the safety department report elsewhere jeopardizes its objectivity and credibility. It is a conflict of interest to have safety reporting to an area that it should be monitoring.

Observations revealed cases where passenger trains were being loaded with interior lights in the cars not illuminated. Passengers also were observed boarding and alighting from moving trains. These are unsafe practices that should not be allowed to continue.

Locomotives and/or control cars were observed in operation without workable speedometers. These vehicles should not be permitted to operate in this condition. The train operator (engineer) is often required to rely on an accurate determination of actual speed in order to comply with the operating rules, signals, or special orders for speed restrictions. If the engineer violates the prescribed speed and the speedometer is inoperative, management must assume part of the blame for any accident that occurs. Moreover, requiring train crews (or others) to operate defective equipment destroys management's credibility, and makes rules enforcement through discipline practically impossible.

The study team is also concerned about the large number of informal, at-grade crossings of the tracks. These informal crossings are by both pedestrians and vehicles, at numerous locations along the tracks between established crossings. In many cases, established crossings themselves lack adequate crossing gates and/or warning lights. A past attitude of many railroads has been that grade crossing protection is the responsibility of the government. In today's more enlightened approach, railroads recognize their responsibility to participate vigorously in grade crossing safety programs. A railroad's self-interest is involved here. Especially when the railroad carries passengers, it can not afford a derailment or collision and fire because of an accident involving a motor vehicle.

- Maintenance

A number of observations revealed that both the fixed facilities and rolling stock of the suburban commuter operation have been poorly maintained. One example is the inoperable speedometers noted above.

On the same "head end" train rides in which the inoperable speedometers were observed, vehicles had inoperable sanders. The supply of sand onboard the vehicles had been depleted, and not renewed. This threatens the safety of the train in case of the need for an emergency stop, or a stop in normal operations on slippery rail. The condition indicates a lack of attention to basic details, and lack of supervision. In addition, the ride quality of the same vehicles exhibited ineffective suspension damping.

Part of the reason for these readily apparent maintenance shortcomings is the operating schedule. The schedule does not allow sufficient time in the terminal for inspections. This is further aggravated by the inability of trains to run on time. Routinely, trains arrive at the terminal five to ten minutes or more late. Thus the already short time for inspections and running repairs resulting from the schedule is all but eliminated. In essence, often the trains go uninspected and unmaintained.

The poor quality and/or lack of maintenance has a cascading, or snowballing, effect. When operating crews and first level supervision observe that defects in track, signals, rolling stock or other equipment go unrepaired, they stop reporting them. Thus the situation gets worse and worse.

- Other

The above observations also indicate the necessity for external oversight of the suburban commuter rail operation. The oversight should include more than safety, as discussed elsewhere in this report.

The study team found that Chile has no federal railroad regulatory agency. EFE sets and maintains its own standards of safety, operations, and engineering. The team was told that EFE evaluates the suburban commuter rail passenger service in terms of on-time performance, passenger injuries, and passenger complaints.

Passenger injury data are obtained from reports of passenger injuries submitted by train conductors. These data are then tabulated by EFE. However, the team was informed that the person who performed this tabulation was no longer employed by EFE. No documents summarizing passenger injuries were received for review.

EFE's standards for fixed plant and equipment were not reviewed. However, EFE staff made reference to standards and guidelines published by the American Railway Engineering & Maintenance Association (AREMA), the U. S. Federal Railroad Administration (FRA), and other industry norms. EFE, although substantially self-regulated, appears to have some oversight provided by the Chilean Ministry of Transport.

- Provision of Oversight

Given EFE's experience in the operation of the railroad, as discussed in Task C the team believes EFE could provide the required oversight of the privatized suburban commuter rail operation. However, EFE must *want* to perform this function, and be able to perform it diligently and professionally.

The study team recommends that the commuter railroad operator and, if contracted separately, the fixed-plant maintainer be required to develop the rules, standards, and procedures for ensuring the safety of operations and the performance of proper maintenance. These requirements would be reviewed and approved by the overseer, initially and on an ongoing basis.

- Development of Requirements

The development of these requirements, or standards, should begin with a review of the existing standards. These standards, together with industry practice and specific local requirements, will provide the necessary foundation upon which the new rules, standards, and procedures will be built. A note of caution, however. In some cases, applicability of any of the current standards has been rendered effectively moot. This applies, as an example, to the suburban service equipment, given its current general state of disrepair. Either the standards for this equipment are inappropriate, or they are not being used.

The safety and/or maintenance standards should address seven critical areas:

- operating practices;
- track;
- bridges, tunnels, and other structures;
- signals and train control;
- communications;
- mechanical (rolling stock) maintenance; and
- grade crossing safety.

The standards should be measurable. This should be achieved by developing procedures that specify the various operations and maintenance parameters, including their frequency and documentation of their performance. This, in turn, will establish the data base from which compliance with performance standards can be determined.

With development and implementation of these rules, standards, and procedures, both the operator/maintainer and the overseer can readily determine progress toward the established goals.

Set forth in the Task I section of this report are common performance measures for the categories of safety, service quality, and efficiency/cost coverage. They are representative, and not meant to be a complete set. But their use will reflect progress toward compliance with standards and achievement of goals. As is pointed out in Task I, other than performance measures should also be used. These could include infrastructure

standards, equipment safety standards, and operating procedures. These measures address conditions and procedures, but should not be overlooked as barometers of the "health and safety" of the operation.

Examples of the performance measures, infrastructure standards, equipment safety standards, and operating procedures that should emerge as barometers include:

Fixed Plant Condition

Track gauge parameters, switch obstruction test criteria, signal and communications cable insulation testing criteria, inspection and test frequencies, requirements for corrective actions, and documentation requirements are examples of meaningful measures of the safety condition of the fixed plant.

Frequency of switch and signal failures, the allowable number of speed restrictions in effect at one time, and ride quality of track are examples of meaningful measures of service quality and reliability that also have safety implications.

Rolling Stock Condition

Standards for equipment condition; standards for equipment inspection, test, and repair; standards relating to equipment service quality; and standards for maintenance levels of ride quality and cleanliness are examples of meaningful measures of the safety, or safety-related, condition of rolling stock.

Operating Procedures

Procedures for and results of efficiency testing, hours of service violations, red signal and wayside restriction violations, education and training requirements, and rules and procedures test and examination scores are examples of meaningful measures of the safety of operating procedures.

- Recommendation for the Tender Package

Based upon all that has been discussed above in this Task E, the study team strongly recommends that a requirement for a systematic safety plan should be part of the tender document. This plan must be developed within the context of similar plans for freight and intercity passenger operations.

A good model for such a plan is found in current criteria published by the U. S. Federal Transit Administration. Similar criteria have been developed voluntarily by twelve U. S. commuter railroad operators for their own use, with the knowledge and support of the Federal Railroad Administration. One Canadian commuter railroad operator has also adopted these criteria.

A systematic safety plan, tailored to local Chilean requirements, would address such items as maintenance and inspections, passenger safety, life safety, and employee safety. Additionally, the plan would identify the entity responsible for oversight.

Task F

MAINTENANCE REQUIREMENTS

Requirements

Define maintenance requirements for equipment and facilities and develop procedures.

Overview

The railroad fixed plant was designed and constructed to a high standard. Its configuration was adequate to support high levels of commuter and intercity passenger and freight services. However, the railroad is in poor condition and is deteriorating rapidly, thereby depleting the capital embodied in the plant. Also, commuter rail (Metrotren) equipment is diverse in age and manufacture. In detail the following conditions were observed:

- Signaling has the greatest need for rehabilitation and improvement, as it is has direct impacts on safety, train capacity, and service reliability.
- The electric traction system requires major improvements.
- Bridges appear to be in good condition, based upon a cursory review.
- Electrification on the proposed Melipilla line to Talagante has been removed. It should perhaps be considered for re-electrification and completion to Melipilla. However, as this would require a major capital expenditure, a decision can be delayed until the results of the initial privatization are apparent. The study team noted that the freight concessionaire is replacing electric locomotives with diesels.
- Track maintenance, other than track inspection, is contracted out.
- Bridge and electric traction maintenance are performed in-house by EFE forces.
- The in-service rolling stock for the commuter operation currently is limited to four electric multiple unit (EMU) train sets, each of four cars. Five other sets are stored in an unserviceable condition. Their status and condition is discussed in more detail later.

The key point with regard to fixed plant and rolling stock is that a significant capital investment is required **prior** to achieving a sustainable operation. Therefore, a detailed condition survey should be undertaken as part of the preparation of the tender package. The survey would establish the rehabilitation and improvements necessary to provide the concessionaire with an efficient and reliable system.

The new commuter rail operator should be required to make its own assessment of how it will perform maintenance, whether in-house or contracted-out. The objective of the maintenance program, regardless of how it is performed, is to maintain the infrastructure and rolling stock in good condition during the entire term of the concession. A requirement must be that all facilities are in good condition at the time of termination of the concession.

The means by which this rehabilitation is to be achieved is a major consideration in structuring any tender package.

Findings

A. Southern Line

The Rancagua (South) line consists of two mainline tracks with interlockings and sidings at the stations. The line is electrified with 3,000 volts DC catenary with four manually

controlled substations. Two major station structures exist, at Rancagua and Alameda (Central Station). The line supports suburban passenger, intercity passenger, and freight train operations.

The Rancagua line had deteriorated into a state of severe disrepair. Some short-term repair work is in progress on the track and signal system. The following is an assessment of each of the fixed plant systems for this line, in descending order of need for rehabilitation.

- **Signals and Train Control**

As constructed, the signal and train control system was an automatic block signal system (ABS) with manned universal interlockings at each of the stations. The interlockings are electro-mechanical with the exception of the one at Rancagua, which is an all relay installation. Equipment is a mixture of British and U.S. manufacture.

The signal system has lost most of its ability to function due to severe deferred maintenance. At the time of the study team's initial visit, for example, the only remaining automatic signals were the distant signals, and approximately half of those were out of service. Consequently the ABS can not be used as a means of train separation. As a result, the railroad is operated as a manual block system, with only one train permitted per block. This has a severely adverse impact on the maximum frequency of train movements. It makes it virtually impossible to safely shorten rush hour headways. Additionally, EFE officials stated that track circuits were so long (3,000 m) that the reliability of broken rail detection is questionable. One interlocking, Buin, had been out of service for two months due to a fire.

For a safe and successful suburban commuter rail service to be operated, the entire line requires:

Resignalization, including design of a new block layout.

Supervisory train control from a centralized operations control center (OCC), and installation of automatic block signals that will permit two-way operation on each track. (However, for the purposes of expediting the improvements, and in consideration of reliability, maintainability, and level of technician training, it is recommended that conventional relay track circuits be utilized.)

Full protection at all railroad-highway grade crossings, with automatic gates and flashers.

- **Electric Traction**

Currently all passenger trains use electric traction motive power. Freight trains also utilize electric locomotives, but the operation is in the process of being converted to diesel operation.

The power system, installed during the 1960's, consists of 3,000 volts DC overhead wires supported by steel and reinforced concrete poles. Power is supplied by four traction power substations. Rectification is accomplished through ignitron rectifiers, but these are currently being modernized to SCR rectification. The substations appear (from the outside) to be maintained, however the condition of circuit breakers, switchgear, cables, and other

equipment is unknown. The extent of the rework encompassed by the installation of the SCR rectifiers requires investigation.

The trolley wire appears highly worn in certain areas, such as adjacent to Alameda Station. Originally the catenary included segments of double trolley, however, the second wire has mostly been removed for use elsewhere. Interviews indicated that much of the wire was, in fact, not suitable for reuse once removed, due to high fatigue. This indicates the potential for a high level of fatigue in the remaining catenary. Records of catenary failures, tearouts, or inspections were not available for review by the study team. Support pole condition varied from highly deteriorated to acceptable.

The retention or removal of the electrification represents a critical decision regarding establishment of an improved suburban commuter rail operation. Further evaluation of the condition of the overhead (clips, wire fatigue, loss of wire section) and support poles is needed to enable an estimate of the cost of rehabilitation or replacement of the system.

Factors favoring the retention of electric traction include: availability of relatively inexpensive hydro-generated power, the high level of air pollution in the Santiago metropolitan area, the tunnel connection between the north and south lines (which does not appear to be ventilated), the imminent delivery of five refurbished Spanish EMU train sets, and the superior operating characteristics electric traction provides. The intercity trains, which are also being privatized, also utilize electric traction. The decision for retention or removal of electrification should consider both operations.

- **Communications**

There are no railroad-owned communication facilities of any consequence. This lack includes train radios. However, engineers are provided with cellular telephones. An aerial fiber optic cable exists in the ROW. However, it does not appear to be utilized by the railroad.

An efficient radio-based system, operating from the OCC, should be introduced.

- **Track Structure and Right-of-Way (ROW)**

The track structure of the Rancagua line is in reasonably good condition. The rail is continuously welded (CWR), 119 pounds to the yard in weight, rolled in 1962, and of Japanese origin. Rail-flaw detection vehicles are not used, but rail welds receive a manual ultrasonic inspection. CWR adjustment temperatures were not obtained

Rail tie condition is fair. EFE has contracted for mechanized tie replacements for each of the last 5 years. However, records of the number of ties replaced and their locations were not obtained. Ballast is good south of San Bernardo, but fouled and in need of cleaning north of that point.

Turnouts are #13, suitable for diverging movements at 60 km/hr. The current maximum authorized speed on the line is 80 km/hr. The goal for an improved operation should be 120 km/hr.

The entire South Line needs surfacing. It was to have been accomplished by a contractor during the 1997 season. The entire line also requires ROW cleanup and ditching.

Much of what is perceived by the rider to be a track surface problem may actually be poor maintenance of the vehicle suspension systems. The ride quality of a new Spanish trainset was greatly superior to that of the existing, in-service EMUs.

EFE uses the United States Federal Railroad Administration's (FRA) standards as a guide for track. However the study team was unable to obtain a copy of the locally-developed track standards.

Many illegal grade crossings exist, and there is no right-of-way (ROW) fencing. The ROW is highly accessible to pedestrians and trespassers. More frequent train operation at higher speeds will dictate the need for fencing in some areas.

All trackwork, except inspection, is performed by various contractors. Different contractors are used for production and basic maintenance. Inspection is the only track activity currently performed by EFE.

For the concessionaire to reliably operate at 120 km/hr., the following track or right-of-way work is required:

A complete and high quality surfacing of the track.

Fencing and ditching in selected areas, to avoid accidents with trespassers using the right of way as a thoroughfare.

A "low density" tie program, to bring the track structure up to acceptable commuter rail standards. (These standards are described below.)

Switch rehabilitation, to enable train rerouting at high speed to support the scheduling of trains on a much greater frequency and in mixed (freight and passenger) traffic.

Verification of CWR balancing temperature at installation and automated rail flaw detection inspection, to enable the concessionaire to start with acceptable track.

- **Bridges and Tunnels**

A number of long-span bridges exist. The longest on the Rancagua line is a deck girder bridge of 3,000 meters.

EFE performs its own bridge inspections and structural repairs.

Bridges have been inspected, but have not been rated since the 1950s.

The tunnel north of Alameda station is single track, approximately 2 km. in length, and electrified. It is the only connection between the North Line to Quilicura and Tiltil and the rest of the system. It is currently used by two to four freight trains daily. The study team could not ascertain the tunnel's condition. It does not appear to have forced air ventilation.

A formal program of bridge rating and tunnel inspection should be instituted immediately.

Appropriate language addressing necessary bridge and tunnel rehabilitation work should be included in the tender documents, if there is any of this work that cannot be performed before award of the concession.

- **Stations**

Some stations are highly deteriorated. Others such as Rancagua are in a state of relatively good repair.

The Central Station at Alameda potentially will require much maintenance on the large train shed and building. Much of its interior space is leased. This station is also a landmark. Thus while Central Station appears to be a large revenue generator, it is also a costly facility to maintain. EFE may wish to design the concession so as to transfer ownership - including maintenance responsibilities - of the station to a third party. However, this should not be done without a financial assessment. The assessment would determine which approach would be most cost-effective for the railroad's operator.

- **Miscellaneous**

Freight impact on the ROW is not major. The maximum loads are 70 tons with 4 axle cars. There are approximately three or four freight round trips daily. However, it is important that the tender package not be finalized until there is complete understanding of future freight traffic projections.

EFE has an electronic rail welding plant along the South Line. This location provides ample space and railroad accessibility for use as a base for maintenance of way activities.

B. Northern Line

The fixed plant for the North Line to Quilicura and Tiltil is single-tracked. The signal system and grade crossing protection have been removed. This line is in service for freight only. As noted above, this line is connected to the remainder of the rail network by a single track tunnel at Alameda (Central Station). Catenary remains in place on the north line, but the study team believes it is not in use. Stations and interlockings also remain, but again are not in use. Tie condition is average, and the rail is generally of bolted construction.

Restoration of commuter service on the Tiltil line would require rehabilitation to the standards detailed below. This would include:

- Restoration of the signal system, including interlockings, and installation of the supervisory train control system recommended for the Rancagua line.
- Tie replacement and track surfacing. The rail *appears* to be in good condition and could remain, subject to further inspection. In time, consideration could be given to replacement with CWR, if demand for the commuter rail service grew substantially.
- Construction of passing sidings, or double-tracking throughout, to support the density of train service.
- Reconstruction of stations. A "park-and-ride" facility should be designed and installed at Quilicura, in time for the introduction of the Phase 2 service, Quilicura to San Bernardo (see Section IV of the report). This station is the ideal point for direct-access highways and substantial parking, in order to intercept motorists from the north before they reach downtown Santiago. This holds the potential for some alleviation of center city traffic, with consequential reduction in air pollution.
- Catenary system rehabilitation, including installation of a supervisory control system.

- Some fencing, drainage and ROW cleanup is required between Santiago and Quilicura, for the reasons mentioned above.

C. West Line

The west line, to Talagante and Melipilla, would require the most significant improvements to support a quality commuter operation. It has good travel demand potential for commuter rail service, since the residential and industrial development is high and the highway system is poor between Santiago and Maipu. The line currently operates as a local freight branch. It would require track improvements (tie and rail renewal, track surfacing), restoration of signal and catenary systems (both of which have been removed), and installation of supervisory train control.

During interviews, EFE officials provided a conceptual plan for improvements that had been developed for the restoration of commuter service on the West Line. This plan called for installation of partial double track.

- **Recommended Maintenance Requirements**

Following is an outline of recommended maintenance requirements that would be incorporated in the tender document.

A. Maintenance Routines

The system and facilities shall be maintained at all times, and shall be returned upon termination of the contract in a state of good repair, subject to normal wear and tear. The contractor will be required periodically to conduct inspections and to report the results to the Government Monitoring Organization (GMO), in accordance with a specified schedule. A provision would establish the right for a GMO representative to participate in these inspections, if desired. Any deficiencies noted shall be rectified prior to the next inspection.

B. Trackwork

A qualified track supervisor shall be appointed by the contractor who shall be held responsible for the condition of the track. The tender document shall be formulated to describe the required track standards, e.g., Class 5 track as defined in the US Code of Federal Regulations, which is appropriate for speeds up 145 kph. The tender document shall also prescribe the frequency and type of inspections to be performed.

C. Electrification

The catenary system shall be inspected according to a regular routine. There will be an annual inspection from the ground for poles, foundations, down guys, and track bonding; and from an on-track vehicle with an elevated platform for the aerial components. Deficiencies will be noted for replacement, and the contact wire measured at points of high wear. When one third of the cross sectional area of the contact wire has been worn away, the contractor will be required to replace the whole section, including the offending worn point.

Electrical substations will also be inspected annually, and recalibrated every two years.

