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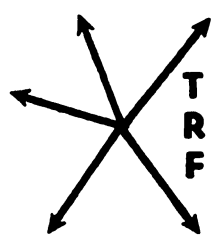

TRANSPORTATION RESEARCH FORUM

An Overview of the ICC's Uniform Rail Costing System

by Mark A. Johnson and Stephen C. Yevich**

ABSTRACT

THE UNIFORM Rail Costing System (URCS) is a new computerized regulatory costing methodology developed by the Interstate Commerce Commission (ICC) as a result of provisions contained in the 4-R Act which call for the use of more relevant and valid cost data. The system incorporates a number of improvements over the current Rail Form A methodology, and will be used by the ICC to develop the cost of service for rail shipments at issue in ratemaking proceedings. The methodology develops costs in a two-phase operation, utilizing data from statistical reports filed annually with the ICC, and Railroad Annual Report (Form R-1) under the new uniform system of accounts.

The first phase of the methodology, regression analysis, is an integral part of the yearly determination of each railroad's average cost of service. Four different equation types are available for finding the strongest relationship between cost consumption and service output for each account or group of accounts. Regression coefficients are used to compute elasticity or average percent variable for later use in the methodology to separate variable and fixed expense and to assign the variable portion to output factors.

The second phase of the methodology is a large matrix formula, represented by a series of worktables, which performs a number of reconciliations, allocations, and calculations to develop costs of service per unit of rail output. The bases for unit cost development are the phase I regression results, and the expenses and statistics reported annually to the ICC. A detailed series of default instructions are invoked for accounts without successful regression results. Account variable unit costs are aggregated by statistic within each major area of rail activity, adjusted to reflect general overhead, and applied to the statistics of specific rail movements to arrive at the calculated cost of rail service.

Features incorporated in the phase II methodology allow the cost analyst: the choice of using a constant percentage markup of fixed costs or of allowing all costs to be treated as variable in arriving at a "fully allocated" cost level; the flexibility of using non-average (e.g., light density) statistics to develop unit costs for portions of a railroad with non-average traffic characteristics; and the ability to include switching and terminal company expenses in the unit cost development.

This paper will provide brief descriptions of both phases of the URCS methodology and major applications of the system. Possible future changes to the system will also be explored, such as the development of "cleaner" statistics for use in regression, and the expansion of the traffic density feature to develop more specific costs.

INTRODUCTION

The Uniform Rail Costing System (URCS) is a computer program developed by the Interstate Commerce Commission (ICC) to replace and improve upon the existing Rail Form A costing methodology. The URCS is a generalized methodology for developing costs of rail services which can be modified by the special characteristics of specific railroad movements in order to arrive at reasonable cost estimates. It is expected that the system will be used primarily by the ICC as the basis for developing rail service costs for input into regulatory rate proceedings. The system may also be acquired by carriers and shippers for similar purposes, and as familiarity is gained with the system, it may be used by carriers in other internal cost related activities.

The major functions performed by the system are as follows:

- —Groups accounts in the functional areas of rail activity, thereby separating those expenses related to general traffic and those related to special services;
- —For each cost element or expense account determines cost variability and assignment to output statistic, through either regression analysis or default procedures;
- —Calculates the variable cost per unit of output within each functional rail activity area by account or cost element;
- —Maintains the distinction within

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each functional area between operating accounts; depreciation, retirement, and lease (DRL) accounts; and return on investment (ROI);
—Aggregates operating, DRL and ROI unit costs by output statistic across the functional areas of rail activity;
—Calculates separate general overhead mark-up ratios for operating, DRL and ROI accounts and applies the ratios to the respective aggregated unit costs;
—Applies the unit costs to specific rail movement output statistics to calculate the total variable cost of the movement.

To accomplish these functions, the system is divided into two parts or phases. Phase I represents the regression analysis portion of the methodology, and Phase II is the more mechanical development and application of unit costs. Both phases of the methodology use financial inputs from the railroad annual report (Form R-1) under the revised regulatory Uniform Systems of Accounts (USOA) effective January 1, 1978, and statistical inputs primarily from Form OS-A Train and Yard Service. The overall relationship of the two phases of the system is illustrated in Exhibit 1.

