BRANCHLINE COSTING MODEL FOR RAIL PLANNING ACTIVITIES

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UGPTI Staff Paper No. 44

January 1983

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JANUARY 1983

SUMMARY

This report summarizes activities which have been undertaken pursuant to and in completion of Activity 5 of the Rail Planning Contract for FY 1982, between the North Dakota Highway Department and the Upper Great Plains Transportation Institute (UGPTI). The activities described herein constitute the development of an avoidable cost model which can be used to analyze large numbers of branchlines simultaneously. The data requirements to Highway Department personnel for application of this model are quite limited as the data bases are developed and maintained internally by the UGPTI. The purpose of this model is to analyze branchlines statewide, early on in the planning process, in order to: (1) identify the future viability of the rail network or particular portions of that network, and (2) to prioritize or order large numbers of line-segments into more manageable groupings prior to benefit-cost analyses.

Overview of the Model

The avoidable cost model developed in this activity allows the prediction of the cost of maintaining and operating a branchline on the basis of existing traffic patterns. The model, in addition, entails the flexibility necessary to analyze questions of viability under "what if" scenarios: that is, "what if", for example, predominantly single-car traffic becomes multiple carload or trainload traffic, or "what if" a portion of the line-segment is abandoned while the remainder is retained. This type of segmentize modeling can result as an extension of baseline capabilities.

Data Bases

The model is designed to work within existing data constraints and does not rely extensively on external data sources such as shipper surveys. The principal data sources which are utilized include: (1) line-density traffic statistics, (2) line and station-specific grain and oilseed movement data (UGPTI), (3) Rail Form A cost coefficients for the Burlington Northern or the Soo Line Railroads, and (4) the "Rail Carload Waybill Sample" (RCWS). This model utilizes, in addition, output from other programs and procedures developed in Activity 4, where the non-grain traffic statistics for each branch-line are synthesized.

Costing Framework

The total cost of operating each line-segment, both on-branch and off-branch, are calculated. Variable Rail Form A operating, maintenance, and capital costs are calculated on-branch. Fixed maintenance of way (MOW) and road capital costs (FRC), in addition, are developed for each line-segment. Since the viability of this line-segment as one component of the system is being measured, these costs are then added onto the traffic as a direct burden on the line-segment. Off-branch costs reflect only the variable or direct cost of the traffic. In this manner, a revenue-to-variable or "direct" cost relationship may be quantified which indicates the rate-variable cost ratio of the entire movement, plus an allocation of the fixed costs of maintaining the capability of the line-segment.

Fixed MOW and FRC costs have been allocated to each line-segment on a per mile of road basis. These expenses do not vary with the traffic, but are incurred regardless of whether one or one thousand carloads is originated. When allocated out to the traffic, in conjunction with the variable costs, they simulate the effects of traffic density on per unit cost. As the traffic increases, the fixed line-segment cost per unit of output declines precipitously, as such expenses are spread-over a greater number of productive units. On a light-density segment, the reverse is true. Per unit costs remain higher, as fewer productive units are available over which to spread the fixed line-segment burden.

A rate of return on roadway and equipment investment capital is allowed equal to the replacement cost of assets at 1981 valuation (11.7%). Current train operating statistics, in addition, are used, derived from the carrier's 1981 R-2 report.

Multiple Car Cost Adjustments

The model, in addition, entails the capability to develop costs (Rail Form A or URCS) for different classifications of shipments. On-branch and off-branch costs are adjusted in the areas of: (1) engine switching minutes, origin-destination, (2) car detention time—loading, unloading, and switching, (3) train weights and characteristics, (4) line-haul switching events, (5) train running times, and (6) station and billing expenses.

Adaptability of Model

The model, as noted earlier, entails a great deal of inherent flexibility. The data bases can be updated annually (i.e. track density charts). In addition, the model is completely amenable to the use of Uniform Rail Costing System (URCS) costs when those become available. When multiple carload traffic statistics become available, in addition, due to revisions in NDPSC reporting requirements, the model will have the capability to cost the traffic on the basis of the current split between service scenarios.

The model, furthermore, can be expanded to include incremental analysis. That is, operating, maintenance, and variable capital costs are calculated on an individual station basis. If a line-segment, therefore, necessitated a segmented analysis, where the portion of line beyond station "Z" was assumed-away, the variable costs could be calculated for stations "X" and "Y" only, and fixed line-segment costs could be allocated only from the junction of the line to "Y". In this manner, a branchline could conceivably be analyzed incrementally from junction to end.