D. Vehicles

A qualified chief mechanical officer shall be appointed and be held responsible for all the moving equipment. The GMO shall approve a set of requirements for periodic inspections of locomotives, EMUs, and locomotive-hauled passenger cars. These requirements will include the frequency and acceptable criteria for each inspection. An example is the inspections prescribed by the US Code of Federal Regulations. Among other things, a daily visual inspection of cars and locomotives for compliance with the applicable safety standards is required. In addition, the tender document should prescribe routine train departure tests and inspections, and running tests to ensure the air brakes and other vehicle systems are working.

E. Signaling and Communications

The tender document shall prescribe the frequency and type of inspections for all signal- and communications-related equipment, including interlocking machines, track switches, signal mechanisms, relays and other electro-magnetic apparatus, and signal cables and insulation.

F. Bridges and Stations

The tender document shall prescribe the frequency and type of inspections for all bridges and station structures. Inspections of over-water bridges shall include, at prescribed intervals, underwater portions of foundations and other structural elements.

Task G

MAINTENANCE FACILITIES

Requirements

Define requirements for maintenance facilities.

Evaluate the maintenance facility needs (rolling stock and fixed plant) required for the proposed commuter rail tender, and evaluate interfacing needs for the freight and intercity options.

Overview

The original railroad configuration provided for a full complement of facilities for maintenance of way and maintenance of equipment (rolling stock). These included shops, yards, and equipment. Unfortunately, the shops are highly deteriorated and are not adequate for the efficient maintenance of modern commuter equipment. The maintenance of way shops appear deteriorated as well.

A new three-track facility for EMU trainset maintenance is going to be built as part of the planning for the commuter rail (Metrotren) concession. The proposed new shop is a separate part of the present EMU shop, which also maintains existing intercity EMUs. The intercity service is provided by a mix of EMUs and locomotive-hauled coaches. A wheel truing facility exists at the shop. Shop forces work mostly on first shift; some work second shift. This raises the question of when do the Metrotren EMUs receive heavy maintenance?

The study team did not observe a right-of-way maintenance facility, other than the rail welding plant. However, the rail welding property is sufficiently large to serve as a base for right-of-way maintenance for the entire system.

Findings

A right-of-way maintenance base is not required at the present time, since track maintenance is contracted out. The study team recommends that the tender specify that the operator will be responsible for track maintenance. The new operator must then make its own decision whether to perform track maintenance with its own forces, or to perform it with contract labor.

The need for improved shop and support facilities is clear. The specifics should be determined as the tender package is developed. It is of importance to note that:

- Remaining available property appears to be adequate to serve the needs of the concessionaire.
- Synergy can be achieved between intercity passenger and commuter operations by utilizing the same shop and support services for both. The current proposal for expansion of the MU shop by EFE provides for this synergy, but may not provide for adequate differentiation between intercity and commuter. The approach and method for achieving the control of this interface must be clearly delineated in the tender document.
- A high quality suburban operation will add new requirements for equipment maintenance, such as a small yard at Rancagua with capabilities for car cleaning and rolling stock inspection and running repair.

The investigation indicated that significant efficiencies can also be gained by reviewing and modifying work practices (e.g. crew shifts) and modernization of equipment and storage practices. Land freed in this process could be rented or put to other uses.

Task H

ROLLING STOCK PERFORMANCE

Requirements

Define technical performance requirements and life cycle costs for rolling stock equipment.

Overview

Delay reports provided information on breakdowns and equipment performance for the commuter rail rolling stock. However the study team did not receive specific detailed data regarding performance, e.g., road failure records and car maintenance and cleaning histories.

The current in-service commuter rail rolling stock consists of three trainsets of Japanese-built electric multiple unit (EMU) trains, each of 4 cars. Five more sets are out of service in the storage yard, in various states of disrepair. This Japanese equipment is about 25 years old, and the suspension systems are in very poor condition.

Rehabilitated equipment from Spain has been received. Five EMU trainsets were to have been delivered in July. Reportedly, three existing MU sets will be rehabilitated after the new equipment is in operation. The study team was also told that EFE is considering rehabilitating one of the out-of-service Japanese EMUs, to provide capacity for added service.

In summary, the current performance of the rolling stock is extremely poor. Indeed, the primary constraint on service is the limited number and poor condition of trainsets. This is being improved by the receipt of the Spanish EMUs.

The lack of detailed rolling stock performance and maintenance data, coupled with the deteriorated condition of the Japanese EMU trainsets, makes the information that was received about the rolling stock of little value. A complete "re-engineering" of the rolling stock, maintenance facilities, and maintenance work practices is required to be able to get to the point where performance criteria and measurements can become useful management tools.

As part of the tender package, the concessionaire should be required to design and/or procure new or rehabilitated equipment sufficient to meet anticipated travel demand and service requirements, while maintaining sufficient spare units to allow for programmed maintenance. Rolling stock performance criteria and measurements should be developed for at least three categories:

- safety, such as door failures and brake failures;
- reliability, such as operational breakdowns and fleet readiness; and
- customer service, such as cleanliness, ride quality, and toilet availability and stocking.

These criteria should be studied and evaluated by the prospective operator before an offer is put forward.

Findings

Performance criteria may have gone into disuse due to the age and level of deterioration of the rolling stock. Deterioration may have occurred as a consequence of the severe

budgetary constraints that developed after the termination of government subsidies to EFE.

New criteria should be developed and included in the tender documents as contractual requirements. These criteria should include appropriate benchmarks for the private operator. These benchmarks should be based, at least in part, on the performance criteria used and demonstrated by the competing intercity bus and Santiago Metro services.

Task I

CRITERIA AND CONTROL PROCEDURES TO MEASURE PERFORMANCE

Requirement

Develop criteria and control procedures to measure technical and economic performance and compliance requirements.

Overview

Various periodic performance measures are used by different entities involved in commuter rail service oversight, procurement, or delivery to evaluate the quality and efficiency of the services provided. Parties which use performance measures include (1) governmental/regulatory bodies, (2) public entities which sponsor, contract for or pay for commuter rail service, and (3) organizations which provide or operate commuter rail service.

Four areas stand out as the most important for performance measurement; they are (1) safety, (2) service quality, (3) efficiency, and (4) cost coverage, the latter two usually expressed in terms of absolute cost or the ratio of revenues to expenses or costs.[1] While the specific form of the measurement may vary, some of the most common measures in each category follow.

- Safety

  passenger injuries

  employee injuries

  other/trespasser injuries

  accidents

  grade crossing accidents

  infrastructure standards*

  equipment safety standards*

  operating procedures*

  *These measures address conditions and procedures rather than performance, but should not be overlooked.

- Service Quality

  on-time performance

  percent of trains very late (perhaps over 20 minutes)

  trains annulled or terminated short of their destination

  ridership

  passenger complaints, or satisfaction measured by surveys

[1] It is important to understand the distinction in this context between expenses and costs. These are not synonymous terms. Expenses are cash disbursements. Costs is a more comprehensive term, encompassing the sum of operating expenses plus capital costs plus non-cash resource expenditure, usually designated as depreciation or amortization.

cleanliness of equipment and stations

equipment availability or failures

performance or failures of critical systems, such as air conditioning

- Efficiency/Cost Coverage

revenues

total operating cost

farebox recovery

operating cost (or deficit) per passenger

operating cost (or deficit) per passenger-kilometer

operating cost (or deficit) per train-kilometer

operating cost (or deficit) per car-kilometer

passenger-kilometers per car-kilometer or train-kilometer

cost per train-kilometer or car-kilometer

operating and capital cost per route kilometer

operating and capital cost per station served

operating and capital cost per 10,000 residents

The study team looked into performance measures presently employed by EFE with respect to Metrotren service, and considered measures used in other commuter services. As the structure and details of the proposed concession emerge in the government's decision process and in the course of negotiation with bidders, appropriate performance measures to be applied to privatized commuter rail service in the greater Santiago region must be developed.

Findings

Chile has no federal railroad regulatory agency, hence EFE sets and maintains its own standards of safety, operations and engineering. The team was informed that EFE measures Metrotren service in terms of on-time performance, passenger injuries, and passenger complaints.

- Metrotren Performance Measures

Metrotren safety performance is measured in terms of passenger injuries. Conductors submit reports of passenger injuries, which are tabulated. The team was informed that the person responsible for this function has left EFE, and no materials were received for review.

A key measure of service quality - on-time performance - is carefully tracked. Information is gathered from dispatchers' sheets (which record all delays), engineers' reports, and by telephone from the stations. Performance reports, including delays

tabulated by cause, are compiled weekly and monthly. Late trains are grouped as five minutes or less and six minutes or more.

On-time performance is poor. Only 52 percent of trains in March, 1997, were on time, using a standard of within five minutes or less of schedule. The figure for 11 months of 1996 was 43 percent (no data was received for November, 1996). A performance goal of three minutes average delay (lateness) per train was indicated.

Service quality also is measured in terms of passenger complaints. Complaint boxes are present in stations and on trains. A monthly summary of passenger complaints is compiled, although it was not provided to the study team.

The study team found no measures of efficiency in place. No cost-based measures are used, because Metrotren costs are not separately traced from those of EFE as a whole. This suggests the need for more sophisticated cost accounting, a subject addressed more fully elsewhere. Neither is there any indication that any measures of physical inputs (such as train crew hours) are used in place of cost-based measures. This is a significant problem in that managers and policy-makers are not able to measure the cost-efficiency of Metrotren service as a whole (or in parts), nor can they accurately assess the impacts of operational or service changes.

The structure of the concession and the form of the contract between the concessionaire and the government will have much to do with the number, types and forms of performance measures which should be applied. Likewise, the structure and role of the Government Monitoring Organization, or GMO, (see Task C) also will have an important impact. The tradeoff between authority granted to the monitoring organization and the latitude given the concessionaire will be reflected in the performance measures employed.

- Performance Measures Appropriate for a Privatized Service

Even though many arrangements are still uncertain, there is no question that performance measures should be employed in the three key areas of safety, service quality (including level of service), and efficiency.

1. Safety

   The GMO should keep track of train accidents, passenger and employee injuries and casualties (deaths). While a good safety performance is cost-effective, it is not sufficient to rely upon that principle to elicit appropriate safety performance from the concessionaire. Present or initial experience should provide a base from which appropriate future rates of improvement may be targeted and measured.

   While the GMO could establish and monitor infrastructure maintenance standards, equipment safety standards and operating procedures, the study team believes that it is more efficient to depend upon performance-based standards such as those indicated above. If government oversight of some standards is deemed necessary, such as approval of operating rules, the concessionaire should be allowed to develop the standards subject to government approval.

2. Service Quality

   Service quality, including level of service, and its measurement should be incorporated in the contract between the government and the commuter service provider. Oversight then becomes the responsibility of the contracting party or its designee. This probably would be the GMO contemplated in Task C.

   At a minimum, service quality measures should include:

   - number of trains to be operated,
   - number of cars per train,
   - number of seats per train,
   - frequency of train service,
   - train on-time performance (adherence to schedule and systematic measurement of deviations),
   - performance of equipment systems and amenities,
   - cleanliness of equipment and facilities, and
   - passenger complaints.

3. Efficiency

   Depending upon the structure of the concession, it is possible to structure the greatest concessionaire latitude and least need for government measurement in this area. The contract should be written so that incentives are present for the operator to perform efficiently, and to enjoy the benefits of such efficiency (perhaps sharing with the government). Thus a profit incentive would substitute for government enforcement of a set of efficiency standards.

   However, the concessionaire should be required to measure its operational efficiency and report the results to the monitoring organization. This information could become important under some circumstances. It may be necessary to structure some service extensions or expansions on a cost-plus or other basis under which measures of efficiency would be important in monitoring the efficiency with which such service is provided. In addition, these measures represent a fundamental depiction of the use of resources and provision of outputs, information about which a service sponsor (and funder) should be aware and accountable.

   An appropriate base of efficiency-related performance measures follows (many others could be used as well):

   - revenues,
   - total operating cost,
   - farebox recovery,
   - operating cost per passenger,

- operating cost per passenger-kilometer,
- operating cost per train-kilometer,
- operating cost per car-kilometer, and
- passenger-kilometers per car-kilometer or train-kilometer.

It is anticipated that the ultimate contract would call for the operator to provide financial and statistical reporting in addition to the information specified above.

Section IV of this report, in the presentation of the proposed tender, also addresses service parameters and performance requirements. In some cases, they are stated with a greater level of detail than presented above.

Task J

RECONCILE MARKET DEMAND DATA; ANALYZE ECONOMIC IMPACT

Requirement

Review and reconcile market demand data for each of the three lines, and analyze the effect of integrated services and economic impacts.

Overview

The objective of this Task is to evaluate future demand for improved rail service in existing and potential commuter rail corridors in the Santiago metropolitan area, to consider the impacts of service integration, and to explain the economic and social consequences of improved rail service.

The approach adopted for evaluating the future ridership consists of the following steps. First, the demand for rail passenger transport in a given region is dependent on the region's population density, economic vitality, rail service quality, the degree of accessibility that the service provides, and the availability of competing transport modes. Therefore, in order to evaluate potential ridership for commuter rail services in the Santiago metropolitan area these factors are investigated. Second, the Argentine experience with commuter rail service privatization and upgrading is investigated. Based on the above, the ridership potential of new and improved commuter rail services in the Santiago metropolitan region is evaluated. This analysis is followed by a discussion of economic and social benefits of privatization.

I. Population, Economy, and Transportation Options in Santiago's Commuter Rail Corridors

The Santiago metropolitan area, with a population of 5.3 million (1992 census), comprises some 45 percent of the national population and is Chile's economic, cultural and administrative center. The impressive growth the country has experienced since the 1980s (an average annual growth rate of approximately 6.5 percent over the past decade) has lead to massive migration to the region. The migration has resulted in the urbanization of the city's outskirts, with the population density of the central business district remaining relatively constant. This suburbanization, similar in pattern to that of North America, has increased the region's dependence on lower occupancy vehicles. While the vehicle fleet remains low at 90 vehicles per 1,000 persons (the US and Western Europe averages are 550 and 380 vehicles per 1,000 persons, respectively)[1] , car ownership is rising at rates up to 20 percent annually.[2]

The commuter rail service in the Santiago region consists of one line in operation since October 1990, the Metrotren from Santiago's Alameda station to Rancagua (81.2 km), and two potential lines stretching out from the central business district westward to Melipilla (61 km) and northward to Tiltil (some 49.5 km).

A recent ETC Transport Consultants' study[3] describes Metrotren's area of influence as consisting of the following "comunas", the last four of which do not have direct rail access:

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[1] Stephen Hall, Christopher Zegras and Henry Malbran Rojas, "Transportation and Energy in Santiago, Chile", *Transport Policy*, 1994 1 (4), pp. 233-243.

[2] Margaret Orgill, "Economic Growth in Chile Adds Up to a Big Pollution Problem in Santiago", *The Journal of Commerce*, September 24, 1997, p. 15C.

[3] The source for all information regarding Metrotren and its area of influence, unless otherwise stated, is ETC Transport Consultants, et al, *Mejoramiento Linea Quilicura - Rancagua, Informe, Diagnostico Sobres los Problemas de Transporte,* April, 1997.

San Bernardo, Buin, Paine, San Francisco de Mostazal, Graneros, Rancagua, Machali, Olivar, Requinoa, and Calera de Tango. This region represents a population of 585,477 over 5,620 square kilometers, or a population density of 104 persons per square kilometer.

Apart from three stations near the central business district, the line serves medium to small cities in mostly rural areas. The region's per capita auto fleet is low, 85 per 1000 persons. This figure is higher for more affluent Rancagua at 108 vehicles per 1,000 persons. In addition, there are an estimated 6,100 vehicles available for commercial passenger transport including buses, taxibuses, and taxis. Private autos and buses constitute Metrotren's major competitors.

As described by the above-mentioned study, there are various types of bus services along the Rancagua-Santiago corridor, providing some 1,450 departures daily. These include both long distance service between Santiago and Rancagua and beyond, as well as local service between Santiago and Rancagua. In addition, Metrotren provides access to Metro (a 27 km urban rail subway system in the process of expansion), and local bus services in Santiago and Rancagua. Except for a 1987 contract between Metro and a private bus company for the provision of a feeder bus service, there is apparently no integration of the various passenger transport modes in greater Santiago[4].

Between 1991 (the first full year of service) and 1996, Metrotren ridership has increased from some 740,000 to over 1.9 million passengers representing a growth rate of 163 percent, despite an important fare evasion problem. However, the initially high annual growth rate has consistently decreased to reach 1 percent between 1995 and 1996.

The present Metrotren service consists of one train every 1.5 to 2 hours during off-peak and every 45 minutes during peak hours in each direction. A survey of Metrotren passengers conducted in 1995 revealed that the general opinion on the service is relatively positive, although those using the service regularly were more critical. The lowest rated aspects of the service were station convenience, frequency of service, and punctuality. Other service characteristics, such as travel time, trip cost, safety and security, were not as poorly ranked.

The proposed Melipilla line can be divided into two segments. The first segment, from Santiago to Maipu, has generally urban characteristics, originating and terminating some 90 percent of corridor trips[5]. The rest of the corridor, westward to Melipilla, lies along predominantly agricultural land. The region has experienced an average population growth rate of 3.2 percent annually, between the census of 1982 and that of 1992. The corresponding rate for Maipu has been notably higher at 8.4 percent. Note that during the same period, the average growth rate for the entire metropolitan area has been 2 percent annually. The urban population along the Melipilla corridor is mainly of lower to medium socio-economic levels. Approximately 46 percent of households own no transport vehicles, and are completely dependent on public transport; only 6.6 percent of the population has access to autos. Thus,

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[4] Stephen Hall, et al, op. cit.

[5] Sources for information on the Melipilla corridor are the SECTRA and INECON studies, *Informe Final, Habilitacion Proyecto Tren de Pasajeros Santiago-Melipilla* (December, 1996), and *Informe Final, Habilitacion Tren de Pasajeros Ramal Santiago Melipilla, Tomo II, Escenarios Alternativos de Uso de Suelo Servico Suburbano* (December, 1996), respectively.

private auto travel accounts for 19 percent of corridor trips, with the remaining 81 percent accommodated by public transport. A majority of trips are during rush hour and are work- or education-related. Buses, taxibuses and private autos would be the main competitors of a suburban rail service.

The Tiltil corridor[6], with a population density of 44 persons per square kilometer, is the least populated of the three corridors, especially as one moves away from the central business district. The eastern reach of the line is residential, with two urbanized areas between Yungay and Quilicura, while its western territory is being promoted as an industrial zone. The region south of Quilicura has had a stable population during the last two census intervals. But the less urbanized region to the north of that point (traditionally a low income, agricultural area) has grown at a rate of 5 percent annually.

II Argentina's Commuter Rail Privatization Experience

The commuter rail privatization in Buenos Aires provides a useful example of service enhancement due to similarities in the reasons it occurred and its regional proximity. Therefore, this discussion examines the circumstances and results of the Argentine experience insofar as it may contribute to the evaluation of potential commuter rail ridership in Santiago.

The Buenos Aires metropolitan area consists of the Federal Capital and 25 departments of the province of Buenos Aires. In 1996, the population of the metropolitan area was estimated at 11.6 million over an area of 3,880 square kilometers[7]. Here, similarly to Santiago, while the population of the Federal Capital itself has almost stabilized, the more remote, less densely populated suburban departments are attracting more and more inhabitants (the annual growth rate for the region as a whole is 1 percent compared to over 2 percent in outer departments).

The metropolitan area is served by seven commuter rail lines (Mitre, Sarmiento, Urquiza, Roca, San Martin, Belgrano Norte, and Belgrano Sur). In addition, there are five subway lines (concessioned with the Urquiza line), one light rail line, 299 bus lines, some 1,800 private charter buses, 65,000 taxis and for hire limousines, and 2.5 million private autos (an average of 216 autos per 1,000 persons).