The remainder of this paper includes brief descriptions of the Phase I statistical analyses, the Phase II unit cost development worktables, several features of the system, and potential alterations to the system.

PHASE I

Great emphasis is placed on statistical analysis in the new methodology: the annual recalculation of regression-derived coefficients relating cost consumption to output factors (e.g., gross ton-miles, train hours) is central to the costing process. Each cross-sectional regression, which eliminates most bias due to inflation and technological change, attempts to define for a given expense a long-run cost curve suggested by the railroads included in the sample. The regression results are used to segregate variable from fixed cost for the expense, and assign the variable portion to output factors which are assumed to be casually related to the expense. The URCS regression analysis procedure requires the expertise of knowledgeable cost analysts to hypothesize and test valid input/output (cost/statistic) relationships. Cross-sectional analysis includes one data point for each railroad included in the analysis with each expense optionally weighted by a measure of size, usually miles of road. This allows the calculation of account variability to take an estimate of a railroad's current capacity level into consideration, and recognizes that variability between railroads of different size as well as output can vary.

The cross-sectional regression analysis may use one of four equation types to approximate an appropriate cost/statistic relationship, with the analysis being performed on individual natural expense accounts (e.g., salaries, materials, etc.), or on groups of related accounts. These equation forms were chosen by the ICC after consideration and testing of a number of alternative forms.[1] Each of the four types (linear, simple nonlinear, geometric, and modified linear) models the interation among the independent variables in different ways, as indicated by the formulae listed below.

Note that the deflator R, unlike the weight, is an explicit variable in the equation. This variable attempts to compensate for bias related to firm size. There is some indication that heteroscedasticity among smaller roads is much more pronounced than among the larger railroads, and that deflation by a common unit of firm size, such as miles

1. $\frac{Y}{R} = a_0 + c_0\left(\frac{1}{R}\right) + c_1\left(\frac{X_1}{R}\right) + \ldots + c_n\left(\frac{X_n}{R}\right)$

2. $\frac{Y}{R} = a_0 + c_0\left(\frac{1}{R}\right) + c_1\left(\frac{X}{R}\right)^1 + \ldots + c_n\left(\frac{X}{R}\right)^n$

3. $\frac{Y}{R} = a_0 + c_0\left(\frac{1}{R}\right) + c_1\left(a^{a_0}\right)\left(\frac{X_1}{R}\right)^{a_1} \cdots \left(\frac{X_n}{R}\right)^{a_n}$

4. $\frac{Y}{R} = a_0 + c_0\left(\frac{1}{R}\right)^{a_0} + c_1\left(\frac{X_1}{R}\right)^{a_1} + \ldots + c_n\left(\frac{X_n}{R}\right)^{a_n}$

Key:

$c_0 \ldots c_n$ - coefficients

$e_0 \ldots e_n$ - exponents

s_0 - constant

$X_1 \ldots X_n$ - independent variables

E - dependent variable

R - deflator (optional)

of mainline track, mitigates that bias in the variances. The second term in the equations, when not constrained to zero, models the variation of cost with respect to the deflator, and can be interpreted as a reflection of the magnitude of returns to firm size; that is, if c_0 is positive and statistically significant, it can be interpreted as an indication that average cost exceeds marginal cost.

Regression coefficients (the usable output of the Phase I regression analysis) can be transformed into cost variabilities by two basic methods, annual percent variable and elasticity. (The actual transformation process occurs in Phase II.) In an economic sense, the "annual percent variable" method represents a measure of intermediate to long run average cost variability. In the linear case this method computes, for each output factor, the ratio of the variable portion of cost to total cost evaluated at a given level of output (with all other outputs constrained to zero) multiplied by the ratio of total cost with respect to that output to total unconstrained cost. For other equation types certain limitations have been introduced into the transformation so that the total annual percent variable cannot exceed 100%.

The "elasticity" method computes short run marginal cost variability, or the cost variability associated with the next unit of output. It measures the partial derivative with respect to output (evaluated at average output) divided by average cost at that output. If marginal cost exceeds average cost, the total variability computed by this method will exceed 100%.

The cost curve is approximated by regressing total annual expense for an account against total annual output statistics. In the variability transformation, the total statistic is used to develop a variability for each railroad's output level. This average variability will be used for most costing done in a regulatory context.