I. INTRODUCTION

The viability of individual branchlines is frequently a concern in terms of rail planning activities. Often, it is desirable to analyze all or a large number of line segments simultaneously. At this level of analysis, a full-blown benefit-cost study is usually not practical, or necessary for that matter; as public funds have not yet been expended for the maintenance or continuation of rail services. The need here, rather, is for a planning tool which: (1) estimates branchline viability rather than project feasibility; (2) can be used to identify potential or future projects, or to prioritized branchlines for future study; and (3) is practical to apply to an entire rail network or major portions of that network. Such a first-stage planning tool might be used prior to the development of a benefit-cost analysis to stratify or categorize a large number of line segments into more manageable groupings.

This study: (1) develop measures for branchline viability and (2) outlines the methods and procedures necessary to analyze any line segment or group of line segments.

Measuring Branchline Viability

A branchline is viable in terms of continued operations if the revenues gained from the traffic hauled exceed the avoidable costs of operating and maintaining the line-segment. Even if a line-segment is not currently viable on the basis of rail traffic, it may potentially be viable on the basis of the revenues which might be gained through a shift in modal shares.

If, for example, a line segment which is not currently viable exhibits a 40-60 rail-truck split for the stations along that line, there may be a potential for viability, if the rail share can be increased. If, on the other hand, the rail share is already 95 percent, it is unlikely that the line will become viable on the basis of increased traffic. Only a technological innovation or a cost-saving expenditure would serve to make the line viable under these circumstances.

In measuring branchline viability, two classes of variables must be estimated: revenues and costs. The calculation of historical and potential revenues is treated elsewhere and will not be addressed in this report. The other component, cost approximation, however, is treated in-depth in the following analysis.

II. COSTING METHODOLOGY

The calculation of avoidable costs, the other side of the viability equation, is a considerably more complex and detailed process than the calculation of revenues. Cost estimation involves the development of operating and train service statistics, the calculation of route mileages between origins and destinations, the calculation of on-branch mileages, the formulation of costing equations, and the use of railroad cost and accounting statistics.

Avoidable costs, as the name implies, consists of those costs which are associated with the maintenance and operation of a line-segment and include, by definition, only those costs which could be avoided if the line-segment were to be abandoned. Certain company or overhead costs, for this reason, may not be considered as avoidable costs unless the elimination of the line-segment were to occur. Certain company or overhead costs, for this reason, may not be considered as avoidable costs unless the elimination of the line-segment results in a reduction in those expense items.

This section of the report describes the avoidable costing procedures which have been developed during the course of this activity, and discusses the manner in which the modeling procedures used here and the data sources utilized differ from historical branchline accounting costs which are developed for abandonment cases.

Why the Model is Necessary

When an abandonment application is filed with the Interstate Commerce Commission, line-specific revenue and cost data are produced. It is only at the time of abandonment, however, that direct expensing of these accounts occurs and such data are available for examination. While the data may or may not be maintained internally by rail carriers, it is normally considered to be proprietary in nature and will not be released.

The use of historical data, furthermore, even if such data were universally available, has some potential problems of its own. For one thing, the costs are static in nature. They reflect historical averages which may have been carried-out under inefficient circumstances. These costs, in addition, reflect only one specific set and type of operating circumstances and cannot be used to model dynamic changes, such as the effects of introducing multiple carload shippers on a line. Historical costs, in addition, may reflect deferred maintenance of tracks. The true fixed cost of maintaining the segment, therefore, will not be reflected in the total.

Historical accounting costs, in short, are good only for purposes of judging the appropriateness of an abandonment application. They are largely inadequate for purposes of modeling transportation alternatives.

The costing procedures developed here are designed to synthesize branchline cost factors from railroad traffic and operating data, without relying on accounting costs furnished by railroads. The model, itself, is designed to be flexible enough to estimate branchline costs under a variety of service assumptions, not just under an historical or base case.

Avoidable Cost Elements

Avoidable costs include both variable or "direct" costs as well as fixed costs.

Avoidable costs may be categorized as to either on-branch or off-branch costs. On-branch costs include those costs which are specific to the line-segment, and consist of: (1) fixed line-segment costs, (2) variable operating and/or maintenance cost, and (3) variable capital costs. On-branch costs thus comprise direct as well as fixed costs. Off-branch costs, however, constitute only those costs which may be considered as avoidable costs related to the remainder of the system. Fixed, line-segment costs, therefore, are not applicable for off-branch portions of traffic.

Fixed Line Segment Costs

Certain costs of operating and maintaining a line-segment are fixed, in the short-run. These costs are incurred regardless of traffic, and can be avoided only by abandoning the line-segment altogether.