The extensive suburban rail network consists of radial lines totaling 901 track-kilometers and 267 stations, most of which were constructed prior to 1950. Thus, rail had long been an important and integral part of passenger transport in Buenos Aires. However, by the early 1990s the number of rail passengers had declined to 209 million from a high of 560 million in the late 1950s, and the rail network had deteriorated drastically[8]. A lack of business-like management and marketing, including neglect of customer responsiveness and a deterioration in service quality, have been cited as reasons for the ridership decline. Further, a passenger survey revealed a high incidence of crime and a lack of personal security on rail facilities as

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[6] Information on the Tiltil corridor was obtained from CIS and INECON study, *Informe de Avance No. 2, Memoria, "Estudio de Prefactibilidad Tecnico-Economica Proyecto Habilitacion Tren Suburbano Santiago-Tiltil"*, March, 1997.

[7] The source for information on the Buenos Aires metropolitan region, unless otherwise specified, is Parsons Brinckerhoff Internacional, SA (Argentina), et al, *Trenes de Buenos Aires-Demand Study Final Report.*

[8] *Latin Rail 97 - Metropolitano.*

the main reason for rider diversion to other modes. Fare evasion was also a considerable problem.

This state of affairs led to the privatization of the suburban rail system in 1994-95. Privatization has resulted in improved service quality with respect to schedules, reliability, safety and security, physical condition of the equipment and facilities. For example, data for the Roca, the San Martin, and the Belgrano Sur lines[9] indicate that within three years of privatization, the number of locomotives and cars available for revenue service increased by 58 and 63 percent, respectively. Correspondingly, peak hour and weekday scheduled services increased by 36 and 30 percent, respectively. Service reliability and punctuality also has benefited greatly. Security has been enhanced by the constant presence of security guards. The control of fare evasion, through the introduction of modern ticketing devices and access control, has contributed to increased security as well.

While projected increases in passenger demand did not in all cases fully materialize (for example, the Belgrano Sur line was predicted to experience a twelvefold increase in ridership within the first year of private operation[10]), the privatization of the suburban rail service has been a tremendous success. Between 1993 and 1996, ridership rose from a low of 212.1 million to 413.5 million passengers annually, representing an overall increase of 95 percent[11]. However, the rate of growth has varied greatly by line, ranging from 47 percent (Urquiza line) to 462 percent (Belgrano Sur line). (Note that the low rate of growth for the Urquiza line may be explained by a lower fare evasion rate prior to privatization.) This increase was accompanied by more efficient capacity usage; the 95 percent increase in system ridership was accompanied by an increase of 37 percent in car-kilometers. It is estimated that anti-fare evasion measures were responsible for some 30 percent[12] of ridership growth. The following table summarizes Argentina's commuter rail privatization experience.

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[9] Ibid.

[10] *Argentina, Transport Privatization and Regulation: The Next Wave of Challenges*, The World Bank, Report No. 14469-AR, June 6, 1996.

[11] Jorge H. Kogan, *Privatizacion Ferroviaria Argentina: Experiencias y Nuevas Oportunidades*, Buenos Aires, May 19, 1997.

[12] Interview with Louis Thompson, The World Bank, May 9, 1997.

Buenos Aires Commuter Rail Service Percentage Change in Ridership, Car-Kilometers and Train Punctuality by Line 1993 - 1996			
Line	**Ridership**	**Car-Kilometers**	**Train Punctuality***
Mitre	103%	33%	20%
Sarmiento	64	17	21
Urquiza	47	15	2
Roca	110	66	15
San Martin	101	16	7
Belgrano Norte	144	24	0
Belgrano Sur	462	206	49
TOTAL	95%	37%	16%

Source: Jorge H. Kogan, op. cit.

* These figures were calculated by subtracting the percentage of on-time trains in 1993 from the corresponding figure in 1996.

Contrary to the situation in Santiago, an important feature of the Buenos Aires suburban rail system is its degree of integration with other transport modes. Operational efficiency has been greatly enhanced by taking advantage of various modal characteristics and introducing convenient and cost-effective integrated tariffs. Note that all awarded concession contracts involve significant direct or indirect participation of private bus companies who, rather than compete with the rail service, provide increased accessibility between rail stations and the metropolitan area.

III Commuter Rail Ridership Potential in the Santiago Metropolitan Area

The preceding discussion has disclosed four important differences between the Santiago and Buenos Aires metropolitan regions. First, the population of the Buenos Aires metropolitan region is twice that of Santiago. Second, the rail network in Buenos Aires is much more extensive and, due to its installation many years ago, more integrated in the travel patterns of the population. Third, there is a conscious effort in Argentina to integrate the various transport modes, in order to take advantage of each mode's specific characteristics. Fourth, the per capita vehicle fleet is more than twice as high in Buenos Aires than in Santiago metropolitan region.

The first three points suggest that potential rail ridership may be lower in Santiago than the Buenos Aires region. Nonetheless, in the study team's view, the lower availability of private vehicles in the Santiago metropolitan area and the higher dependence on public transport make rail an attractive transport mode.

Based on the foregoing, it is estimated that improved service quality in terms of frequency, reliability, facilities, and equipment rehabilitation, station accessibility, safety and security, in conjunction with anti-fare evasion measures, may result in a 60 to 100 percent increase in ridership for the existing Rancagua line within 5 years of privatization. It is assumed the fare evasion problem in Santiago is less severe than that experienced in Buenos Aires, and may amount to some 15 percent of total ridership[13]. As the passenger survey described above revealed, an important area of needed improvement is station convenience and accessibility. As illustrated by the Buenos Aires case, integration of the system with other transport modes, both at points of departure and destination, is essential. Accessibility to stations can be improved by increased availability of parking spaces and by the introduction of feeder-bus services.

Further, as long as rail fares are lower than bus fares, it is unlikely that small fare increases will have significant negative impacts on rail ridership. First, as a rule of thumb transit fare elasticities are assumed about -0.3. This means that a one percent increase in fares will result in a ridership decrease of 0.3 percent. Although this figure is generally higher for commuter rail in industrialized countries and could be as high as -0.9[14], fare elasticities estimated for the Mitre and the Sarmiento suburban lines in Buenos Aires are quite low, ranging between -0.04 and -0.08[15]. This is in part explained by the price competitiveness of the rail mode compared to buses. Second, given the low per capita vehicle fleet in Santiago and the dependence on public transport, commuter rail fare elasticities are expected to be low. Third, evidence suggests that the relationship between fares and ridership is less clear when more complicated fare structures are introduced. Therefore, careful development of the fare structure could be an important tool in increasing revenues while maintaining ridership.

The rapid growth rate that Metrotren has experienced and is likely to experience after privatization, however, cannot be sustained without conscious and concerted effort on the part of the various Chilean government agencies. This effort should focus on increasing accessibility to the rail corridor, and reducing the demand for automobile travel through demand management measures. Such measures could include congestion pricing, wider use of toll roads, increased parking fees, and provision of alternate transit services. Research in the U.S. suggests that individuals are responsive to such price signals, and behave rationally[16]. Such measures tend to be better received by the public if the motives are broader than simply congestion management, and if the earnings are spent on improving the transport infrastructure. Without such effort, the growth in ridership will likely decrease to a rate of 1 to 2 percent annually, in line with the population growth of the region.

Since service is presently non-existent on the Melipilla and Tiltil lines, ridership projections for these lines are highly speculative, and should be treated with caution. However, based on demographic, economic and social characteristics of the Melipilla corridor, it can be expected

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[13] Based on interviews with EFE officials.

[14] See, for example, Tae H. Oum, W. G. Waters, II, and Jong Say Yong, *A Survey of Recent Estimates of Proce Elasticities of Demand for Transport*, The World Bank, January, 1990. Alos, P. B. Goodwin, "A Review of New Demand Elasticities with Special Reference to Short and Long Run Effects of Price Changes", *Journal of Transport Economics and Policy*, May, 1992.

[15] Parsons Brinckerhoff Internacional, SA, et al, op. cit.

[16] National Research Council, *Meeting the Challenges of Megacities in the Developing World*, May, 1996.

that ridership growth after service is instituted on that line will follow a similar pattern to that of the Rancagua line. This would certainly be the case if measures are taken to encourage development along the corridor, especially at locations removed from the central business district.

As for the Tiltil line, given the low population density of the region at present, it is hard to evaluate its ridership potential. It may be some ten years before the population density of the corridor reaches a level that would economically justify a commuter rail operation. Further, the amount of travel between zones is dependent on the amount and type of activity found there. For example, retail floor space generates 10 times more trips than office space, while manufacturing and warehousing generate a quarter of the trips generated by office space. Therefore, given that the region along the Tiltil corridor is being promoted predominantly as an industrial zone, the ridership potential of this line may be lower than the other two lines, even in the longer term.

IV Social and Economic Impacts of Improved Commuter Rail Service

There are a number of social and economic impacts related to increased use of the rail mode. These include environmental, congestion, safety, output and productivity, land-use, development, and balance of payment impacts. These impacts and their economic and social aspects are often intertwined. The following paragraphs discuss these impacts, in order of apparent importance to the community.

Probably the most important effect of increased rail use in greater Santiago is reduced fuel consumption and environmental degradation. Like many large metropolitan areas, Santiago has a severe air pollution problem. The region has higher rates of respiratory problems (e.g., coughing, asthma, pneumonia) and higher mortality rates due to air pollution than Chile as a whole[17]. Recent evidence indicates that particulates may present the most serious air pollution-related health threats[18]. A 1995 Santiago study[19]concluded that a 10 microgram increase in PM-10 would result in a 0.6 percent increase in mortality, excluding cumulative impacts of air pollution on patients with respiratory illnesses and cancer. Furthermore, this result is as valid for healthy individuals as for elderly and frail individuals.

The adverse effects of lead in gasoline are also well documented. The impacts are more pronounced in children, who tend to suffer from behavioral problems, lowered IQ's, decreased ability to concentrate, and in some cases irreversible brain damage. Lead is also linked to high blood pressure[20]. The plan to mandate the use of unleaded gasoline in Chile is an important step in reducing lead levels in the environment. At the same time, given the price differential between leaded and unleaded gasoline, this measure will increase the competitiveness of public transport, particularly rail, compared to private autos.

Another important consequence of improved rail service, and the resultant increase in rail ridership in the Santiago region, is reduction in congestion and highway investment needs.

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[17] Stephen Hall, et al, op. cit.
[18] National Research Council, op. cit.
[19] Bart Ostro, Jose Miguel Sanchez, Carlos Aranda, Gunnar S. Eskeland, *Air Pollution and Mortality, Results from Santiago, Chile*, The World Bank, Policy Research Working Paper No. 1453, May, 1995.
[20] National Research Council, op. cit.

Transport of passengers and goods is an important production factor. Congestion-related delays cause tremendous losses in productivity and output. First, the cost of time lost in traffic delays by passengers is significant both at the individual level (i.e., lost income), and in terms of forgone productive capacity (stress caused by the traffic delays is believed to lower labor productivity). Congestion also creates considerable logistics, storage, and warehousing costs for businesses. As an example, it is estimated that in Bangkok, Thailand, nearly 33 percent of potential output is lost due to congestion related delay[21]. Reduced congestion also lowers fuel consumption, pollutant emissions, and accident rates

Less auto travel will, as well, lower the demand for highways. This has positive financial, land-use, and social consequences. Studies indicate that it is more costly financially, and less efficient in terms of land-use management, to accommodate the transportation needs of the population by building highways[22]. Further, construction and maintenance of roadways implies a transfer of resources from the general population to auto users. In the case of Chile, given that a large percentage of the population is dependent on public transport, this factor has particular significance.

As for potential development impacts of rail investment, experience in the U.S and Europe has shown that, with a conscious planning effort, these impacts can be significant for commuter operations. The positive side of this phenomenon is exemplified in the experience of California's Bay Area Rapid Transit (BART), which in certain regions serves as a suburban railway. The biggest impact of BART in suburban areas, attributable in large part to the actions of local planning authorities, has been in the development of multi-family housing within a quarter mile of stations[23]. Likewise, significant mixed-use development around rail stations is evident throughout the Washington, DC, Metro system. For housing and mixed-use units, both the magnitude of rental prices and the likelihood of residents to commute by rail are greater than at further distances from stations. It should be noted, however, that the likelihood of rail-based housing residents to use the rail mode also depends on the degree of accessibility to jobs it provides. Promotion of rail station-based office development in Toronto and Stockholm has been cited as the reason for the success of rail projects in these cities.

Finally, the balance of payments impact of rail investment needs to be considered. These include the impacts of lower fuel and auto imports, on the one hand, and those of foreign capital investment and rail equipment imports, on the other hand. Detailed analysis is required to determine the net balance of payments effect of these factors.

Findings

Based on demographic, economic and social characteristics of the three rail corridors, the ridership potential for improved and new commuter rail operations is estimated as follows. First, for the existing Rancagua line, improved service can be expected to result in a ridership

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[21] Michael Cohen, "Megacities and the Environment", *Finance and Development*, June, 1993.

[22] See, for example, Kathleen Benton, *Virginia Railway Express Versus Equivalent Highway Capacity*, Northern Virginia Transportation Commission, April 24, 1995.

[23] Robert Cervero and John Landis, "Twenty Years of Bay Area Rapid Transit System: Land Use and Development Impacts", *Transportation Research*, Volume 31, No. 4, 1997, pp. 309-333.

increase of 60 to 100 percent within five years of privatization. This estimate assumes a present fare evasion rate of 15 percent. The degree of service improvement and integration with other modes are important factors in determining the actual ridership growth. In the long run, however, the trend in ridership growth will be very much dependent on government policies toward corridor development, congestion mitigation measures, and cost-based pricing for other transport modes.

The Melipilla line is expected to follow, although with a delay of a few years, a similar growth pattern to that of the Rancagua line, if development is promoted along the corridor. However, ridership growth on the Tiltil line will be slower, due to the corridor's present development level and the promotion of this region for industrial use.

The positive economic and social impacts of commuter rail services in the Santiago metropolitan region are numerous. The most important of these are lower pollution, congestion, and highway infrastructure needs. These factors should be considered when evaluating the social return potential of a rail project.

Task K

FINANCIAL SCHEME FOR IMPLEMENTATION

Requirement

Develop a financial scheme for the implementation of services, including priorities, phases, etc.

Overview

Although under certain circumstances privately owned commuter rail services have been self-sustaining[1], in general this has not been the case. This can be explained by the capital-intensive nature of rail operations; the indivisibility of investment necessary for increasing capacity in response to growing demand; the fact that investment in plant and equipment must be sized to peak-period loads, with consequent underutilization much of every day; the length of time required for ridership to mature; as well as governments' desire to provide affordable transportation. Therefore, the goal of privatization is to reduce government funding by maximizing revenue generation from the privatized service. Thus, the financial scheme under which the operation will be privatized will depend necessarily on the structure and characteristics of the concession contract, including investment, service, and tariff requirements.

As for government contributions, a wide range of options may be used in financing rail transport services. These include:

1. Recoupment of betterment associated with rail projects.
2. Zoning, planning obligations, and land impact fees.
3. Leasing rail rights-of-way access for non-transportation uses.
4. Financial support from universities and other public entities.
5. Road pricing, congestion, and pollution mitigation policies.
6. Various modes of taxation.
7. Sale of securities (stocks and/or bonds) in rail projects as an investment in the future of the country.

The following paragraphs discuss international experience with the above financing options.

1. Recoupment of betterment associated with rail projects.

Recoupment of betterment refers to capturing property value gains that are a result of improved transport infrastructure and accessibility. It is today a commonly used method of financing capital investments in public transport, particularly in the United

[1] Approximately a dozen major commuter railroads serving Japan's largest metropolitan areas are privately owned and profitable. These enterprises, however, operate in extremely densely populated areas and are involved in other lines of business, such as shopping malls, entertainment centers, feeder-bus services, etc. Another, less recent, example of profitable commuter rail service was the three-line operation of the Chicago & North Western Railroad (C&NW) in the United States. After rehabilitation of its service and the introduction of new equipment in the 1950s, the C&NW operated profitably until 1975. At that time, in order to prevent fare increases, the [Chicago] Regional Transit Authority first subsidized, and subsequently purchased, the service.

States and the United Kingdom. However, it is generally considered as a supplementary source of funding since, although capable of raising significant contributions under the right circumstances, it is unreliable in terms of amount and timing of contributions.

Another drawback of this form of financing is that it is hard to implement, requiring a relatively large skilled staff. Although it is possible to demonstrate, as in Toronto, Canada, for example, that improvements in transport infrastructure coincide with property value increases, it is more difficult to isolate project impacts from other contributing factors. Knowledge of a baseline property value is needed in order to estimate value gains with new infrastructure. Further, the portion of the increase in property values attributable to improved infrastructure needs to be measured as well.

There are several approaches to collecting betterment gains, including taxation, public/private partnerships, and direct land acquisition by the public sector in the vicinity of the rail project.

Betterment Taxes

Betterment taxes, if applied to property values, require the existence of a well-functioning system of property taxation. These taxes could be based on property front footage, area, appraised value, or any combination of these factors. Generally, bonds that are serviced with revenues from the betterment tax are used to finance the infrastructure investment.

A local payroll tax such as the French "Versement Transport", justified as a means of recouping betterment due to transport-related widening of employment catchment areas, may be seen as an alternative to a property based tax. In France, proceeds from this tax initially were used to subsidize reduced fares for employees. Later, its uses were extended to general fare support and the financing of capital investments. This form of taxation, however, has a drawback in that a location-based tax may cause movement of jobs in order to avoid it. This appears to have been the case in France where, while initially successful, the proceeds from this tax have gradually dwindled to a point where other methods of financing have been sought.

Public/Private Partnerships

An alternative to taxation is receiving betterment contributions through public/ private partnerships. However, this approach is unlikely to succeed after the government has declared its commitment to the project. Also, a private sector developer is more likely to contribute if others concerned are contributing as well. Negotiations can be complicated by the diversity of private sector interests, and are usually carried out by specialist agencies on behalf of the public sector.

Various arrangements have been used, including the following: (1) A developer builds a rail facility, such as a station, later deeded over to the railroad for operation and maintenance. (2) A developer agrees to purchase a number of rail passes for an agreed upon number of years. (3) A developer, either through contributions or by forming a joint venture with the government, finances all or part of the cost of

building rail infrastructure. (4) A joint venture agreement between the government and private developers, where the government contributes land while the private sector partners develop the property and provide the infrastructure. However, given the decision already taken to sell excess land owned by EFE, the latter arrangement may not be an option for financing commuter rail operations in Santiago.

Public Acquisition of Land

A more direct approach of tapping into development gains to finance rail infrastructure is for the public authority to engage in land transactions at pre-investment prices, or at prices adjusted for the cost of infrastructure enhancement. This type of financing is commonly seen in the United States. For example, in Portland, Oregon, the transport authority purchased land near a proposed light rail route, and leased it to the private sector for development of a hotel and a shopping area.

In France, the local authorities must be informed of land transactions in areas affected by transport infrastructure (zones d'intervention fonciere). The authorities have the right of first refusal at the previous year's price. This type of scheme has been successful in reducing gains to the private sector and curbing land speculation, but has not succeeded well in promoting development in the vicinity of stations.

2. **Zoning, planning obligations and land impact fees.**

As mentioned above, channeling betterment gains through public/private partnerships is difficult once the public authority has committed itself to a project. In such cases, planning obligations and impact fees could be used in financing transport investment. However, planning obligations have a limited scope, and pertain only to situations where planning permission is required. Land impact fees, on the other hand, are part of the mandatory contribution paid to the public agency by the developer.

Also, relaxation in land use or density zonings have been granted in return for contributions to public transport financing. This is justified by the fact that improved accessibility can support a greater population density. For example, in the U.S. State of Florida, expedited review of land development projects that incorporate a transport management plan, including non-motorized transport, has been adopted.