Although the regression function is primary, two other purposes are served by the Phase I program. Pairwise correlation (Pearson product-moment) is available for use in analyzing relationships among and between expenses and statistics. Through this analysis the cost may discover which independent variables to focus on in initial regression efforts, and whether total functional expense (e.g., dispatching trains, servicing locomotives, etc.) or the respective natural expense components of functional expense should be aggregated for analytical purposes.

The other function of the Phase I program is to maintain the data base necessary for regression/correlation analysis and for unit cost development. The major data file, the Rail Data File, may hold up to five years worth of data for 2900 expense accounts and 1100 statistics for 50 railroads. Creating and maintaining the file may be accomplished through either an interactive or batch processing mode.

PHASE II

The second phase of the URCS methodology is a computerized process, with limited user control, consisting of a series of worktables which adjust and allocate expenses and statistics, calculate unit costs, and apply unit costs to specific rail movement statistics to develop variable and "fully allocated" movement costs. The activity and sub-activity distinctions defined in the USOA are maintained in the unit cost development process. Each total functional freight expense account is handled separately through the methodology, as is each depreciation, retirement, and lease expense account, and each return on investment cost element (as calculated).

Expense accounts which are successfully regressed in Phase I (primarily

UNIFORM RAIL COSTING SYSTEM
GENERAL PROCESSING
FLOW

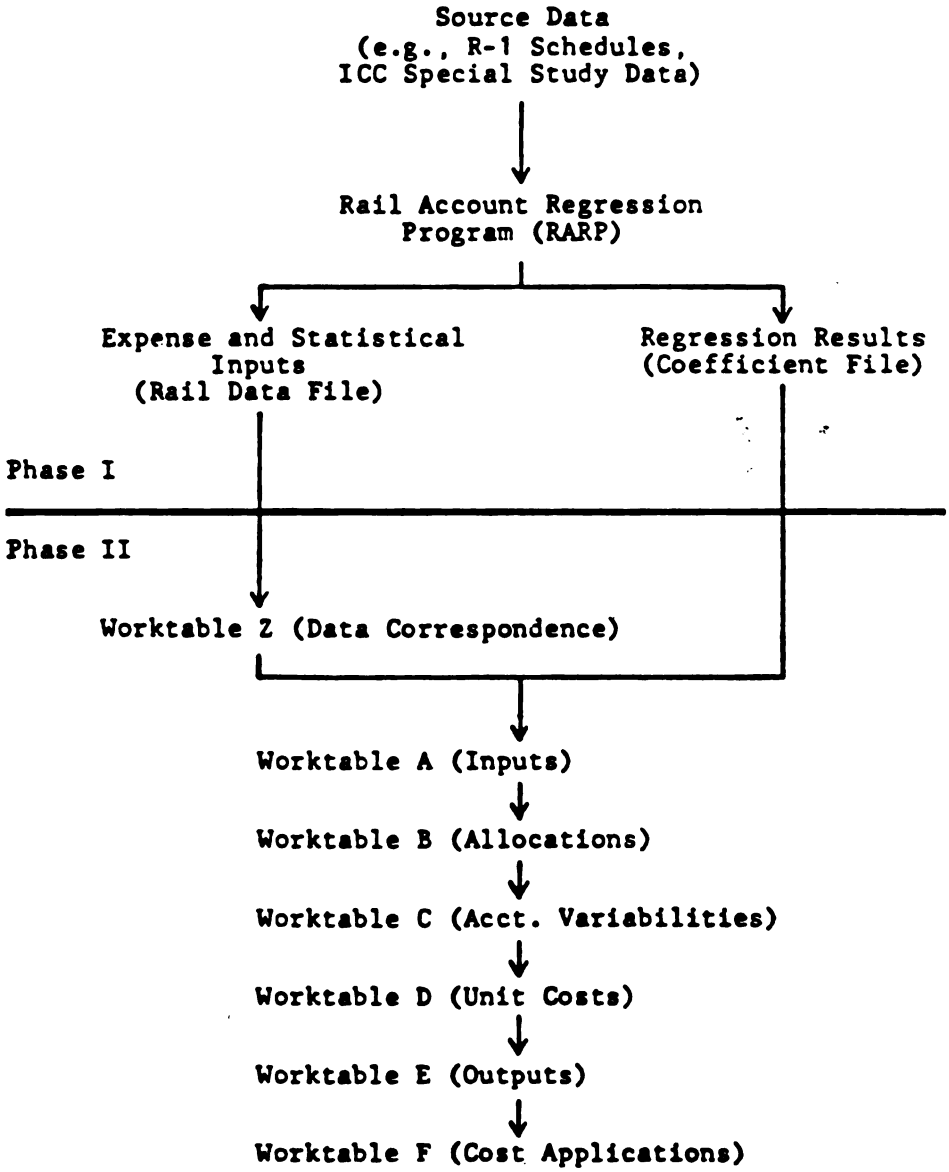

EXHIBIT 1

functional operating expenses) flow directly to the unit cost calculations performed in Worktable D of Phase II. Those remaining operating accounts which were not successfully regressed, along with DRL and ROI costs, are adjusted and allocated to the USOA subactivities with which they are associated for unit cost development. The general flow of statistics through the Phase II methodology is very similar to that of expenses. The majority of statistics used in unit cost calculations flow directly to Worktable D, with an alternate flow for those requiring prior adjustment. Finally, the unit costs are listed and applied, as desired, to specific movement characteristics to develop movement costs.

The worktables included in the Phase II methodology are processed sequentially from A to F. (Each, with its major divisions, is identified in Exhibit 2.) The next sections briefly discuss the functions of each major group of worktables.

Worktable A—Financial and Statistical Inputs

Worktable A serves as a data base for the remaining worktables, accepting all financial and statistical data from the Rail Data File and regression results from a coefficient file. This worktable also maintains the default instruction file for accounts lacking successful regression results.