Fixed line-segment costs are of two varieties: capital and operating/maintenance. Capital costs comprise the expenses necessary to provide the capability to serve. For any line-segment, these consist of capital costs for roadbed and structures, as well as right-of-way and acquisition costs; a certain portion of which is fixed for any given time-frame (other than the true long-run situation).

Maintenance of way (MOW) costs, in addition, are fixed to a certain degree, per mile of track. Expenditures for items such as vegetation control, snow removal and track superintendence are somewhat independent of the carloads originated. Steel rail, for example, may be replaced due as much to weathering or simple ageing than to gross ton miles. The result is some fixed expense incurred for any given line-segment, during an accounting period, which bears little or no relationship to the traffic level.

These two items, in short (MOW and fixed road capital costs), comprise collectively a fixed burden on any line-segment which must be borne by whatever traffic is originated. When the fixed burden is allocated-out to light-density lanes, therefore, the burden per unit becomes increasingly prohibitive.

Variable Costs

Variable on-branch costs would include costs for materials, fuel, supplies, crew labor, maintenance of track and equipment, as well as costs for capital assets which vary with traffic. These would essentially be related to the line-haul or running activity, or to the switching of cars at customer's sidings. The ownership costs of the car due to the time spent on branch, both time and mileage, are also included.

Variable off-branch costs include the same elements as the on-branch, in terms of line-haul activities. Off-branch costs, in addition, include terminal-related expenses, such as station and billing costs, claims, and station or platform services, in addition to intermediate yard and destination switching.

Source of the Data

The primary source of data used in developing costs for this model is Rail Form A--Formula for Determining Rail Freight Costs. RFA variable costs are applied in a manner similar to that utilized by the I.C.C. in developing off-branch costs. A complete and detailed documentation of the variable cost estimation techniques is included in the forthcoming description of the revised benefit-cost model.

The difference in the costing procedures there, as well as in I.C.C. procedures, is that here fixed line-segment costs are also derived from RFA accounting data and assigned to the line-segment, rather than assigned pro-rata across the traffic. This has the effect of approximating FRC and MOW costs for the branchline segment, in addition to the variable costs.

Fixed Line-Segment Expenses

Rail Form A treats return on investment (ROI) as 50 percent variable for road. This variable ROI is included in the variable RFA unit costs and is reflected in the on-branch and off-branch calculations. The fixed portion, or the remainder, is assigned to individual line-segments on a per mile of road basis.

RFA also partitions MOW of running tracks into variable and constant components. The expense is treated as 57 percent variable. Once again, the variable portion has been included in the variable RFA unit costs (gross ton mile, locomotive mile and train mile, primarily). The fixed portion, as was done before, however, has been allocated on a mile of road basis. In conjunction with FRC, therefore, they approximate the fixed line-segment burden noted earlier.

Line-Segment Densities

Line-segment densities are derived from railroad tonnage charts. These show the total gross ton miles on each branchline segment. These raw estimates are adjusted to reflect only the revenue gross ton miles in the manner described in the report **Non Grain Traffic Analysis of North Dakota Branchlines**. Once this is done, the fixed line-segment burden, developed from RFA accounting data as noted above, may then be allocated to this traffic base to show the line-segment burden per gross ton mile.

III. SUMMARY OF MODEL USE AND APPLICAITON

The branchline costing model, as described above, uses RFA inputs in conjunction with available railroad tonnage charts, to allow estimations of the avoidable cost of any branchline operation. The avoidable cost includes both variable or direct movement costs as well as fixed branchline cost factors.

The model is designed to be applied to the entire state, or a similar system of line-segments simultaneously. The data bases required for usage are maintained internally by the UGPTI, including: (1) the grain traffic base, (2) mileage files, (3) density charts, and (4) individual carrier Rail Form A applications. The model may therefore be applied, on an annual basis or otherwise, to the State's rail system as whole for purposes of early planning analyses.

Verification of Model Results

Preliminary verification of the model results have already been undertaken and will continue during the current year. Preliminary comparisons against Wier-Dick's economicengineering estimates, up-dated to current levels, provides sound indications that the model is predicting accurately for various density categories. Further comparisons are being made against Wier-Dick and other engineering studies.

Recent econometric studies (Harris--1978) have also shown the fixed burden per mile of road gained from the estimating procedures is that similar to that gained from cross-sectional analysis of Class I railroads.

The model should continue to be developed and verified as it is in its evolutionary stages. Preliminary results show, however, that there is considerable potential for its use as an analytical tool in rail planning.