3. **Leasing rail right-of-way access for non-transportation uses.**

Non-transportation uses of a railroad right-of-way are diverse, and include advertising, easement to cross or to run parallel to the right-of-way, and air rights in urban areas. The market demand for access to a railroad right-of-way may come from various sources. These include public utilities and long distance carriers, for electric and fiber cable emplacement; petroleum and gas pipeline needs; and water and sewage company pipelines.

4. **Financial support from universities and other public entities.**

   Another source of funding for rail projects may be contributions from universities and various government entities, through rail pass purchases for students and employees. These contributions may be presented as benefiting society as a whole (through reduced pollution and roadway congestion), those for whom passes are purchased (through reduced travel costs), and for providing for other government interests (such as encouraging development of an area). This financing scheme has the advantage of promoting rail ridership and familiarizing the population with the rail mode. For example, in the United States a discounted pass, providing unlimited access to transit, is sold to employers. It is this general concept of "government interest" that forms the basis for what is described in Sections II, IV, and V of this report.

5. **Road pricing, congestion and pollution mitigation policies.**

   Road pricing and congestion mitigation policies are becoming increasingly accepted by public opinion. This is especially so when presented as a means of promoting efficient allocation of transport resources, and financing alternative transport modes. For example, Singapore and Bergen, Norway, have instituted schemes under which a special permit needs to be purchased in order to have access to the cordoned off central business district[2]. Hong Kong experimented with electronic road pricing, but the Government was faced with strong opposition from the public on the grounds that it was an invasion of privacy[3].

   Based on a recent *Journal of Commerce* article[4], Chile may be considering additional congestion mitigation measures. These may provide funds for rail projects. The article also suggests that firms may be required to switch to cleaner-burning fuels. If such a policy were to be implemented, it may be possible to relax such requirements in exchange for contributions from firms to other pollution reduction programs, such as rail infrastructure development.

6. **Various modes of taxation.**

   A wide variety of taxes have been used to subsidize public transport. These include: (1) local taxes on business turnover, profitability, or payroll; (2) property taxes; (3) taxes on motorists, including sales tax, registration tax, road tax, gasoline tax, and parking charges; and (4) taxes on hotels, tobacco, alcohol, etc.

   Although earmarking reduces the budgetary discretion of governments and may lead to misallocation of resources, it may also generate extra revenues. This is especially the case if taxpayers perceive themselves as the ultimate beneficiaries of the tax benefits.

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[2] Margaret Heraty, ed., "Urban Transport in Developing Countries, Lessons in Innovations", *PTRC*, 1991.
[3] Ibid.
[4] Margaret Orgill, "Economic Growth in Chile Adds Up to a Big Pollution Problem in Santiago", *Journal of Commerce*, September 24, 1997, p. 15C.

According to a recent article[5], Chile is considering an increase in the tax on interest payments to foreign investors to counter the threat to its export sector presented by capital inflows. Is there any better way to use the proceeds from this tax than to increase mobility and output by investing in rail infrastructure, while at the same time keeping the environmental impacts of growth in check?

7. **Sale of stocks and bonds in rail projects as an investment in the future of the country.**

   This financing scheme consists of presenting the rail project as an investment in the future of the country. In the case of the Santiago commuter rail project this approach may be appropriate, given the extent of pollution and congestion problems facing the region. Such a scheme was implemented for financing an automated guideway transit system in the city of Kobe, Japan. The consortium responsible for building the system issued stock that was purchased by the City and 42 private Japanese companies. Stockholders expect no return on their investment until all capital costs have been recovered. The system is expected to become profitable after 10 years of operation, and begin to pay dividends after 20 years[6].

Findings

Although the intent of privatization is to reduce government transportation outlays, it must be recognized that government financial support, at least initial capital investment, will be required. Among the financing options reviewed in this task, several seem particularly suited to the case of Santiago commuter rail improvements. These include:

(1) applying proceeds from additional congestion-reduction measures and a tax on foreign interest payments to improving the rail network;

(2) allowing firms to make contributions to these projects in place of switching to cleaner-burning fuels; and finally

(3) educating the public on the benefits of commuter rail, in order to attract contributions in the form of pass purchases or investment in the project.

[5] *The Wall Street Journal*, "Chile Weighs Higher Investment Tax", September 26, 1997.
[6] Peter White, "Public Transport: Privatization and Investment", *Transport Policy*, 1994, 1 (3), pp. 184-194.

Task L

TECHNICAL, LEGAL, ECONOMIC, AND INSTITUTIONAL CONDITIONS; PLAN FOR PARTICIPATION OF PRIVATE SECTOR; POLICY AND LEGISLATIVE ISSUES

Requirement

Investigate all technical, legal, economic and institutional conditions and develop a plan suitable for the participation of the private sector. Identify policy and legislative issues requiring new laws or revisions of existing ones.

Overview

General

This task examines the boundaries in which an operator (concessionaire) will be allowed to conduct its affairs, and develops the plan for private sector participation.

The boundaries should not be too confining. The object of privatization of Santiago's commuter rail system is to increase the value of the asset. Properly structured, privatization will encourage the efficiencies and economies inherent in private for-profit business practices, avoid waste and bureaucracy, and foster an orientation to attracting customers so as to improve ridership.

It is expected that the private sector will be motivated to enhance productivity and reduce costs in order to make a profit. A guiding principle in this task is to make it possible for the successful bidder to provide efficient, economical and passenger-friendly commuter rail service at a fair profit, while protecting the public interests with regard to safety and accountability concerning the use of public resources (the infrastructure and rolling stock will remain the property of the state).

The privatization plan should be attractive to prospective operators. At the same time it should preserve the fundamental fiduciary interest of the government with regard to the underlying state-owned property, and with regard to any state funding provided to the successful bidder for purposes of capital improvements or operational subsidies. The successful bidder should make a profit, but not an excessive profit. The overall public interest must be protected.

Listing of Pertinent Policy and Legislative Issues, and Any Other Key Issues

The law governing the State Railroad Enterprise (Empresa de los Ferrocarriles del Estado, or "EFE") authorizes EFE to contract out parts of its operation. EFE must approve the bidding basis and the contract. There are some restrictions. There may be no removal of track without EFE approval, and any restrictions applied to the EFE operation must also be applied to the suburban rail service concession. ("Suburban rail" is to be considered equivalent to "commuter rail" in this report.) Otherwise, the successful bidder is at liberty to operate as he sees fit. A real estate subsidiary of EFE can execute rent and lease contracts without competition. Public bidding is necessary only for major contracts.[1]

[1] This discussion of legal and policy issues, in this and the following paragraphs, is based upon an interview in Santiago on April 17, 1997, with Juan Enrique Miquel Munoz, Abogado (lawyer), former Under Secretary of Public Works, Chile; Alejandro Rivera Artigas, Gerente Concesiones Corredor Sur, EFE; and Claudio Moraga Klenner, Abogado.

Renting of advertising space by a concessionaire is permissible, likewise rental of station space, and on-train sale of food and beverages. A concessionaire may rent, or even sell, his contract, but cannot sell property. EFE must approve any new concessionaire, and a new concessionaire must agree to the same contract terms and conditions.

EFE is empowered to issue its own internal regulations in connection with traffic management, safety requirements, equipment and trackway standards, and technical provisions.[2] EFE is authorized to transfer railway functions and operations to third parties by granting concessions, and it was under this legal authority that EFE, in 1994, granted FEPASA the right to use lines and operate freight trains on its network.[3]

Under a different law, in the case of highway concessions, the investor's risk is limited. Revenues are estimated, and the state may agree, for example, to grant the concessionaire 80 percent of the estimate. If revenues fall short of that, say to 65 percent, the state pays the difference to the concessionaire. Chile's Public Works Minister, Ricardo Lagos, is reported in the Wall Street Journal to have recently announced a government guarantee of 11% profit in concessioned toll road projects.[4]

The statutes governing EFE do not permit the payment of financial shortfalls by the government to operators. To limit the operator's risk, EFE can make an agreement putting its own (EFE's) money on the line. But EFE has only limited financial resources, and it is an inadequate assurance to accept an EFE estimate that a contractor will earn, say, at least 80 percent of the revenue estimate.

There is a difference between "subsidy" and "contribution". For example, if an investment project is estimated at $100 million, and the concessionaire raises $75 million, EFE can put up the remaining $25 million as a capital contribution ("aporte") for the capital improvement. This EFE contribution would require approval of the Ministries of Transportation and Treasury, and must be enacted into law by the legislature.

The government process is this: in September the government (executive branch) sends its budget to the legislature, the legislature discusses it in October, and must complete its actions in November. On December 1, if the legislature has not acted, then the government's proposal becomes law.

On the other hand, subsidies are more complicated and difficult. The aporte is a one time contribution, but its disbursement can be over the following three years. EFE cannot approve a 30 year subsidy. The Treasury, in a 1993 law, took over the EFE budget. EFE can assume obligations, but the government will not guarantee them. Therefore EFE, which has a limited net worth and a debt of $200 million, cannot assume any large obligations. If EFE says it will commit $10 million to a project, that's believable. But an

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[2] "Infrastructure Investment Areas in Chile", a report prepared by the law firms of Morales, Noguera, Valdivieso & Besa, and Estudio Miquel Ltda., p. 30, February, 1997.
[3] Ibid.
[4] "More State Firms Brought to Auction", *The Wall Street Journal*, June 6, 1997, p. B9 (special advertising section on Chile).

EFE ostensible commitment of significantly larger magnitudes would have no credibility.[5]

The Ministry of Public Works law is more general and less restrictive. Any public works project, including a railroad project, can be bid under the public works law. EFE can apply to the Ministry of Public Works to use its more general statutory authority, which allows the giving of subsidies as well as contributions. But as a practical matter, the Ministry of Transportation does not make such requests; there are "political problems". The Treasury position is that EFE may fund from its own resources any subsidy to which it commits, absent an assurance or guarantee from the Ministry of Finance, or the President.[6]

The commuter train system will need at least some assistance in revitalizing its infrastructure in order to furnish an acceptable standard of service. Revenue assurance granted by the state would also encourage more bidders.

By Chilean law and custom, there are two ways to address this situation: by passage of a special statute, which would require a 60 percent favorable vote by the legislature, or consummation of a "four-part contract", agreed to by EFE, Transportation, Public Works, and Treasury, to bid the operation of the suburban trains under the Public Works law. Perhaps Public Works and the Treasury and the President, or the President alone (Eduardo Frei until March 11, 2000) would be enough.[7]

There is an advantage in framing the arrangement under the provisions of the Public Works Concessions Law, since it: (1) provides modern and equal treatment to private concessionaires; (2) is based on a contractual principle; and (3) provides certain subsidies or governmental financial guarantees in favor of the concessionaire. These advantages of the Public Works Concessions Law mitigate in favor of its use as opposed to the General Railways Law.[8]

It is believed that only with a state guarantee, as allowed in the Public Works Concessions Law, will private sector interest in commuter rail service operation be stimulated. This belief is supported by worldwide experience: with few exceptions, public passenger rail transportation is subsidized.

If a good framework designed for the tender package is missing, privatized commuter rail service is not feasible.

In Chile, much infrastructure investment is needed, and the state is willing to pay for that. Metro is a public service, a "sociadad anonima" (limited liability corporation), but with 100 percent public ownership. The same is true for water and sewage. There is agreement that the state should pay for infrastructure, which is a public investment. Metro pays for its equipment, and operating costs, and by some standards, is said to make a profit. The Finance Minister is now asking Metro to pay a part of its infrastructure cost. Heretofore,

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[5] April 17, 1997, interview with Juan Enrique Miquel Munoz.
[6] Ibid.
[7] Ibid.
[8] "Infrastructure Investment Areas in Chile", op. cit., p. 32.

the state has been willing to pay completely for infrastructure because of its social benefit. If, by the same token, the state will pay for commuter rail infrastructure, privatization may be feasible.[9]

A viable plan might be to join FESUB with Metro, since the government will not permit EFE/FESUB to manage the fiscal resources required to improve suburban train infrastructure. Then, after a commuter rail-Metro union, perhaps the suburban train service could be privatized. The government is concerned that money provided to EFE would be used to pay off EFE debt, rather than be invested in capital improvements.[10]

It is politically permissible, and within the bounds of acceptability in Chile, to recommend that government pay for the infrastructure capital investment, and that the operator pay for train operation, plant maintenance and equipment.[11]

Regarding foreign investment and tax incentives, there are no special rules or favored groups. There are no special tax breaks. All must pay. However, from the general law, there may be an opportunity to exempt import tax on equipment, given an appropriate interpretation of the Constitution. (It is not known whether EFE has paid or will pay the 11 percent import tax on the five trainsets acquired from Spain.) There are no exceptions with regard to payment of the Value Added Tax. Even the government pays it, notwithstanding the fact that it "takes the money out of one pocket and puts it in another".

The tender package must be approved by the Ministry of Treasury, and that ministry will ask for SECTRA's approval. If SECTRA is convinced the public benefits are high, it will help.

Labor unions ("sindicatos") are not a problem. The private concessionaire can anticipate having no difficulties here. The choice of where one works in Chile is free, and enrollment in a union is not required. There is no "union shop". If a worker has safety responsibilities, a special license is required, as is the case for "mecanistas" (locomotive engineers).

In summary, the following advice is offered with regard to this project: Display the business terms clearly. Show what is to be invested, for what service, and for what equipment. The business feasibility should be apparent. The social benefits should be displayed. If this is done well, then the rest can be arranged. When the business prospects are good, then everyone will support it.

Public Works may require a bank guarantee. If a bank will guarantee the project to 5 or 8 percent, that would be in the project's favor. If a bank doesn't believe a proposed project is credible, then neither will the government.

The bidding process may include pre-qualification and economic rules, such as financial and operational fitness and ability. It is not required to accept the high bid, i.e., the bid providing the highest monetary returns to EFE, or to the government. There can be other considerations, as well as weight factors.

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[9] April 17, 1997, interview with Juan Enrique Miquel Munoz.
[10] Ibid.
[11] Ibid.

Recent practice indicates that the government of Chile is amenable to the idea of imposing minimal constraints on the suburban commuter rail concessionaire. It has not imposed burdensome conditions on other concessionaires.

It therefore appears that the principal issue, which may require a government of Chile policy-level decision, relates to the capital funding and operational subsidy. Both are required in order to make the service viable, and to attract private contractors to manage the property and service.

Argentine Model

In 1990, Argentina decided to privatize its commuter railroads serving Buenos Aires. By that time, the state-owned Ferrocarriles Argentinos (FA) commuter rail services had become unreliable, fare evasion was high, and stations had deteriorated badly.[12] There were no precedents for privatizing commuter railroads. Many consider the privatization of Buenos Aires' commuter railroads to be a success (reliability has improved, fare evasion is reduced, and ridership has increased greatly). Since it is the only relevant commuter rail privatization model available to examine, a summary of the essential factors is in order.

The Government of Argentina, in defining the terms of the solicitation, decided to retain ownership of rolling stock, infrastructure and all facilities. The concession would be "vertically integrated", that is, the concessionaire controls all the railroad functions: maintenance of way, maintenance of equipment, transportation (train operation, dispatching and propulsion), marketing and passenger services, and administration and management.

For each corridor, the government defined maximum fares and minimum service requirements (coaches per hour, frequency, travel time, on-time performance).[13] Service quality standards were set, including percent of on-time trains and percent of canceled trains. As a performance incentive, concessionaires are allowed to increase tariffs beyond the maximum levels, if they reach or exceed the service standards.[14]

Concessionaires were free to develop their own staffing requirements. Retirement of railroad workers not hired by concessionaires was financed by the government.

The government defined and financed the multi-year investment plan to rehabilitate infrastructure, rolling stock, and facilities on each commuter rail line.

Each bidding consortium was required to include an experienced foreign railway operator that would be responsible for commercialization, transport operations (i.e., train services), and maintenance of plant and equipment.[15] Business plans were also required, with financial results exhibited on a year by year basis. If the plan projected a profitable

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[12] Kopicki, Ron, and Thompson, Louis S., "Best Methods of Railway Restructuring and Privatization", The World Bank, August, 1995, p. 154. Much of the following discussion is adapted from this reference.
[13] Kogan, Jorge H., and Thompson, Louis S., "Reshaping Argentina's Railways", *Japan Railway and Transport Review*, June 1994, p. 28.
[14] Kopicki and Thompson, p. 155.
[15] Ibid.

performance in addition to a reasonable fee for the concessionaire, it would be expected to pay the government for use of public assets. If the cash flow were negative, the government would pay a subsidy. The required subsidy (or payment to the government) was expressed on an annual basis, and, among bidders with acceptable credentials and plans, the concession was awarded to the bidder requiring the lowest subsidy in present value terms for the first 10 years.[16]

The Argentine model provides not only a precedent for what Chile desires to do with its commuter rail service, but perhaps the only available precedent which applies specifically to privatization of commuter rail service. By almost any measure, the Argentine model has been a success. The government today provides a lower subsidy to its Buenos Aires commuter rail operation, and ridership is much greater. To the extent the Argentinean experience is adaptable to Chile, Chile has the opportunity to enjoy similar benefits of privatization.

Lessons from Argentina

Perhaps the most important lesson to be learned from the Argentina model is that, despite concerns over whether private industry would be interested in assuming responsibility for politically controversial, badly deteriorated commuter rail lines, bidders did in fact come forward.[17] And the privatization result has by any measure been a success: supportive expenditure by the Government of Argentina is less, and ridership has grown beyond expectations. Ridership continues to grow, at a reported rate of ten percent in 1997.[18]

Vertical integration works. The Buenos Aires concessionaires have full responsibility for all rail activities: maintenance of rolling stock, infrastructure, and facilities; marketing; and train operations.

Another important lesson relates to the concessionaire's ability to borrow money. Since the Argentine concessionaires did not own the rail assets, they found it difficult to obtain financial resources within the short concession term (10 years, with 10-year extensions as agreed by the parties).[19] The renegotiation of one concession has included a term of 20 years. In at least one other case, the contractor proposed extending the concession term to 30 years.[20]

The Argentine concession contracts restrict the ability of the concessionaire to raise rates, and they require minimum service standards. This provides the concessionaire a strong incentive to raise ridership, in order to increase his profit.[21]

Other lessons from the Buenos Aires commuter railroads following privatization were the elimination of fare evasion, immense growth in ridership resulting from improved security, and major improvement in service reliability. The extent of ridership growth was not anticipated in the concession structure and the schedule of investments. Also, since

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[16] Kogan and Thompson, p. 28.
[17] Ibid.
[18] "Crecio el Numero de Pasajeros que Viaja en Tren", *Clarin* (Buenos Aires), October 9, 1997, p. 72.
[19] Unpublished paper obtained from Mr. Menkhoff, The World bank, p. 10.
[20] "Trenes de Buenos Aires - Demand Study Final Report", Parsons Brinckerhoff International.
[21] Unpublished paper obtained from Mr. Menkhoff, op. cit.

the ridership patterns changed, there was a need to modify the government-financed investment program. Responding to this "problem of success" required action by the Bicameral Commission of Congress, responsible for overseeing Argentina's privatization process.[22]

Investment in infrastructure receives much credit for the turn-around.[23] There had been no investment in Argentina's railroads for decades.

The Buenos Aires commuter trains receive direct government subsidies, both operating subsidy and state infrastructure investments to modernize and improve the service.[24]

In summary, Argentina provides a useful precedent with regard to privatization of commuter railroads. The Argentine experience shows that government subsidies may be reduced, at the same time service improves and ridership expands.

The FDP Contract

Consummated on September 29, 1994, a contract between EFE and Ferrocarril del Pacifico S.A. (FEPASA) establishes the corporation for the transport of freight by rail.

An interview with Eduardo Gacito Lillo, FEPASA's Director of Engineering, revealed that FEPASA seemed to have no difficulty with its concession agreement, except with regard to payment of a flat fee to EFE for use of the latter's rail lines. A use fee would be preferred by FEPASA.