Expenses entering Worktable A by natural expense type (i.e., salaries, materials, purchased services, and general expense components of each functional expense) can be indexed to a common economic level. Since the worktable can accommodate up to 5 years of expense (and statistical) data, this indexing feature allows the user to adjust historical expenses to a more current level because of inflation, for example, or to index current expenses into the future based on various economic scenarios to determine the potential effect on unit costs.

Worktable A also annualizes each expense (indexed) and statistic over a number of years (up to 5) as determined by the user. This function allows the user to reduce the effects of random or periodic changes in expense or rail output (statistic) levels which could unreasonably bias the unit costs produced by the Phase II methodology. For example, major track maintenance efforts are typically periodic in nature and can be "leveled out" or normalized over a number of years using this procedure.

Worktable B—Account and Statistic Adjustments and Allocations

Worktable B performs a number of intermediate calculations necessary for unit cost development. The ICC requires carriers to report on schedule 410 of the R-1 their annual railway operating expenses in accordance with the USOA. Additional reporting requirements include a series of subschedules (e.g., 412, 414, 415) on which are reported expenses in detail (e.g., by property account or by car type). The subschedules

U R C S
PHASE II WORKTABLES

Worktable A—Financial and Statistical Inputs
- A1—Operating statistics
- A2—Operating expenses (schedule 410)
- A3—Operating expenses (sub-schedule detail)
- A4—Investment costs
- A5—Phase I regression results
- A6—Default variability and assignment instruction file
- A7—(Optional) Traffic density factor inputs

Worktable B—Account and Statistic Adjustments and Allocations
- B1—(Optional) Switch and terminal company calculations
- B2—Sub-schedule reconciliation
- B3—Development of allocation bases
- B4—Working capital (reference)
- B5—Property account adjustments
- B6—Switch engine minute calculations
- B7—Car day and car mile calculations
- B8—Miscellaneous allocations
- B9—Operating account adjustments

Worktable C—Calculation of Cost Variability and Assignment to Output Statistics

Worktable D—Unit Cost Development
- D1—Running track ownership and maintenance
- D2—Switching track ownership and maintenance
- D3—Road operations and road locomotives
- D4—Yard operations and yard locomotives
- D5—Clerical and carload
- D6—Freight car ownership and maintenance
- D7—Specialized services
- D8—General overhead
- D9—Loss and damage

Worktable E—Output Unit Costs
- E1—Output unit costs
- E2—Unit cost adjustment factors

Worktable F—Unit Cost Application

EXHIBIT 2

are reconciled to Schedule 410 expenses to insure that the detailed subschedule expenses total to the appropriate expenses in schedule 410. This prevents any expense discrepancies due to the reporting of detailed expenses from entering the unit cost development process.

The reconciled expenses for depreciation, retirement, and lease/rentals are also allocated in Worktable B to the basic areas of rail activity as represented in the USOA. For example, depreciation of structures is allocated to the Running, Switching, and Other sub-activities.

Similarly, a series of functional operating overhead accounts are allocated to USOA sub-activity areas. Functional overheads are distinguished from general overheads in the URCS methodology by their specific relationship to one or more USOA activities. General overhead accounts, those which cannot be related to a specific USOA activity area, are handled separately in the URCS methodology in Worktable D.

Worktable B also calculates return on investment by property after computing a series of account adjustments and allocations. In general, total investment by property account is increased by an allocation of working capital and decreased by adjusted accumulated depreciation to arrive at a net investment base by property account. The net investment base is multiplied by a user input cost of capital rate to arrive at the total return on investment cost by property account. These cost elements are used later in the methodology to calculate return on investment unit costs.

A number of derived freight car statistics are calculated in Worktable B. These derived statistics are either used in the unit cost development process (as in the case of total switch engine minutes, and line haul and yard car days and car miles by car type), or are simply listed as output freight car statistics for use in costing particular movements.

Worktable C—Calculation of Cost Variability and Assignment to Output Statistics

Worktable C translates the regression coefficients developed in Phase I into cost variability and assignment percentages. The two basic methods, annual percent variable and elasticity, were briefly discussed in the Phase I section of this paper. The transformation is a mathematical process using the four equation forms available for regression analysis. Since regressions can be performed on natural expenses as well as on the total functional freight accounts, Worktable C also calculates weighted average cost variabilities for natural expenses associated with a given functional account. This is necessary because Phase II develops unit costs based on functional accounts only (and not on their natural expense components).

In addition to the two basic methods above for calculating cost variability, the user has two options available in the variability transformation process to reflect special costing situations. The Traffic Density option allows the user to introduce non-average output statistics into the variability calculation to approximate the cost variability associated with branchline or heavy density operations. The 100% Flow Through option is an alternate method for allocating constant costs to output statistics (normally accomplished in Worktable D8, discussed below). This option assumes all costs to be 100% variable, and assigns 100% of costs to output statistics for unit cost development on the same basis as determined through regression analysis or default procedures.

Under normal operation of the URCS (no options selected), a cost variability calculated by Worktable C represents an average account variability at average output or the annual percent variable. It is important to recognize that since the variability transformation process uses statistics unique to the data base being used in Phase II, it is extremely likely that cost variabilities for a given account will be different for every U.S. railroad, and may change from year to year.

Worktable D—Unit Cost Development

Worktables D1 through D7 calculate unit costs for each account in their respective areas of rail activity, as listed in Exhibit 3, in the following general manner:

—(Functional freight expense)*(Cost variability percentage associated with each output statistic) ÷ (Associated output statistic) = (Variable unit cost per associated output statistic)

For example, given . . .

—Functional freight expense E = $1,000.

—Functional freight expense E is 80% variable; 50% of the variability is associated with the statistic train miles (TM), and 30% with the statistic carmiles (CM).

—TM = 10,000.

—CM = 20,000.

. . . the variable unit cost per train mile and per car mile for expense E are calculated as follows:

OUTPUT STATISTICS AVAILABLE FOR UNIT COST DEVELOPMENT FOR EACH D WORKTABLE

Worktable D1 Running Track Ownership and Maintenance
- — Gross Ton-Miles
- — Car Miles
- — Train Miles

Worktable D2 Switching Track Ownership and Maintenance
- — Switch Engine Minutes

Worktable D3 Road Operations and Road Locomotive Ownership and Maintenance
- — Gross Ton-Miles
- — Car Miles
- — Train Miles
- — Locomotive Unit Miles
- — Carloads Originated or Received
- — Switch Engine Minutes

Worktable D4 Yard Operations and Yard Locomotive Ownership and Maintenance
- — Switch Engine Minutes

Worktable D5 Clerical and Carload
- — Car Miles
- — Carloads Originated and Terminated
- — Carloads Originated or Received

Worktable D6 Freight Car Ownership and Maintenance
- — Car Miles (Running and Yard)
- — Car Days (Running and Yard)

Worktable D7 Specialized Services
- — Specialized Services Output Statistics (e.g., tons hauled, trailer and container unit days, motor vehicle unit hours) depending on specific service

Worktable D8 General Overhead
- — General Overhead expenses are not assigned to output statistics for unit cost development. Mark-up ratios are developed.