The EFE-FEPASA contract contains agreements regarding the rights and obligations of the parties, use of the rail lines, conservation and modification of rail lines, train operations, rates and tolls, establishment of a commission to administer the contract, arbitration, and other appropriate items.

Policy and Legislative Issues Requiring Attention

The single most important issue brought to the consultant team's attention concerns the means by which the government of Chile promises long-term support. Based on the discussion above, it appears that EFE lacks authority to provide any government guarantee of long-term funding, let alone approve a 20- or 30-year subsidy. Public Works Concessions Law can be used to provide a long-term government subsidy. It is believed that only in this manner, with a state guarantee, will private sector interest in commuter rail service operation be stimulated.

General Character and Nature of the Concession to Be Tendered

Interviews conducted by the study team, in and out of Chile, assisted immensely in this study. They defined the issues which require evaluation and resolution in order to produce the tender package which will attract private industry, on the one hand, and protect the interests of the citizens and government of Chile, on the other hand.

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[22] Ibid.
[23] "Crecio el Numero de Pasajeros que Viaja en Tren", op. cit.
[24] "Trenes de Buenos Aires - Demand Study Final Report", op. cit.

The interviews produced a number and variety of important ideas with regard to the character and nature of the concession. Indeed, it was appropriate and necessary to discuss and reduce the options here considered in detail. This was necessary in order to avoid diluting study effectiveness, by spending excessive resources on unlikely courses of action. The options for consideration are set forth below.

1. Size and structure of commercial activities limited to suburban train operation.

   a. (Option 1.a.) A separate concession package for each commuter rail line, for train operations and marketing/passenger services function only. That is, dispatching and infrastructure maintenance would be performed by others.

      This option was discarded two reasons. First, it is important to allow the concessionaire a reasonable profit, but with minimum government subsidy. Economies of scale, not to mention coordination of services, suggest integration of all three commuter rail lines. Second, the requirement given to the consultant in the Request for Proposals is integration of planned and existing Santiago commuter rail lines. Thus, since there are no cogent reasons for not integrating the lines under one contract, this option was discarded.

   b. (Option 1.b.) Integration of all three commuter rail lines, operations dispatching, and marketing/passenger service functions only. Infrastructure maintenance would be performed by others. Dispatching functions would extend only to the limits of commuter rail territory.

   c. (Option 1.c.) Integration of all three commuter rail lines, with concessionaire responsible for operations, dispatching, infrastructure maintenance and marketing/passenger service. Infrastructure maintenance and dispatching functions would extend only to the limits of commuter rail territory.

      Options 1.b. and 1.c. are discussed together, as the difference between them is simply whether the concessionaire, or another party, accomplishes the infrastructure maintenance.

      It is recommended that the commuter rail operator should carry out dispatching on commuter rail territory. It is the commuter rail operator that will be responsible for operation of the greatest number of daily trains on its corridors, and which will likely be the highest producer of revenue on those corridors. Adding to dispatching the maintenance of way function (Option 1.c.), provides the contractor even more control over its destiny. It appears especially reasonable and appropriate if the operator also is given responsibility for appropriate expenditure to install the required capital improvements on commuter rail lines. Thus there is a strong argument in favor of Option 1.c. as a way of: (1) inducing the contractor to consider maintenance, while planning and executing the necessary capital improvements; and (2) transferring to the contractor the means to exercise more control of the attractiveness of the service to its customers. The economies of scale argument also favors 1.c.

An additional advantage of 1.c. is that span of control is geographically compact. The contractor can direct operations from a head office in Santiago.

Option 1.c. is recommended.

d. (Option 1.d.) This option combines Option 1.c. with intercity passenger rail service, including dispatching and maintenance of way for that service.

This option was considered because there is some logic, in addition to economies of scale, in aggregating responsibility for similar service. Because this option goes far beyond the intent and scope of our present study, and because the subject of a separate intercity concession is being evaluated currently by EFE, it was dropped from consideration.

2. Organizations which use other activities to cross-subsidize commuter railways.

By cross-subsidy is meant that some non-commuter-rail revenue-producing enterprise helps to support commuter rail service.

a. (Option 2.a.) This option consists of a concession combining commuter rail service with real estate development (Japan model).

Some Japanese passenger rail service operations are aided by revenues from real estate development activities including, but not limited to, housing development.[25]

b. (Option 2.b) This option combines commuter rail with Santiago Metro in one concession.

The advantage of this option is that Santiago Metro is a robust and indispensable component of Santiago's transportation scene. It is understood that Santiago Metro's revenues, including those from retail businesses in Metro stations, cover, or come close to covering, Metro operating costs. It is also understood that Metro is considered well-managed. The team believes that management of the commuter rail operation could be improved.

Cross-subsidy options relate to policy considerations and decisions beyond EFE/FESUB's control, and these options should be pursued only by those who can assure their success. Also, pursuit of this option is somewhat removed from the scope of this contract. Therefore these options are not pursued further.

3. Direct subsidy organization.

In this option (Option 3), the concessionaire takes over operation of commuter services, and the Government of Chile reimburses actual losses. The concessionaire's incentive or profit could come from its retaining all or some portion of revenue growth and/or cost reduction.

[25] Other known Japanese activities where revenues are combined with suburban railways under a single corporate umbrella are department stores and amusement parks.

This arrangement amounts to "cost plus" contracting which, as a non-commercial type of enterprise, has not received high marks for encouraging creativity in reducing costs and improving revenues. Therefore this option is eliminated.

4. Business-oriented concession structure.

   a. (Option 4.a.) In this option, the government provides standards (maximum fare, minimum number of trains, maintenance requirements), and each bidder states the amount he will pay the government (positive concession), or the amount the government must pay him (negative concession), to operate the concession.

      Option 4.a. encourages private industry to assume risks, reduce costs, attract customers, and strive to develop and maintain a profitable operation. Private industry must assess risk, and make its "business plan" an integral part of its bid on the tender package.

      There are any number of variations or refinements which could be made to Option 4.a. For example, the government could provide to the concessionaire a lump sum (or installments, staged over time), representing the capital improvements required to bring the Rancagua, Melipilla and Tiltil lines to a state of good repair for commuter rail operation.

      This is an option worth pursuing. It asks private industry to do what private industry does best.

   b. (Option 4.b.) This option joins the commuter rail concession with completely non-rail-transport enterprises. These include department stores, or firms such as bus operators, which could be encouraged, for a variety of reasons, to join their on-going enterprises to the commuter rail service, given a properly structured tender package.

      Although this option has some merit, it moves somewhat distant from the nature and scope of study parameters, and is therefore discarded.

Based on the discussion above, the remaining study effort is focused on Option 1.c. in combination with Option 4.a.

Even if continuing government operating subsidies are required to sustain the commuter rail operation, likely improvements in efficiency, effectiveness and attractiveness to present and prospective riders justify the change to private enterprise concessioning. The Argentine example has shown that it is possible to reduce subsidies, and at the same time improve service and ridership.

In summary, Chile's plan for commuter rail privatization should include a competitive bidding process. In this, bidders should detail their capital investment and operational subsidy funding requirements to operate the service. Alternatively, if the bidder believes revenues will exceed operating and maintenance costs, its bid may include the annual amount proposed to be paid to the government. The responsible bidder which provides the most attractive proposal to the government is then selected to operate the service.

Plan for Private Sector Participation

The ideal plan should: (1) maximize those attributes inherent to private enterprise which encourage productivity, efficiency, and the attraction of customers; (2) allow the concessionaire the opportunity to make a profit; (3) minimize inherent risk by sharing it between the private sector and the government; and (4) provide a measure of protection of the public interest.

In order to maximize the strengths of private enterprise, the plan should: (1) impose minimum restrictions and reporting requirements; and (2) be structured in a way that encourages the prospective concessionaire to make its own analysis, prepare a business plan, and exercise due diligence before submitting its bid.

The plan should provide for government investment funding. This is in recognition of the fact that capital infusions are necessary to bring track, signals and communications, power distribution systems, rolling stock, stations, and other facilities up to a state of good repair. The funding should be transferred to the contractor for implementation of the improvements.

The amount estimated by the government may or may not be stated in the tender package. In any event, it would be appropriate for the prospective operator to make its own estimate. This estimate would be included in its proposal. The proposal should also include a schedule for government capital payments, and a plan and schedule for accomplishment of rehabilitations.

The government's tender package should, at the least, include a description of the standards to which the line is to be rehabilitated and maintained.

In recognition of the belief that an operating subsidy may be required, the bidders should also be required to provide a pro forma schedule of operating income and expenses. This can be readily done with regard to the Santiago-Rancagua line, which exists and is operational.

With regard to the Melipilla and Tiltil lines, where some new construction will be required, the requirements can be stated by the government (standards of construction and rehabilitation, number of trains per day, etc.), and the prospective concessionaires may relate their bids to those specifications.

The concession period should be at least 20 years. This would enable amortization of capital investments and benefits from operational improvements to be realized by the concessionaire, by the government, and by the citizens.

Selection of the winning bidder may be based upon: (1) the bidders' proposed capital improvements funding schedules, including amounts deemed necessary to meet the government's standards; (2) proposed operating surpluses or subsidies; and (3) other responses to the solicitation requirements.

One of the problems of the Argentine model was that ridership growth so exceeded expectations, that the concession structure was unable to deal with it effectively. In the

Santiago tender package, bidders should be required to state their plan and price for accommodating increases in ridership.

In general, the team's approach to this tender package is to obtain the optimum concession agreement through the bidding process. Following is an outline tender package, which will of course require additional specifics and details.

Outline Tender Package

1. Objective: The objective is to improve Santiago suburban commuter train service and attract riders to this transportation mode. This, in turn, is expected to make available to the public numerous benefits, including reduced traffic congestion, improved air quality, and enhanced travel choice.
2. Plan: The selected contractor is to rehabilitate existing rail lines emanating from Alameda to Rancagua, Melipilla, and Tiltil, and operate and maintain revitalized suburban train service, attracting ridership from other modes. The government of Chile will provide initial capital investment funding to bring the three lines to a state of good repair, and will provide operation and maintenance funding to the extent necessary. The contractor will execute the capital investment rehabilitation program, and operate and maintain suburban train service, and is expected to make a profit of at least 11 percent. The period of contract is 20 years, extendible in 10-year increments. Existing service on the Alameda-Rancagua line is to be maintained during rail line rehabilitation.
3. Information Required by Bidders.

   (Complete description of the existing infrastructure including track charts, and detailed description of available rolling stock. Descriptions of all other aspects of EFE suburban train operations, including cost of diesel fuel and cost of electrical power; wage rates; track use charges/access fees, if any; present train schedules, ridership figures, and fares; and government of Chile plans with regard to the development of land in the direction of Tiltil. In general, it will be necessary for EFE to provide all objective data necessary for due diligence investigations, and preparation of detailed business plans.)
4. Contractor's proposal/bid package must include a complete business plan, among other things showing:

   a. Financing; working capital; management structure; labor requirements; key operating assumptions; timeliness for meeting financial, ridership and operating goals; key personnel to be assigned; equipment to be acquired/rehabilitated; and assets/support to be supplied by government.

   b. Operations and safety plans.

   c. Year-by-year plans for execution of the government-funded capital rehabilitation program on each of the three rail lines:

      Alameda-Rancagua;

      Alameda-Melipilla; and

Alameda-Tiltil (future option to be exercised by government).

The government may or may not exercise the Alameda-Tiltil option.

The year-by-year plans are to include rehabilitation funds required by year and by line, and the dates upon which specific rehabilitation projects will be completed.

d. Anticipated ridership, revenues, and operations and maintenance costs on each of the following rail lines:

Alameda-Rancagua; and

Alameda-Melipilla.

e. Year-by-year, and for each rail line: either (1) amount to be paid by contractor to government, or (2) amount of government subsidy/support required. Basis: 11 percent profit.

f. Competence of bidder to perform the work.

5. Contract requirements:

a. Service standards (specify minimum number of trains; passenger capacity, seated and standing; headways on each line).

b. Fares are to be no higher than those of competing bus service. Exceptions, based on service improvements, may be negotiated with the government.

c. Contractor is to rehabilitate existing rail infrastructure and rolling stock to a state of good repair and/or obtain new rolling stock, which will allow safe 120 kilometer/hour passenger train operation at five-minute headways. Contractor is to maintain the infrastructure and rolling stock in a state of good repair. (Standards must be established and included in the tender package, addressing infrastructure, rolling stock operating parameters, rolling stock safety features, and operating and emergency procedures.)

d. Safe operation of the suburban train service shall be a top priority. (Safety standards must be established and included.)

e. Contractor will be responsible for dispatching of all trains within suburban train territory, including freight and intercity. (Dispatching paradigm/rules must be established and included.)

f. Accounting and reporting requirements (establish and include).

g. Settlement of disputes (establish and include).

h. Labor requirements (state, for example, training requirements).

6. Criteria for selection of contractor:

a. Completeness of business plan.

b. Proposed capital improvements execution schedule.

c. Proposed ridership, revenue, and cost schedules, and support thereof.

d. Amount of annual: (1) payment to government, or (2) government subsidy required.

e. Demonstrated competence, including experience of proposed management team.

Plan Viability in Terms of Anticipated Revenues and Costs, and Plan for Government Support (Subsidy)

An EFE objective in this project is to reorganize the suburban train service so as to cover operating costs as a minimum. The PBI team stated in its proposal that although worthy, this is an ambitious objective. No major passenger transportation system exists, bus, truck, ocean or river vessel, airline, or highway, in which revenues cover all costs, including those relating to capital investment in infrastructure plus those relating to its use. Already mentioned above is the statement by Chile's Public Works Minister, Ricardo Lagos, that the government of Chile guarantees an 11% profit in concessioned toll road projects.

United States commuter railroads are subsidized, and their farebox recovery ratios are, on average, about 50 percent. That is, farebox revenues pay for half the operating and maintenance costs. It should also be noted that these U.S. commuter railroads are not privatized operations. They are owned and operated by state or local government entities. If privatized, these U.S. commuter railroads would be expected to improve their farebox recovery ratios.

The only commuter railroads relevant to this study which have been converted to concessioned, or privatized, operation are those serving Buenos Aires. It is understood that even after privatization of the Buenos Aires commuter railroads, a government operational subsidy remains.

Recommendations

The consultant team recommends that the government of Chile:

1. Use the outline tender package, above, to prepare its solicitation to private industry.
2. Utilize the Public Works Concessions Law, which permits a long-term subsidy commitment to the concessionaire.

Task M

FARE STRUCTURES AND COLLECTION SYSTEMS

Requirement

Investigate the feasibility of adopting fare structures and collecting systems that will be consistent with other transportation modes.

Overview

General Considerations

Following are some of the considerations which may affect fare structures and collecting systems:

Fare Structures

- Cost recovery target/public policy.
- Distance traveled.
- Quality of service.
- Peak and off-peak travel times.
- Discounts for fare pre-payment or quantity pre-payment.
- Transfer to connecting transit system.
- Discounts for children, senior citizens, students, etc.

Collecting Systems

- Prevention of fare evasion.
- Security: internal and external theft.
- Data collection for statistical analysis.
- Cost.

Fare Structure

Cost Recovery Target/Public Policy

Ridership, and therefore much of a transit system's income, is highly dependent upon fare structure. The dynamic relating fare structure, ridership, revenues, and costs is an important feature in every passenger transportation system. Interviews with EFE, and other, officials in Santiago indicate their conviction that promotion and stimulation of ridership is an important priority in the improvement of suburban train service. Indeed, the purpose of this study was to facilitate privatization and improvement of suburban train service, so that more riders will be attracted to it.

A principal goal of this aspect of the study is to discuss how best to maximize covering of operating costs by revenues, i.e., a farebox recovery ratio (farebox revenues divided by operating costs) of at least 100 percent. Experience in other passenger transportation systems indicates the difficulty in attaining this goal.

Until very recently, transit ridership in the U.S. has been declining[1], costs have gone up, and revenues have remained essentially constant over the past two decades. This has resulted in a decline in farebox recovery ratios, from about 80 percent in 1970 to about 30 percent in the early 1990's.[2]

These adverse trends reflect a number of factors, such as the declining market share of public transportation; various government policies, including the underpricing of congested road space and the unequal tax treatment of transit and private vehicle commuting costs[3]; population shifts from older transit-oriented cities to younger automobile-based cities; and public ownership of large transit systems[4].

These facts nonetheless provide a perspective on the complex dynamics which relate fare structure, ridership, revenues, and costs, as well as on the increasing difficulties faced by public passenger transportation systems in an era of growing automobile use.

The experience of public transportation systems in countries other than the United States also confirms that Chile faces numerous practical problems in attaining the goal of covering operating costs with farebox revenues.[5] It is worthwhile to explore the role that use of "government interest", as that term is defined in Task K and in Sections I, II, IV, and V of the Final Report, can play in eliminating a traditional "subsidy". It is toward this goal that the study team focuses attention in this task report.

Flat Fare Vs. Differential Fare

Distance traveled, quality of service[6], peak and off-peak travel times, discounts for pre-payment, and transfers are discriminators upon which to base differential fares. Passenger transportation officials and others have debated the utility of the single "flat fare" (one fare, regardless of distance traveled or other factors), as opposed to fare differentiation (based, for example, on trip length, trip time, or quality of service, e.g., first class, second class), and bulk pre-payment discounts (for example, for a monthly pass or ten-trip ticket).

Flat fare pricing greatly simplifies and reduces the cost of the collection process, while differential fares may respond to a greater economic logic, and promote a sense of fairness. For example, the higher cost of longer trips, and of operating during peak

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[1] Commuter rail ridership has seen marked increases in the last ten years.

[2] Kemp, Michael A., "Transit Fare Issues in the !990s - Where Are We, and How Did We Get Here?", Workshop of Transit Fare Policy and Management: Research Needs and Priorities: July 11-14, 1993, *Transportation Research Circular Number 421*, April, 1994, Transportation Research Board, National Research Council, Washington, DC, pp. 26-29.

[3] Ibid.

[4] In the United States, Federal Policies and practical local government economics have resulted in increasing privatization of transit systems. For example, in the suburbs of Washington, DC, county governments have turned to lower cost private industry to operate some, but not all, bus services.

[5] This subject is discussed also in the Task L portion of this study report.

[6] Quality of service includes frequency, modernity, amenities, and personal attention to individual riders. Amenities may include more comfort, less crowding, and separate facilities (e.g., first class and second class). Higher fares are justified by enhanced amenities.

periods, and the perception that short-distance riders are subsidizing those who take longer trips, all argue for differential fares. On the other hand, simplicity, local political considerations, and lower cost of administration may justify a flat fare system.

It is appropriate to base any decision regarding fare structure on careful analysis of the many factors involved, including expected ridership and revenues, and estimated operating costs, as well as public policy.

Continued fare differentiation is recommended for Santiago's suburban trains. This is so for the following reasons: (1) flat fare pricing generally is deemed inferior as a revenue generator; (2) the great differences in distances traveled by Metrotren users; and (3) the opportunity to set prices based upon time of day and/or market segmentation (differences between commuters and other travelers in riding habit and willingness to pay more).[7]

Transfer to Connecting Transit System

The issue of transferring to a connecting transit system relates to both fare structure and fare collection. The importance of this subject is that any transit system that wishes to gain ridership should explore the feasibility of making changes which assist and attract riders. Many transit systems provide free transfers between modes, for example, bus to rail and vice versa. Where a free transfer is not offered, a combined and/or discounted fare covering all portions of the journey provides a great convenience to passengers.

Collecting Systems

In the case of commuter trains, the following collecting systems may be considered:

(1) On-board fare collection. Passenger pays conductor.

(2) Fare pre-payment. Passenger purchases ticket (or pass) prior to boarding train. Conductor collects ticket (or inspects pass) on train.

(3) Fare collection at station with barriers. This requires a closed station[8] and controlled boarding/de-boarding, as well as ticket inspectors or automated equipment to insure proper fare amount is collected. Automated fare collection equipment provides the opportunity to collect ridership and revenue statistics automatically. These data may be used for several purposes, including marketing/advertising to enhance ridership, and making fare structure adjustments in order to maximize ridership and/or revenue. Automatic collection machines reduce the requirement for, and therefore cost of, collection personnel, but require a substantial capital investment; at the same time, they help to reduce internal and external theft.

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[7] There are numerous papers advancing the opportunity to improve transit revenues through differential pricing. One such is Dawson, John A., "Fare Structures and Marketing Segmentation", prepared on behalf of the Policy and Planning Committee, American Public Transit Administration, October, 1983.

[8] A closed station, through use of gates and/or barriers, restricts train access to individuals who have paid their fares.

(4) Self-service fare collection without barriers. This is the "honor system", also called "proof of payment system". It requires inspectors to conduct random rider sweeps or surveys, in which riders show their tickets upon demand, to discourage fare evasion. Either personnel or ticket vending and validating machines may be utilized to sell and validate the tickets; the machines would require a capital investment.

The elimination of fare evasion is deemed an important objective, and one which the private concessionaire must take seriously if its contract is structured to motivate enhancement of ridership and revenue, as it should be.

Elimination of fare evasion will have a cost: increasing the number of inspectors, to verify fare payment; or addition of equipment (train cars),to reduce standees[9]; or installation of physical barrier systems, to prevent unauthorized access and egress; or procurement of modern ticket vending/validation machines, magnetically-coded farecards, or "smart cards", in combination with physical barriers; or some combination of the foregoing.

The discouragement of internal theft (fare revenue larceny by transit system employees) is another factor worthy of considering, with regard to collecting systems. The more automated the system, the fewer the required staff, and therefore the chance of theft is reduced. By the same token, theft by non-staff individuals is discouraged with the acquisition of modern ticket vending devices, constructed so as to be practically impervious to tampering.

Summary: Fare Structure and Collecting Systems

The fare structure and collecting system for a privatized suburban train system should: (1) encourage ridership, (2) enhance revenue, (3) minimize fare evasion and theft, and (4) entail reasonable administrative costs.

Observations with Regard to Metrotren

General

Metrotren employs a conventional commuter rail fare structure in which fares increase with distance, but generally at a decreasing rate per kilometer traveled. A discount is offered in connection with the purchase of multiple (10) trip tickets, a common practice on other commuter rail systems. A 14-trip promotional fare was in effect when the team conducted interviews with EFE in April, 1997. The fare structure has been adjusted at least once since system start-up, but that experiment was terminated when it resulted in lower revenues. Peak pricing is not utilized, because Metrotren has only a five percent market share[10](and, presumably, because of infrequent peak hour service).

The ticket taker-dependent collection system employed by Metrotren reflects EFE's historical trade-off between the costs of labor (inexpensive and available) compared

[9] Throughout the world, crowded vehicles with many standing riders provide an ideal environment for staff to overlook fare collection or verification.

[10] Interview with Sergio Landa Espinosa, Asesor Directorio EFE, April 21, 1997. Another source states Metrotren's present modal share as four percent.

with capital (expensive and unavailable). Fare evasion is deemed to be a problem, though its extent is unknown. The percentage of Metrotren riders who avoid payment was estimated to range anywhere between 5 and 25 percent.[11] Furthermore, several individuals interviewed expressed the opinion that the opportunity existed for ticket takers to collect passenger fares, but not turn over all monies collected. Some such fraud was believed to be taking place.

The fares are said to be based on, in fact equal to, the fares charged by Metrotren's chief transit competition, private bus operators. Another EFE source stated that bus fares are considered, but that the rail price is generally a little above bus price. Rail fares cannot change rapidly like bus fares. When commuter rail service had operating problems and poor performance, fares were reduced to attract passengers back to rail.

Commuter fares are zone based; a zone is about 21 kilometers. At the time of the April, 1997, interviews, a promotion was in effect in which a 20 percent discount was given with the purchase of a 10-trip ticket, and a 25 percent discount with a 14-trip ticket.

For a variety of reasons, it is difficult to examine the appropriateness of the current Metrotren fare structure. The prices charged by competing bus companies are a good starting point for establishing Metrotren fares. However, the fact that a bus ride, at least from Rancagua, is a more pleasant passenger experience, is approximately competitive with regard to time duration of trip, is offered with greater frequency, and is far more reliable, suggests that current rail fare levels may be too high.

The increasing number of motor vehicles traveling in the corridor between Santiago and Rancagua since Metrotren service was initiated has periodically resulted in longer bus transit times. However, a continuing series of government-funded improvements to the highway infrastructure (most recently including a bypass around San Bernardo) has enabled the bus operators to schedule the same elapsed time between those points today as when the Metrotren service was initiated.[12] In other words, massive public sector investment in the highway system has undermined the competitiveness of Metrotren service.

Fares

Fare level and structure are the chief mechanisms for maximizing revenue produced by the service, with a given number and schedule of trains operated. However, given the present ride experienced by the Metrotren customer, it is difficult to judge how much more Metrotren could charge if its service more closely approximated the optimum. For example, the ride experienced by the current rider is at great variance with the ideal: rush hour trains are overcrowded; trains do not depart or arrive on time; seats are torn; windows and floors are dirty; the equipment lacks toilets and running water.

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[11] Another EFE official estimated fare evasion at between 10 and 15 percent.

[12] This information comes from a bus operator. Actual experience riding the bus from Rancagua to Santiago on a Saturday was that travel time was greater than that on Metrotren. Turbus travel time was one hour and forty five minutes; Metrotren timetable travel time is one hour and fifteen minutes.

The "new" (rehabilitated) RENFE trainsets, received by EFE in mid-1997 from Spain, will of course be greeted with enthusiasm. The utilization of this new equipment will provide riders an entirely different perspective with regard to train travel between Santiago and Rancagua.[13] Later, when capital rehabilitation improvements are made to the track and signal systems, it may be appropriate to consider fare structure increases, at least on a market segmentation basis.

Fare Collection

The existing Metrotren ticket collection function is extremely labor intensive. Depending upon the normal number of passengers who ride a given train, one or two conductors are assigned to check that every passenger has a ticket, to holepunch every ticket inspected, and to sell and holepunch all tickets sold on trains. While conductors were observed to be diligently inspecting tickets, it is not possible for them to inspect the tickets of all passengers on those trains which are fully loaded.

No one knows how many Metrotren riders avoid buying tickets regularly, because of the inability of conductors to move through crowded rush hour trains. Under the present system, one can evade fare without risk; a customer can buy a ticket and simply keep it for another day if the conductor does not punch it. It is clear is that fare evasion probably is greatest on those rush hour trains on which paying customers are forced to share inadequate space with fare-evading customers.

A second problem with Metrotren ticket collection, even on those trains which are not full, is that there is no protocol for checking that customers do not ride beyond the station indicated on their tickets. In other words, there is no mechanism except the conductor's memory for ensuring, for example, that southbound customers boarding at Alameda station don't buy a ticket to San Bernardo, and then ride to a station beyond.

Discussion

Until the service provided by Metrotren improves beyond what is offered today (and as this report is being written, the new Spanish trainsets are being introduced), at least two fare structure concepts suggest themselves.

First, a larger discount associated with a greater number than 10 rides per ticket should be considered. Such an option would provide at least three significant benefits: (1) it would accelerate cash flow to the concessionaire, (2) it would reduce the number of ticket sellers otherwise required, and (3) provided such tickets were not sold on board Metrotren, it would reduce the opportunities for fraud occurring in connection with ticket sales.

Were this concept carried to its logical and optimal extreme, a majority of Metrotren riders would automatically receive monthly passes in the mail, having authorized Metrotren to debit their bank or credit card. The savings in manpower that could be

[13] One negative point with regard to the new trainsets is that they do not have bathrooms. It is the study team's opinion that commuter trains operating between Santiago and Rancagua should be equipped with toilets.

realized from such a system would be significant. Also, it would provide a convenience and encourage ridership. Additionally, it would produce very useful information about Metrotren's customer base. The actual ticket-sale function could easily be contracted out to the private sector.

Second, the crush load carried by certain trains on a regular basis discourages ridership. This condition provides the least customer-friendly ride during the very time that Metrotren presumably enjoys its greatest competitive advantage over its bus and private automobile competition. The conditions on such trains are bound to discourage revenue-paying ridership that otherwise would be attracted to the service, notwithstanding its shortcomings. It is understood that the crush load problem will be alleviated when the new Spanish trainsets are put into service.

Further experimentation with fare structure, levels, and marketing should be conducted. Ideally, this should happen only after the new Spanish trainsets are completely installed in revenue service, and have demonstrated their superior reliability. However, better data than that collected today will be necessary to assess the true impacts of such changes in the fare structure. In particular, good baseline data will be required.

As to fare collection, the labor intensity and potential for fare evasion can be reduced in a variety of ways, most of which substitute increasing amounts of capital for labor. Current procedures allow passengers to purchase tickets on Metrotren (an attractive convenience, given the low premium supposedly charged). That feature must be weighed against the cost of employing a second conductor on certain trains. It also must be weighed against the revenues foregone as a result of some on-board ticket selling. That practice slows the progress of conductors through the train, and results in some riders not being asked to show their tickets.

Metrotren single-ride tickets are valid until used. Failure of conductors to reach all passengers on a given train may well result in continuous reuse of a ticket, until a conductor by chance completely and fully covers his designated rounds. Therefore, Metrotren should strongly consider the elimination of ticket selling on trains. The elimination of this practice could be accompanied by the addition of automated ticket vending machines at Alameda, Rancagua and San Bernardo, to complement human ticket sellers. Furthermore, should capital be available, Metrotren ticket sales might be eliminated at all stations, except via the use of automated ticket issuing machines.

A higher level of capital investment, in combination with a change in ticket collection procedures, would involve the construction of a semi-closed system only at the three highest volume stations, Alameda, San Bernardo and Rancagua.

Interconnecting, inexpensive, low barriers and gates could be built around the perimeter of one or two Metrotren departure platforms. This would discourage the dangerous practice of passengers walking across several sets of tracks while moving to or from the expected arrival or departure track.

In addition, southbound Metrotren customers would have to show a Metrotren ticket to a ticket checker to pass into the gated (or "paid") area. The on-board ticket

collector could then concern himself with issuing indicators of the passenger's appropriate destination station (seat checks). Several US commuter rail systems, including Virginia Railway Express, employ a narrow strip of metal or fabric on the seat backs into which either the customer or conductor fits a collected ticket. The conductor then can easily verify the destination on the ticket. Often this process is facilitated by color coding tickets with a unique color for each destination, regardless of origin.

The same system also could be employed at San Bernardo. Boardings on southward trains beyond San Bernardo are so insignificant that they easily could be handled by one conductor. Likewise, were such a limited barrier system installed at Rancagua, one conductor easily could process all tickets before reaching San Bernardo. Quite likely, northbound San Bernardo riders are the greatest source of lost revenue. This is so because of the large volume of boardings at that location, in combination with the relatively short distance/time between San Bernardo and Alameda. Together, the large number of boardings and the crowded conditions on several peak period/direction trains inhibit the realization of maximum revenues.

A closed ticketing system, employing automated gates to process and regulate entrance to and exit from Metrotren platforms, would offer several advantages. Most importantly, it would reduce the opportunities for fraud, and would provide excellent and inexpensive data about the demand for Metrotren service by time of day and station pair.

Patrons of Santiago's Metro easily use such an automated system. This suggests that an automated system at Metrotren stations would be acceptable to the public, and would cause only minimal, initial confusion.

To the extent that Metrotren passengers also use the Santiago Metro, use of the same automated ticketing technology on both systems would enhance the possibility of through tickets. Just one piece of paper or plastic would be used for a trip which begins on Metrotren and ends on Metro (or vice-versa). Thereby significant reductions could be achieved across the revenue collection, accounting, and recording cost spectrum, and in the number of transactions necessary to use both systems.

The Argentineans reportedly solved fare evasion in a multi-step process, starting with more security and more checks, and then proceeding to automated fare collection and enclosed stations.[14]

In Curitiba, Brazil, an innovative system utilizes a boarding tube station. Bus doors open directly onto an elevated boarding tube, thus allowing level embarking and disembarking, a faster process compared to step-up/down boarding/de-boarding.[15] (Also, disabled passengers may more easily get on and off the bus.) Boarding passengers pass a turnstile and pay their fare. Exiting passengers depart the bus at the

[14] Bravo, Raul, Private Communication, 6 June 1997. (Mr. Bravo is a transportation consultant in Northern Virginia, USA.)

[15] Major, Michael J., "Brazil's Busways: A Subway That Runs Above Ground", *Mass Transit*, May/June, 1997, p. 26.

other end. It may be that features of the Curitiba boarding tube could assist Metrotren with regard to improving fare collection.

Let us assume for sake of discussion that fare evasion is 20 percent (which may be high). Annual revenues would be 25 percent greater if all were required to pay. Using 1995 EFE statistics, the 25 percent greater revenues would mean an additional 180 million pesos, or approximately U.S. $450,000. The issue becomes, what expenditure for fare evasion reduction can be justified by the amount of revenue gained? The study team believes that a semi-enclosed system at Alameda, San Bernardo, and Rancagua could be attained for a fraction of the additional annual fare revenues that would probably result.

Findings

With regard to fare structures and collecting systems for Metrotren, it is recommended that:

1. Fares be competitive with the bus.
2. The raising of fares be considered only when service is improved, and when increased ridership demonstrates a greater demand.
3. Peak hour fares, that is, higher fares during the morning and evening rush hours, be considered.
4. Marketing of 10-ride tickets and monthly passes be emphasized.
5. Consideration be given to measures which would reduce fare evasion, based upon a comparison of the costs of the measures and the increased revenue they are expected to produce. Measures to be considered may include the installation of automatic ticket-vending machines, additional conductors on trains, and/or institution of new controls, including physical barriers/fences, at the most highly-used stations to perform ticket-checking functions prior to boarding of trains, or some combination of these measures.
6. Through ticketing with Metro be investigated.

Section IV.

PROPOSED TENDERS

A. Criteria

The proposed tender for operation of the Santiago commuter rail system must satisfy each of the following criteria. These are critical requirements for structuring the business and operational aspects of the tender.

1. Address Capital Needs

The present condition of the railroad is such that service comparable to Tour Bus or other competing carriers cannot be offered. Buses are modern, clean, and reliable, and operate over an excellent and constantly improving highway network. Likewise, the Santiago Metro provides a quality of service superior to that offered by suburban rail. In order to compete economically, commuter rail must provide service levels comparable to these other modes. Capital investment for upgrading is required as quickly as possible. Some improvements to passenger comfort and train frequencies can occur immediately upon the delivery of new rolling stock. However, if refurbishment of the fixed plant is not implemented, the railroad will never reach its full potential. It will remain at a competitive disadvantage to other modes.

See Exhibit IV-1 for a description of the proposed capital cost allowance for the initial Alameda to Rancagua segment. Expanding the estimate in Exhibit IV-1 to cover the whole system to Melipilla and Tiltil, the estimated cost would be in the order of US$350 million.

Note that rolling stock was not included in the estimate. The question of who pays for the vehicles needed to expand the commuter services must be decided. The study team recommends that the government pay for and retain ownership of the vehicles.

2. Avoid Continuing Government Subsidy

The concept of continuing operating subsidies is contrary to the policies of the government of Chile. However, government interest may be provided in forms other than operating subsidy, such as capital investment.

While no commuter rail system in the world covers its true costs, this tender will be structured to avoid continuing operating subsidy. Instead of subsidy, this tender proposes the concept of continuing government interest, in a form that permits an appropriate sharing of the economic risk. The government and the private operator would share in this risk. Most importantly, this sharing would provide the catalyst for achievement of the cost and operating efficiencies which are inherent in a privatized operation.

3. Quickly Improve Service Level and Quality

It is imperative that the poor public perception of commuter rail be quickly changed. Currently, commuter rail is less expensive to ride than the bus, but it is not as comfortable or clean. Although commuter rail can provide a faster trip, its

EXHIBIT IV-1

Santiago Commuter Rail System, Proposed Rehabilitation of Existing Infrastructure

Order of Magnitude Cost Implications for the Alameda to Rancagua Segment*

Category	Costs (in US $)
Track Rehabilitation	
Ties	3,600,000
Interlocking Timbers	100,000
Track Surfacing	3,700,000
Ultrasonic Inspection of Rails	50,000
Grade Crossing Renewal	320,000
Right of Way Rehabilitation & Maintenance	
Fencing	12,660,000
Ditching	220,000
Signals and Train Control	
Wayside Automatic Block Signals	100,000,000
Interlockings	3,500,000
Supervisory Control	500,000
Radio Communications	5,000,000
Grade Crossing Protection	4,800,000
Communications Backbone	0**
Structures	
Bridge Rehabilitation	1,000,000
Tunnel Rehabilitation	5,000,000***
Traction Power	
Catenary System Rehabilitation	7,400,000
Poles	200,000
Substations	300,000
Buildings, Fare Collection, and Parking Lots	
Stations	2,000,000
Miscellaneous Buildings	320,000
Automated Ticketing Equipment	1,280,000
Barriers and Turnstiles	800,000
Park & Ride Lots	0**
Maintenance Shops and Equipment	
Shops	11,900,000
Equipment and Tools	1,000,000
Rancagua Yard	2,000,000
TOTALS	167,650,000

* 81 km of double track main line with 5 interlockings.
** Cost covered by others.
*** Rough estimate; thorough inspection needs to be performed to develop actual cost.

reliability is poor. On-time performance is at a level far too low to attract people to the mode. To the public, commuter rail is the "cheaper" but less desirable alternative to the bus. However, an improved commuter rail system with its inherent advantages can quickly become the "carrier of choice".

4. Staged Implementation

Opportunities exist for implementing suburban rail service along the lines to Melipilla and Tiltil. However, practicality and business risk dictate the immediate improvement of existing service as the first priority. Later improvements would see service extended according to a staged plan. In this way, phased service extensions could be used to stimulate ridership demand. This would provide for rational service growth, without creating undue business risk for the operator.

5. Coordination with Other Tenders

The joint operation of freight, intercity passenger, and suburban passenger services was a design goal when the railroad was originally formed. Thus the designers provided a high degree of operational compatibility.

Today, the creation of independent, privatized businesses must be accomplished equally as thoughtfully. Their creation must occur in a manner that preserves the operational compatibility, respects the operational intricacies of joint service, and provides for a fair assignment of required operating and capital costs. In addition, the privatization of the real estate interest and the changing role of EFE itself require careful review. The goal here is to preserve assets that may be required either for commuter rail operations, or for revenue opportunities for the commuter rail operator.

6. Regulation

Critical aspects of the privatized commuter rail operation must be regulated. These include safety and service quality. In theory, proper performance in these areas is simply good economics. However, they are so important that regulation is required to ensure that short-term deviations do not occur. The regulation is simply a tool to hold the private operator accountable. In addition, special oversight is required during the construction and rehabilitation phase due to the size of the government's capital investment.

7. Benchmarks

Standards, or "benchmarks", have been designed to which safety, service quality, service levels, and other key performance indicators are targeted. It is important that these benchmarks be pertinent to Chilean criteria and standards. These, in some cases, may differ from North American practice.

8. Achieve a Balanced Transportation System

The goal of commuter rail privatization is not to create a monster that will gobble up all competing modes of transport. Rather, the goal is to meet the commuting needs of the greater Santiago area by providing a balanced transportation network.

Each mode has its purpose and usefulness. Additionally, the high density constraints imposed by the natural terrain and the apparently healthy public transport habit of the traveling public augur well for commuter rail. These factors indicate that a balanced transportation system can be supported through a free-market system, with comparable levels of government interest provided to all modes.