Worktable D9 Loss and Damage
- — Tons by Commodity

EXHIBIT 3

—Variable cost per TM = ($1000.) * (0.50) ÷ (10,000.) = $0.05
—Variable cost per CM = ($1000.) * (0.30) ÷ (20,000) = $0.015

Variability and assignment percentages developed in Worktable C from regression results are used for those accounts reflected in the regressions; however, the default instruction file (Worktable A6) is referred to during Worktable D processing for each account lacking regression results in Worktable C. The default instruction file contains a number of different types of default specifications depending on the specific account in question. Two general types of default instructions include:

—Use of the variability and assignment percentages of an account or group of related accounts handled previously in the same D worktable (e.g., a way and structures operating account may default to the weighted average percentages of the primary running track maintenance accounts);
—Use of fixed variability assignment percentages as shown in the default instruction file (e.g., 68% variable, 34% assigned to gross ton-miles and 34% assigned to train miles).

Each operating account typically has a series of default instructions listed in priority order, with the first priority being to use the variability and assignment percentages of a previously handled, successfully regressed, related account or group of accounts. The last default in priority order is generally a fixed percentage variability and assignment instruction based on the current Rail Form A percentages. Therefore, regardless of the number of successful regressions obtained during the Phase I program operation, the Phase II program can always be operated, with assignment percentages developed for every account. It should be emphasized that it is possible for any cost in a given D worktable to be assigned to any or all of the outputs available in that worktable.

The above discussion of Worktable D applies primarily to D1 through D7. Worktable D8 handles all general overhead accounts (i.e., those which cannot be traced to a specific USOA activity or subactivity, but are incurred in support of all activities). The methodology allows the user to regress general overhead accounts in Phase I (or use the default instruction file), but it does not assign the variable general overhead cost to output statistics in Phase II. Rather, these costs are used to create general overhead markup ratios (one ratio each for use with operating, DRL and ROI variable costs). The general overhead ratios are then applied to the unit costs, which have been aggregated by output statistic, to arrive at adjusted variable unit costs. Worktable D8 also calculates a constant cost ratio for use in applying costs to specific movements in order to develop fully allocated movement costs. The constant cost ratio is simply the ratio of total railway expense to total railway variable cost.

Loss and damage cost per ton by commodity is calculated separately for cost application in Worktable D9.

Worktable E—Output Unit Costs

Worktable E gathers into one table the output unit costs and various output adjustment factors used in applying unit costs in Worktable F.

Worktable F—Unit Cost Application

The concluding table of the methodology is an automated process that calculates the variable and fully allocated costs for specific rail movements. Using the unit costs and output factors in Worktable E, coupled with user data (car type, commodity, actual or short line distance, shipment weight, etc.) entered through an auxiliary input file, Worktable F calculates the following:

- —Mileage—computes total loaded and empty mileage by type of train (unit, way, through) using actual or short-line loaded mileage.
- —Linehaul Costs—computes car miles, gross and net ton-miles, locomotive unit miles and train miles (by train type), and carloads originated, received and terminated. Variable costs are then developed for nonclerical car mile-related costs, gross ton-mile costs, locomotive unit mile costs adjusted for train type, carload and clerical costs, mileage-related crew costs adjusted for train type, and non-crew train mile costs.
- —Terminal Costs—computes switch engine minutes by type of switching, totals these, and develops variable terminal costs. If applicable, variable costs for interterminal and intraterminal movements can be calculated.
- —Freight Car Costs—computes car miles and car days for road and yard. Private line rentals or time and mileage costs for railroad-owned cars are calculated, based on user inputs or URCS-derived values. An allocated charge for accessorial services is applied to the movement. If applicable, mileage and time costs are calculated for interterminal and intraterminal moves.
- —Special Service and Loss and Damage Claim Payment Costs—calculates claims charge and any applicable specialized costs (e.g., protective service or trailer pickup and delivery).