B. Tender Outlines

The Parsons Brinckerhoff International team recommends an approach that requires two tenders. One is for design. The other, for Build-Operate-Maintain (BOM) services. This approach is favored over the Design-Build-Operate-Maintain (DBOM) method, due to the concurrent progression of the intercity passenger rail tender and to the relative quickness with which the design can be completed. The proposers on the intercity tender must be provided with accurate information on the levels of improvements to be made to the railroad. Therefore the commuter rail rehabilitation requirements should be included with solicitations for the intercity passenger service concession. They must also be made aware of their associated capital and operational benefits and requirements.

The BOM Approach

The Build-Operate-Maintain (BOM) approach is recommended for the following reasons:

- Provides a firmer basis for pricing by both the intercity and commuter operators. The current fixed plant and related rail systems are not capable of providing the levels or quality of service that would be specified in the commuter rail tender. The intended level of rehabilitation of the railroad, expressed in engineering drawings, would provide valuable information to prospective operators during solicitation of the BOM tender. This information would serve to reduce the level of economic risk, both for the prospective operator and the government. The same information would be just as valuable to proposers on the intercity tender, as much of the infrastructure would be jointly utilized in the greater Santiago area.
- Saves time, since the design package can be completed concurrently with preparation of the BOM package. For example, the completion of design for the Rancagua Line is estimated to take less time than the preparation and solicitation of the business tender. A typical schedule is included as Exhibit IV-2.

The Design Tender

The design tender will be based upon use of "off-the-shelf" technology, that will enable swift implementation at minimal cost. The design will be specified to be to a level of completion comparable to North American practice, or 30 percent. For example, signal design would be specified to include block layout and typical, but not detailed, circuits. In this manner, design can be accelerated, and should be

able to be completed within six months of the notice to the designer to proceed. It also ensures competition by different signal manufacturers, as each will be able to offer their proprietary standard hardware.

The BOM Tender

The BOM tender will be more complex. It will include two major aspects. The first will be completion of final design followed by construction. The second will be to operate and maintain the system.

The following presents a detailed outline of a proposed BOM package that would be submitted to prospective operators.

1. Purpose

The purpose of this offering is to provide for:

a. Completion of the final design for rehabilitation of the railroad between Rancagua and Quilicura (Rehabilitation Stages 1A and 1B), shown on Map IV-1, including Alameda Terminal (Central Station), as indicated in the attached 30 percent design package.

b. Rehabilitation of fixed plant and rail systems of Stages 1A and 1B, according to a schedule similar to that included in subsection C, Implementation Plan, below.

c. Final design and rehabilitation of fixed plant and rail systems of Stages 2A and 2B, according to a schedule similar to that included in subsection C, Implementation Plan, below.

d. Operation of transitional improved suburban service between Rancagua and Alameda Terminal during rehabilitation Stage 1A.

e. Implementation and operation of specified levels of service on the Service Improvements segments shown on Map IV-2 for a period of 20 years, with a provision for renewals for 10-year periods.

f. Progression of staged capital improvements to the West (Melipilla) and the North (Tiltil) lines, followed by staged service improvements as described in subsection C, Implementation Plan, below.

g. Provision (if specified) and maintenance of the required rolling stock.

h. Provision for the maintenance of the fixed plant and rail systems, including those delineated in this tender that are utilized by freight and intercity passenger operators in areas of joint operation.

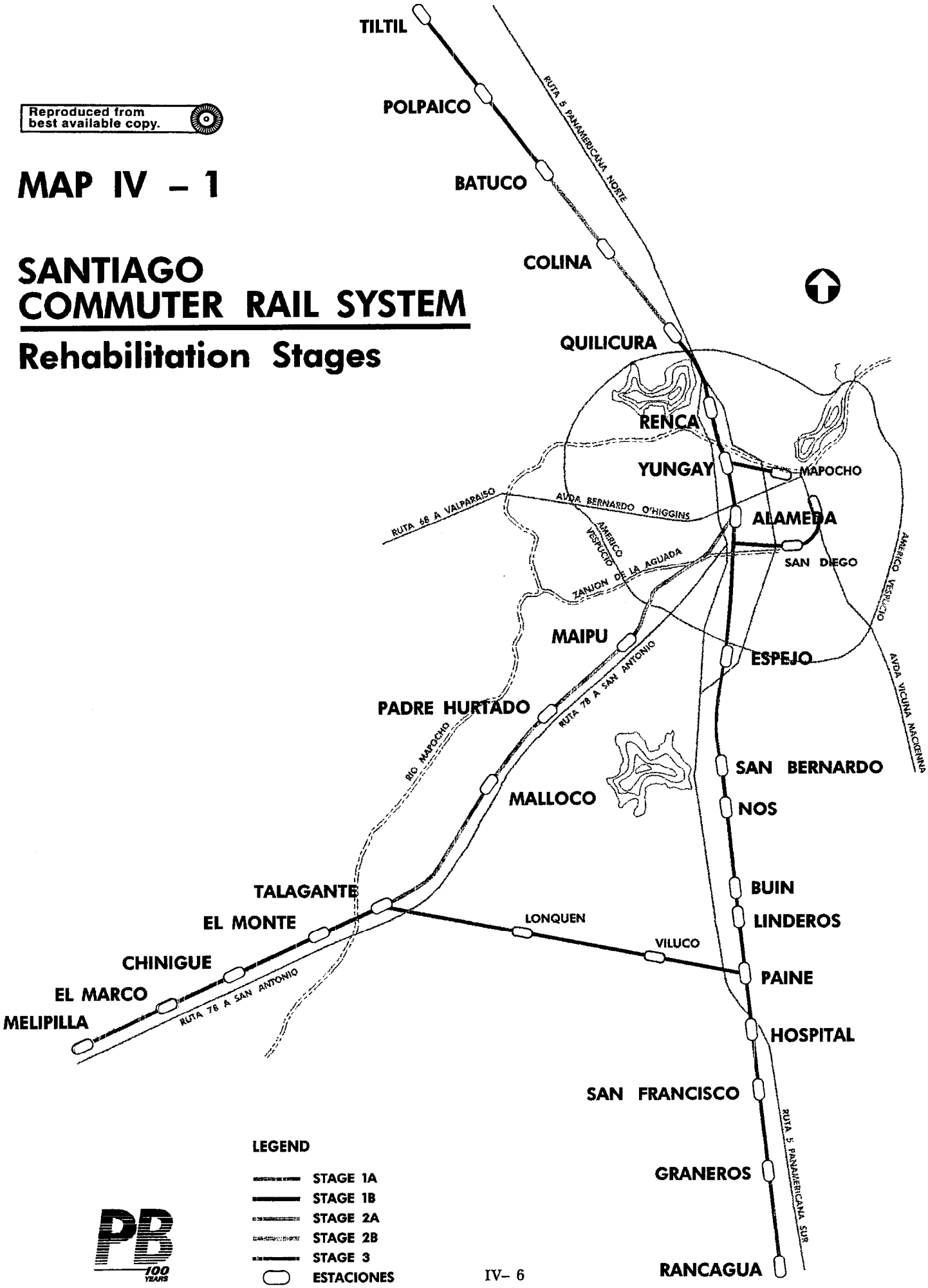
i. Provision of train and electric propulsion power dispatching, including dispatch of intercity passenger and freight trains in areas of joint operation.

Reimbursement for these services will be provided as specified.

MAP IV - 1

SANTIAGO COMMUTER RAIL SYSTEM

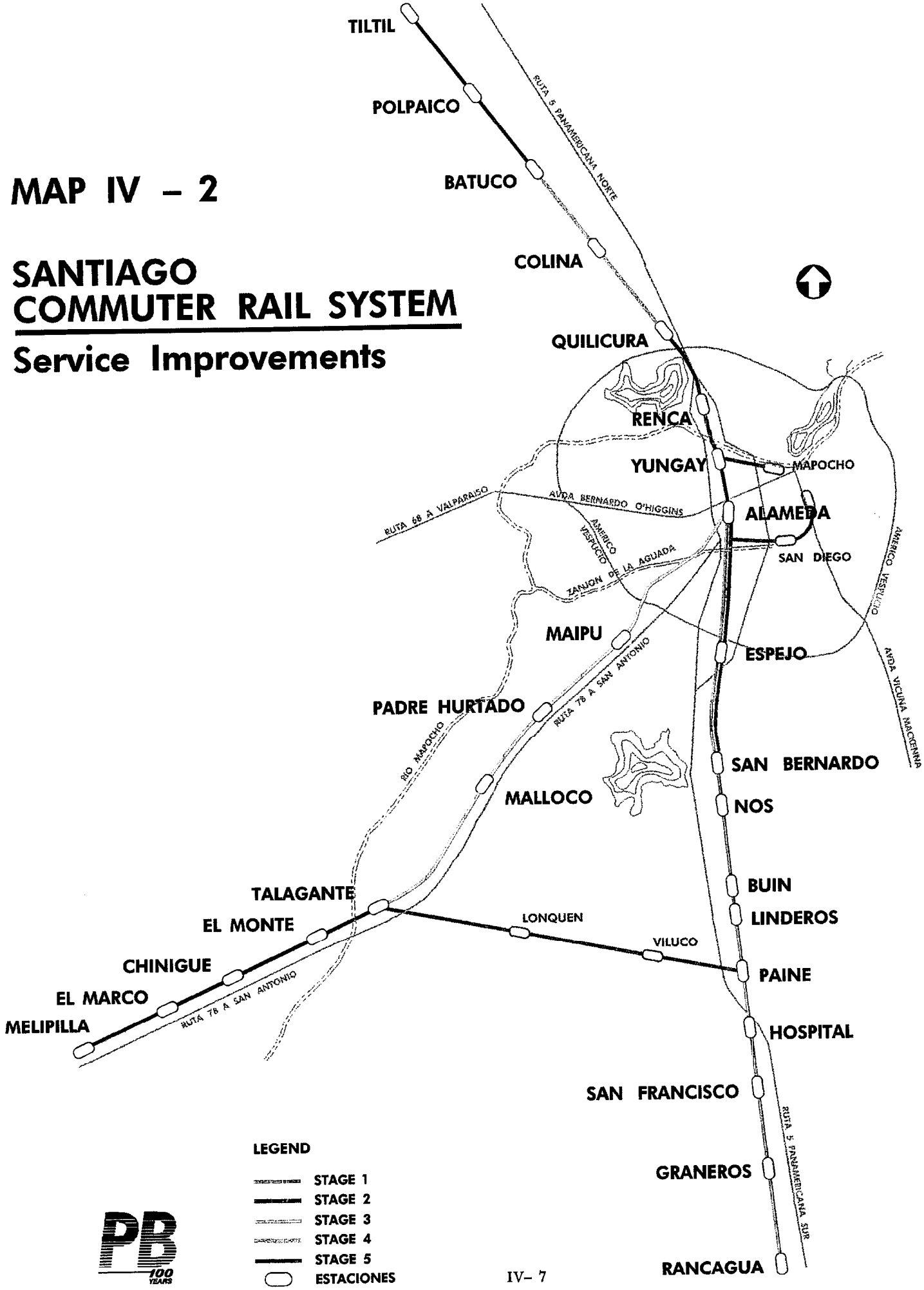
Rehabilitation Stages



MAP IV – 2

SANTIAGO COMMUTER RAIL SYSTEM

Service Improvements



2. Scope

The scope of this tender includes provision of services over the following line segments.

- Main line, Alameda Terminal to Rancagua.
- Main line, Alameda Terminal to Tiltil.
- West Line, Alameda Terminal to Melipilla.
- Alameda Terminal, including related yards and shops.

The services to be performed by the operator, to the schedule outlined below in subsection C, Implementation Plan, include the following:

- Final design of the infrastructure rehabilitation and improvements.
- Rehabilitation of railroad fixed plant and systems.
- Improvements to rail systems, including installation of new systems (e.g., signals and train control) and shops.
- Provision of new or rehabilitated rolling stock (if required by the government).
- Maintenance of plant, systems, and rolling stock.
- Rail passenger operation, including responsibility for safety, security, scheduling, and internal training.
- Provision of services and support to the freight and intercity operators, including maintenance of way, electric traction power, train dispatching, and security, in areas of joint operation.

3. Service Parameters

Service parameters will be specified to cover the following:

- Scheduled trip times.
- Minimum number of trains per hour, peak hours.
- Minimum number of trains per hour, off-peak hours.
- Minimum number of seats per hour, peak and off-peak.
- Hours of service.
- Frequencies and times, or slots, for movements of intercity passenger trains.
- Frequencies and times, or slots, for movements of freight trains.
- Priority of train movements during delays and recovery from delays.

4. Performance Requirements

The terms of the proposed tender will provide the commuter rail operator with major incentives to minimize operating costs. While it is clearly desirable to

reduce these costs through improvements in efficiency, safeguards must be provided to protect the level and quality of service. Therefore, the tender must delineate specific performance requirements, or parameters. These can be categorized as follows.

- Safety.
- Service levels.
- Service quality.

Good examples of appropriate parameters are found by examining the competing suburban bus operations, or the Metro. However, care must be exercised when comparing the service characteristics of heavy rail rapid transit and commuter rail.

Because the commuter operator will supply certain functions to the intercity passenger and freight operators, these subjects must also be addressed, together with the method of payment for the services.

As mentioned previously, a regulatory function is also necessary to monitor and oversee the performance against these parameters. The team recommends that it should be provided by EFE.

Following are typical parameters that are recommended for inclusion in the tender package.

a. Safety

Performance goals with respect to safety should include specific safety standards, as well as measures of performance against defined parameters. The types of standards and the level of performance should be benchmarked against typical Chilean criteria, such as are used on Tour Bus, MERVAL, or the Santiago Metro. The use of North American standards and criteria will be selective, since they may not necessarily be appropriate in the Chilean context. Quantifiable parameters for measuring safety performance can include:

- Employee injuries per employee man hours.
- Passenger injuries per passenger kilometer and/or per million passengers.
- Frequency and cost of yard and mainline derailments.

Specific safety standards will address broad aspects of operations, and include:

- Criteria for employee training and periodic qualification, such as on operating rules and physical characteristics of the railroad.
- Criteria for rolling stock, such as brake and wheel conditions, door operation, and on-board communications.
- Inspection and test requirements for rolling stock.

- Safety standards for fixed plant systems, such as track conditions. These standards are not to be considered as design standards, but are to be used only as they pertain to safety.
- Inspection and test requirements for fixed-plant systems.

In addition to complying with specific safety standards and criteria, it is recommended that the operator be required to implement a Safety Quality Control System. Such a System would include maintenance of records, and "spot", or efficiency, checks on these performance requirements. This System would, in turn, be subject to review and approval at the start, and then be audited on a regular basis, by the regulatory authority (EFE).

b. Service Levels

Performance goals with respect to levels of service should include specific standards, as well as measures of performance against defined parameters. Quantifiable parameters for measuring levels of service can include:

- The minimum number of train departures per hour.
- The minimum number of train arrivals per hour.
- The minimum number of cars per train.
- The number of seats per train.

c. Service Quality

Performance goals with respect to service quality are broad in scope. The following are just some that could be included:

- Cleanliness of rolling stock.
- Amenities aboard rolling stock, and their functionality. For example, are restrooms provided? Do they work, and are they stocked?
- Ride quality (a function of train-track dynamics).
- Interior noise levels.
- Air conditioning.
- Schedule performance. Elements of measurement could include adherence to schedule, i.e., arrival at destination station no more than five minutes late; whether all scheduled station stops were made; and whether the train was operated. There are also other measures that could be used, such as total minutes of delay, or terminal delay, per day.
- Number of road failures of trains per day, or per rush hour period, etc. This measures the number of trains that break down enroute and have to be taken out of service, with passengers discharged short of their destination.
- Number of passenger complaints per day, by category.

In addition to these quantitative measures, a sampling of general customer satisfaction can be taken through surveys or questionnaires. A requirement might be imposed for the taking of independent surveys on a periodic basis, with results reported to the riders, to the public, and to EFE.

Appropriate performance criteria might also be extended to the intercity passenger and freight operations. For example, the operators of these services should be held accountable for a minimum level of on-timeliness of their trains.

5. Design Requirements

It is important to recognize the relationship between the performance requirements and the design criteria. The design of the capital improvements, and the actual capital investment, must be such that the performance goals are realistically achievable, without unreasonable strain upon operating resources or budgets. An example is the design of the train control system. A five-minute design headway is recommended. This is required to support a maximum peak hour schedule frequency of 13 trains per hour for each of the three lines ultimately planned. Such a design headway is also required to allow flexibility for movement of intercity passenger and freight trains, and to enable recovery from delays.

6. Intercity Passenger and Freight

The commuter rail operator must coordinate scheduling, planning, and fixed-plant maintenance with the providers of the intercity passenger and freight services and, where applicable, Nueva Via. In addition, agreements must be executed with the other railroad operators covering the following areas:

- Reimbursement of the commuter rail operator for the dispatchment of trains.
- Reimbursement of the commuter rail operator for the provision and dispatchment of electric traction power (intercity passenger only).
- Reimbursement of the commuter rail operator for the maintenance of track, signals, power, and communications.
- Reimbursement of the commuter rail operator for the provision of maintenance facilities and equipment (intercity passenger only).
- Reimbursement of the commuter rail operator for the servicing of intercity passenger locomotives, cars, and train sets.
- Reimbursement of the commuter rail operator for the operation of a central storeroom facility (intercity passenger only).
- Priorities for train movements of the three operators in the event of delays.

7. Optional Stages

The prospective operator would be given an option for implementing service improvements. The operator could follow the proposed plan for the staging of commuter rail service improvements, as set forth in subsection C., below. Or the operator could advance its own plan for implementing improvements. If the prospective operator recommends its own plan, it must be able to demonstrate the plan's superiority. Superiority must be demonstrated in the areas of cost and time to implement, without reduction in the desired safety and quality of service.

8. Schedule

The schedule for implementation of this offering is set forth in subsection C., below. The prospective operator may recommend an alternative schedule, provided it accomplishes the desired results in the same amount of time, or less.

9. Financial Requirements

The prospective operator must prove it is fiscally responsible. It must provide a notarized letter, or letters, of credit from a responsible financial organization, preferably one that is Chilean-owned. If it is already a railroad operator, it must provide documentation of the financial health of its railroad operations for the past five years, or from their inception if the operation is less than five years old.

10. Regulatory Requirements

The BOM package should clearly describe the regulatory requirements with which the prospective operator will be expected to comply. These requirements should cover the areas of safety, service quality, service reliability, and tariffs. The package should also specify that the operator will be subject to periodic and unannounced audits of the regulated areas, and that the operator must produce required documentation within a reasonable time after a request is made. It should be understood by the prospective operator that its financial records are subject to these requirements. The BOM package should also specify the individual, department, and organization responsible for the regulatory oversight.

C. Implementation Plan

The proposed implementation plan justifies the view that the required effort should be regarded as the deployment of a new commuter rail system. There are two reasons for this view. First, the extent of the required rehabilitation of the fixed plant. Second, the change in the nature of the service to be provided from low-frequency suburban commuter rail to intense, high-frequency, region-wide commuter rail.

An Implementation Plan is required for such a deployment. It provides a basis for the continuation of existing services during the implementation period. It also enables the

public to be given a comprehensive perspective of the coming service improvements and extensions.

In order to be effective, the Implementation Plan must address the following issues.

- Mitigation of the impacts of reconstruction and rehabilitation on existing service, including assurance of safety.
- Coordination of the intercity passenger and freight tenders with the commuter rail operator's operational and business requirements.
- The staging of service extensions to achieve coordination with growth in ridership.
- The schedule for drawdown and availability of capital funds.

As a result of the study team's review of the rehabilitation and operational aspects of the system, the following recommendation is made:

- That development and deployment of the new commuter rail operation be accomplished in stages.

A preliminary schedule for the first three stages is outlined on Exhibit IV-2. The timing of the fourth stage - final service extensions to such areas as Tiltil - is difficult to forecast, based on data presently available.

Stage A - Conceptual Design of Improvements; Bid and Award of the BOM Contract

This stage includes preparation of the following:

- 30 percent design specification for improvements to the fixed-plant and related systems for the railroad. It also includes the physical condition survey report of all the infrastructure and rolling stock. Maintenance facility performance requirements would also be specified.
- A Prospectus describing the proposals, to elicit Expressions of Interest from teams. It will require information to be provided by interested parties so that EFE can prepare list of acceptable qualified bidders.
- A biddable package for the business tender, together with its distribution to the qualified bidders. The preparation of this package will dictate the duration of this stage (Stage A), as the required engineering design is expected to be rather basic.

The final element of this stage is receipt of bids, and award and negotiation of a BOM contract. The award would be expected to occur within 18 months of the notice to proceed with Stage A.

Stage 1 - Rehabilitation, Quilicura to Rancagua

This stage, the first involving the BOM contractor, includes final design and actual rehabilitation of the railroad, and implementation of other improvements, between Rancagua and Quilicura. This work would be expected to begin within 6 months of receipt of the contractor's notice to proceed. Other improvements would include

construction of new park-and-ride lots, and the delivery and commissioning of additional rolling stock.

This stage will be divided into two sub-stages, which will be worked together. Stage 1A is Alameda to Rancagua. Stage 1B is Alameda to Quilicura. The operator would be expected to introduce the improved service between Alameda and Rancagua approximately 12 months after receiving the notice to proceed. A shuttle service between Quilicura and San Bernardo would replace and expand the Alameda to San Bernardo service, presently operated once a day. This service should be introduced nine months after start of construction.

Some level of improved service will be implemented during Stage 1 between Rancagua and Alameda Terminal (Central Station). This service should be referred to as "Transitional Service".

The goals for this transitional service period should be to improve on-time performance and minimally increase the frequency of trains. Improved passenger comfort should be almost automatic, through use of the newly arrived Spanish trainsets. Further attempts at service improvement - such as shortening trip times, extending service to new areas, and increasing off-peak frequencies - are not recommended during this period of major reconstruction.

Close liaison with the freight and intercity passenger operators is absolutely necessary during this stage. Also during this phase, the commuter rail operator would assume responsibility for the maintenance of way and dispatching of the Rancagua Line. These responsibilities should be assumed prior to the start of the major rehabilitation work that will require track outages. The construction of this stage can be expected to begin within six months after the award of the BOM contract. It will be initiated following final engineering, mobilization, and the stockpiling of materials.

Stage 2 - Rehabilitation of Additional Line Segments

Stage 2 will include implementation of all service improvements between Quilicura and Rancagua. To occur will be significantly increased peak period train frequencies, shortened trip times, increased off-peak frequencies, opening of all park-and-ride lots, and coordination of aspects of service - such as feeder buses and joint ticketing - with other modes.

Also during this stage, reconstruction work for the operational segments Alameda to Talagante and Alameda to Batuco will begin. At this time, the commuter rail operator would assume responsibility for the maintenance of way and dispatching of these segments.

Stage 2 rehabilitation segments are projected to be the extension of North Line service from Quilicura to Batuco, and the extension of West Line service as far as Talagante. Both extensions would include construction of park-and-ride facilities.

The reconstruction of the Stage 2 lines is expected to take 12 months. While these lines could be reconstructed during Stage 1, this is not recommended, for the following reasons.

- The BOM contractor must initially focus on upgrading existing commuter rail service.
- The assumption of responsibilities for track maintenance and train dispatching requires coordination with the rehabilitation contractors. Both the rehabilitation work and the new operating responsibilities are best accomplished in phases.
- Assumption of maintenance and dispatching responsibilities requires close coordination and cooperation with the freight and intercity passenger operators. It is also best to accomplish this in phases, rather than to try and do it all at once.
- Initiation of new service is best timed to follow immediately after rehabilitation. But Stage 2 service improvements should not be initiated until ridership has increased on the Stage 1 line segments.

Stage 3 - Rehabilitate and Implement Service on Remaining Line Segments

Stage 3 would include rehabilitation of physical plant and initiation of commuter rail service on the remaining line segments. This would be to such destinations as Tiltil and Melipilla. At this time, the extent of Stage 3 improvements and their timing are difficult to project. This is because much of what will be done in Stage 3 depends upon successful implementation and public acceptance of Stages 1 and 2.

D. Implementation Schedule

The schedule for accomplishment of what has been proposed is attached as Exhibit IV-2. The critical path for Stage A will be the final preparation and award of the tender, not the engineering design.

Stage 1 is estimated to require 18 months from notice to the concessionaire to proceed with the work. The critical path activity during this stage will be the design, procurement, installation, and implementation of the new signal and supervisory control system.

As recommended, the private concessionaire should assume responsibility for maintenance and train dispatching at approximately month 6 of this Stage. This would occur while final design of the modifications is underway, prior to initiation of major trackwork, catenary renewal, and other activities that will require extensive and close coordination with train movements. Also during Stage 1, procurement of Stage 2 items requiring long lead times, such as signal equipment and electrification hardware, should be initiated.

Stage 3 is difficult to predict in both timing and level of service, as explained above. However, a tentative duration of a further 12 months has been shown in the schedule.

E. Coordination with Others

In joint operation with intercity passenger and freight, a successful regional suburban commuter service will place severe demands upon the railway. As we have already noted, the railway infrastructure was originally designed for a high degree of

EXHIBIT IV-2

Santiago Commuter Rail System, Schedule* for Implementation of Rehabilitation and Improvements

Stage	Task No.	Task Description	Time to Complete Task (Mos.)	Task Completed by End of Month No.	Year 1 Quarter 1 2 3 4	Year 2 Quarter 1 2 3 4	Year 3 Quarter 1 2 3 4	Year 4 Quarter 1 2 3 4	Year 5 Quarter 1 2 3 4
		Monitoring (Regulatory) Organization							
	1	Establish GMO	6	6					
A		**Design and Concession Formulation**							
	1	Select Consultant	3	3					
	2	Condition Survey	3	6					
	3	Conceptual Design	6	9					
	4	Issue Prospectus	1	6					
	5	Formulate Concesion	6	9					
	6	Prequalify Bidders	3	9					
	7	Receive Bids	6	9					
	8	Negotiate Contract**	3	15					
1		**Quilicura to Rancagua**							
	A1	Alameda - Rancagua.							
		Design & Rehabilitn.	12	30					
	A2	Alameda - Rancagua							
		Add New Service	1	31					
	B1	Alameda - Quilicura							
		Design & Rehabilitn.	9	33					
	B2	Quilicura - San Bernardo							
		Add New Service	1	33					
2		**Extensions to Talagante & Batuco**							
	A1	Alameda - Talagante							
		Design & Rehabilitn.	18	42					
	A2	Alameda - Talagante							
		Add New Service	1	42					
	B1	Quilicura - Batuco							
		Design & Rehabilitn.	18	48					
	B2	Batuco - San Bernardo							
		Add New Service	1	48					
3		**Extensions to Melipilla and Tiltil**							
		Schedule Indefinite							

* In Months from Notice to Proceed by the Government.

** For Stages 1 and 2.

compatibility between the two classes of passenger service and freight. The recommended improvements will serve to improve this compatibility.

However, improper coordination of business tenders with all parties involved can have adverse effects upon compatibility for joint operations. Such effects would result in undesirable operational and financial problems.

To prevent such undesirable effects, proper coordination is required between each of the railway tenders and the emerging real estate business (Nueva Via). This coordination must address capital costs, operations and maintenance costs, and operational requirements. Each of these factors is discussed below. Exhibit IV-3, Beneficiaries from Capital Expenditures, displays the entities that will benefit from each category of capital expenditure. Before discussing these factors, however, it must be emphasized that privatization of the suburban rail operations must occur within the context of these other business transactions. Specifically:

- The terms and conditions of the private tenders for freight operation must be considered.
- The concurrent privatization of the real estate and intercity passenger businesses presents a dynamic situation requiring integration with the suburban business. This is especially critical given PBI's recommendation for assumption of maintenance of way and train dispatching responsibilities by the suburban commuter rail operator.

In the following sections, the specific coordination factors of capital costs, operations and maintenance costs, and operational considerations are discussed.

1. Capital Costs

Certain elements of rehabilitation previously described will benefit the intercity passenger and freight operations and the real estate organization, as well as the commuter rail service. These elements include:

- Rehabilitation of the track.
- Rehabilitation of the traction power system (directly benefits intercity passenger only, as freight has been converted to diesel propulsion).
- Security enhancements.
- It is reasonable to anticipate that the freight and intercity passenger tenders and Real Estate would support a portion of these costs, considering the return for the derived benefits. See Beneficiaries from Capital Expenditures, Exhibit IV-3. Other capital work is aimed more directly at improving operability (i.e., capacity and reliability of the railroad) in order to support multiple services without conflict. These works are more appropriately referred to as *improvements*, as distinguished from *rehabilitation*. They require that a strategy for cost-sharing be developed with all of the beneficiaries. Examples of work that can be identified as *improvements* include:

EXHIBIT IV - 3

Beneficiaries from Capital Expenditures

Capital Expenditure Category	Beneficiaries			
	Commuter Rail	Intercity Passenger	Freight	Real Estate*
Track Rehabilitation	x	x	x	x
New Ties	x	x	x	
Interlocking Timbers	x	x	x	
Grade Crossing Improvements	x	x	x	
Track Surfacing	x	x	x	
Ultrasonic Inspection of Rails	x	x	x	
Right-of-Way Rehabilitation	x	x	x	x
Fencing	x	x	x	
Ditching	x	x	x	
Signals and Train Control	x	x	x	x
Wayside Automatic Block Signals	x	x	x	
Interlockings	x	x	x	x
Supervisory Control	x	x	x	x
Radio Communications System	x	x	x	
Bridge Rehabilitation	x	x	x	x
Tunnel Rehabilitation	x	x	x	x
Traction Power	x	x		
Catenary System Rehabilitation	x	x		
Catenary Poles	x	x		
Electrical Substations	x	x		
Passenger Station Rehabilitation	x	x		x
Park-and-Ride Facilities	x	x		x
Land Development	x			x
Security Measures	x	x	x	x
Shops and Maintenance Facilities	x	x		x
New Rolling Stock	x	x		x

* Real Estate will benefit indirectly from a number of the capital improvements. As commitment to improved suburban regional commuter rail service is demonstrated and ridership increases, the related facilities and landholdings will become more valuable to entrepreneurs and investors.

NOTE: The government and EFE will benefit directly and/or indirectly from all of the capital improvements. As the suburban commuter rail infrastructure and rolling stock are rehabilitated and improved and new service is added, the economic and societal benefits will begin to accrue to EFE and the government.

- Resignalization, to permit higher track capacity and reverse running (i.e., the operation of trains in either direction on either track). This will benefit significantly the intercity operator and to a lesser extent the freight operator.
- Installation of supervisory control, to permit safer and more efficient dispatching of trains.

Capital cost sharing may also occur with the real estate company for such items as park-and-ride and the economic development of major stations.

2. Operations and Maintenance Costs

The intercity passenger and freight operations will receive services from the commuter operator. These include train dispatching, power dispatching (intercity passenger only), and track maintenance. It is recommended that an operating agreement be structured between these entities. The agreement would provide for the reimbursement of these costs to the regional commuter operator on a *fully allocated* basis. In addition, the intercity passenger operator would provide reimbursement for such special uses as traction power, stations, and ticketing. Additional joint use/reimbursement opportunities exist related to the maintenance of rolling stock, e.g., wheel truing and locomotive and car servicing and cleaning.

Because the commuter operator will control the movements of the trains of the other two operators, it would be beneficial to consider a provision for incentive payments to the intercity and freight operators if certain targets for on-time performance are achieved. Conversely, a schedule of penalties should be considered if such targets are not achieved.

Special arrangements with the real estate company can delineate the sharing of operating costs and revenues from station concessions and park-and-ride facilities.

3. Operational Considerations

Because three separate operating organizations will be using common track and, in some cases, facilities, there must be a true spirit of cooperation, coordination, and communication between and among them.

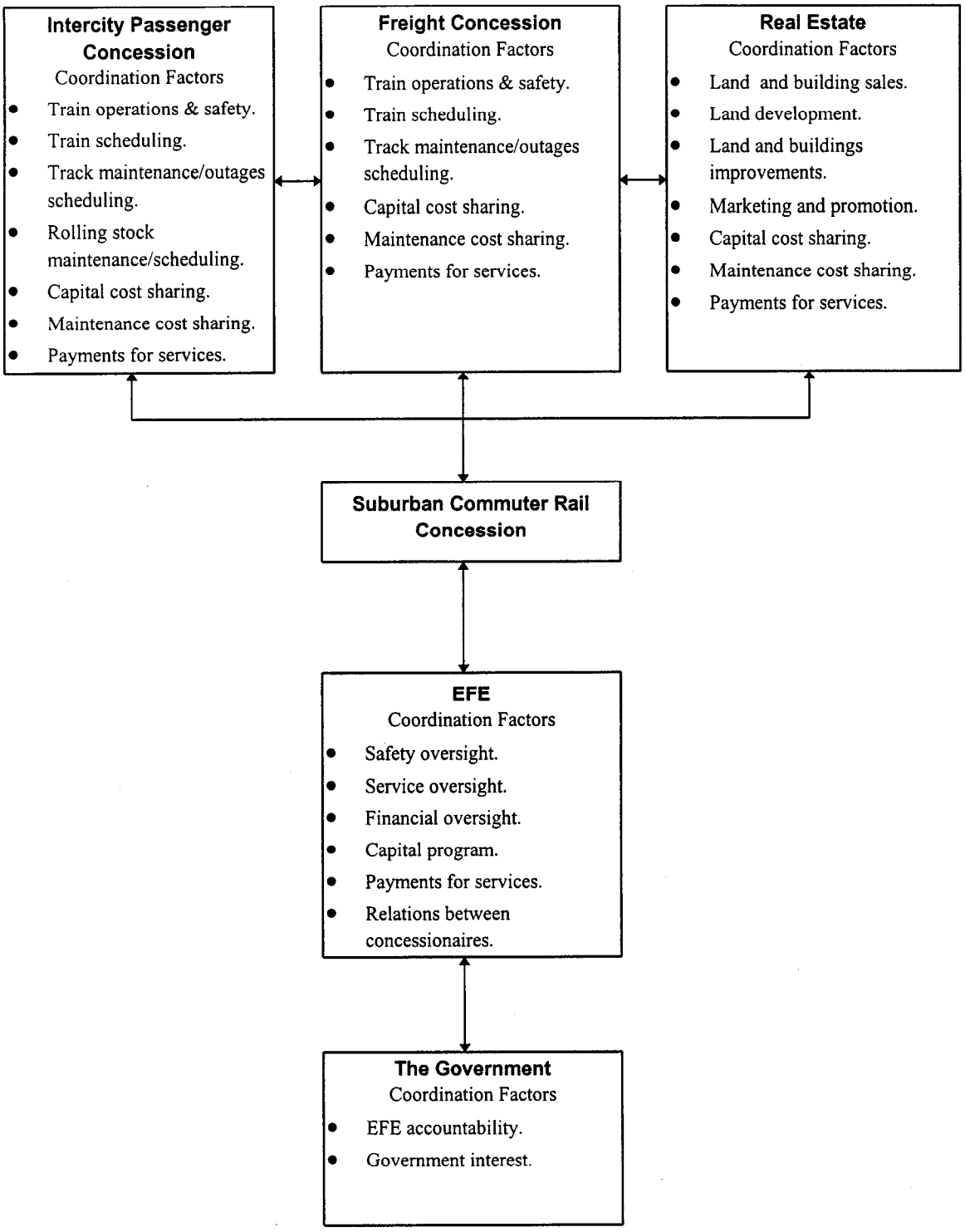
In many cases, the commuter rail operator must take the lead. This is because it will be responsible for dispatching trains and traction power, and for providing track and other infrastructure maintenance.

Firm written understandings will be needed amongst the parties prescribing the requirements for: scheduling trackwork and other maintenance activities that will take track out of service or impose operating restrictions; priority of train movements during delays; delay-recovery strategies; emergency notification telephone call lists; responsibility for site management in the event of accidents or other emergencies; time slots or hours of operation for freight and intercity passenger trains; etc.

4. Coordination Chart

See Exhibit IV-4, Coordination Chart, for a schematic of the coordination required between and among the commuter rail concessionaire and all other parties involved in the privatization concessions.

EXHIBIT IV-4
Coordination Chart



Section V.

SUMMARY AND RECOMMENDATIONS

The PBI study team recognizes the viability of privatization of commuter rail service in the Greater Santiago region.

The study team recommends that EFE and the government move forward with this privatization, in the manner recommended in Section IV of this report. The reasons for this recommendation are summarized below:

A. Status Quo Cannot Continue

The considerations that led EFE to investigate the privatization of FESUB are not going to disappear. The government is determined to advance the privatization of the railways as part of its overall economic plan. The financial drain the Santiago commuter rail operation has placed on EFE is not going to miraculously disappear. EFE has seen the benefits that privatization can bring to rail freight operations within Chile, and is knowledgeable of the benefits that have accrued in Buenos Aires from the privatization of its commuter rail services. EFE is committed to moving ahead with the privatization of intercity rail passenger services, and has already restructured FESUB to bring it under the control of the operators of the Santiago Metro. Thus, it is clearly time to move forward with full privatization of the greater Santiago commuter rail service.

B. Future Optimistic

It would appear that the time is right for the privatization of commuter rail service. The economies of Chile as a whole and of the greater Santiago area in particular are booming. Santiago and its suburbs are growing, and travel demand is increasing apace. Increased travel demand cannot be met solely by building highways and adding more buses. The societal and economic costs of least-best use of land, increased air and groundwater pollution, and travel delays argue against building more highways. However the public's acceptance and use of the modern, frequent, and reliable bus service, and continuing use of a severely substandard commuter rail service, are indicators of the latent demand for a modern rail service. Solid proof of public response to an improved rail service is as near as Buenos Aires.

C. Government Interest, but Not a Subsidy, Is Required

Despite the anticipated demand for a revitalized and expanded commuter rail service in the greater Santiago area, it is not prudent to anticipate that commuter rail revenues will be sufficient to cover all operating or capital costs. This is a universal truism, applicable to all modes of passenger transport. No mode of passenger transportation in existence today covers the full costs of its operation and capital replacement. Conversely, all modes of passenger transportation, private and public, are receiving some form of subsidy. The government of Chile's goal of full privatization is commendable, and the form of government interest proposed herein in support of a privatized commuter rail operation supports this goal. The government's purchase of commuter rail service can be a powerful economic and social tool. In the long term, such purchase of service could be diminished or discontinued, as economic growth and commuter rail patronage burgeoned. But it would not be honest to suggest this as

a certainty. Indeed, the broader values of the purchased service - its "multiplier effect" - might be such that the government would not wish to discontinue it.

D. Government's Role Is Crucial

The role of government in the development of transportation habits can be pre-eminent and determinative. The study team believes that an agressive Chilean government policy encouraging use of public transportation can have important overall public benefits. In particular, these benefits include the improvement of Santiago's air quality and the reduction of traffic congestion (see Task J, part IV, Social and Economic Impacts).

E. Time Is of the Essence

EFE can not afford to delay moving forward with commuter rail privatization in Santiago. Every day that passes sees the fixed plant deteriorate a little more, more of the assets sold off, the privatized freight operation becoming more institutionalized, and the intercity rail privatization efforts forging ahead. Every day sees the patience of the faithful commuter rail riders wearing thinner, as they experience delays and long waits between trains. And every day sees the economic drain on EFE continuing to erode its finances, and the patience of the Ministry of Transport and the government.