After the above costs are calculated, all variable costs are aggregated to develop the total variable cost for the movement. The constant cost markup ratio is applied to variable cost less loss and damage, and the variable loss and damage charge is added back in to develop the "fully-allocated" cost. Constant cost is not allocated on a ton/ton-mile basis.

Every value calculated in Worktable F can be superseded by user input, so that the most specific costs possible may be used to determine the total movement cost.

FEATURES OF THE METHODOLOGY

Considerable flexibility has been incorporated into the design of the system to allow the costing analyst the freedom to compute costs in numerous ways. The use of non-average (e.g., light density) statistics to recognize the effects of density on account variabilities has already been mentioned, as has been the optional derivation of variabilities using a short run marginal cost approach. The analyst has the choice of using a constant percentage markup of fixed costs to arrive at a "fully allocated" level for a given movement, or allowing all costs to be treated as variable in the derivation of unit costs and thus allocating fixed costs in that manner. If desired, the analyst can conclude switching and terminal company costs incurred in the provision of service for line haul carriers. The analyst can also use data annualized over the number of years deemed appropriate (with a maximum of 5 years available), and use specific indices to adjust accounts when these indices differ from those resident in the data base.

The Phase II user has considerable freedom in adjusting special factors for use both in developing unit costs and in applying those costs. Of particular interest here is the ability to input whatever cost of capital rate is desired for a given unit cost calculation process. Dated special study factors used by the ICC for developing certain expense and statistic items (particularly in the switching activity) can also be easily overridden by more pertinent inputs where such data is available.

Because of all the flexibility incorporated into the design of the system, the URCS can be used as a modelling tool to analyze "what if" costing scenarios. For example, current costs could be indexed to a future period to develop pro forma costs for a particular commodity. The per-shipment effect of different cost of capital rates could be explored. Examination of the relationship between marginal and variable costs could lead to a rethinking of basic costing strategy, and the effects of particular costs (e.g., fuel) could be easily isolated from other costs. Additional ways to use the URCS may

become evident as analysts gain familiarity with the system.

POTENTIAL CHANGES TO THE URCS

The new costing system is a considerable improvement over Rail Form A; however, certain areas have already been identified as worthy of additional study and potential revision.

The first of these concerns the instructions for calculating "default" variability and assignment percentages when regression-derived variabilities are not available. The ultimate default instruction is almost always a Rail Form A variability as determined in a 1973 study of railroad cost variability. Frequently, the file will reference a related account first —if that account has regression results available to it, those results will be used as a default for the account at hand, and the Rail Form A default instruction will not be invoked. As experience with the system is accumulated, it will be desirable to re-examine the defaults, develop new instructions to replace the limited number of Rail Form A variabilities, and adjust the intermediate defaults where appropriate.

A second set of potential improvements is in the area of accurate data for use in statistical analysis. This is a particular problem for Trailer on Flat Car (TOFC) statistics, which in most instances are adjusted before use in regression. The use of "clean" rather than adjusted data is of course preferable in regression, so that extraneous influences due to the adjustment are not introduced into the analysis.

Another subject of great concern is the ability of the system to develop situation specific unit costs. As it is now configured, the system develops average unit costs for the carrier (using the carrier's average variabilities or an assumed approximation of light density variabilities). Modifications would likely have to be made to the methodology to accept costing inputs that would be reported under the ICC's proposed cost center accounting and reporting system. A completely revised methodology for allocating indirect costs might be needed if the system were to develop costs for specific units of physical plant (e.g., line segment and yard). The URCS has been designed as an improved generalized costing methodology containing considerably more flexibility than the current Rail Form A procedures, and developing more detailed costs of rail service than has been routinely available to the ICC.

FOOTNOTE

1 Haskins & Sells, Peat Marwick Mitchell & Co., "Final Report, Project II, Development of an Improved Regulatory Costing Methodology for Common Carriers by Railroad," Dec. 5, 1977, pp. III. 1-III.51.