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TRANSPORTATION RESEARCH FORUM

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TRANSPORTATION RESEARCH FORUM

Strategic Planning at the ICG

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BACKGROUND

DURING the last several years, Illinois Central Gulf (ICG) management has concentrated on major rehabilitation of high density lines and abandonment of low density lines as main components of corporate strategy. The abandonment component of this strategy was intended to raise ICG average route density, which was only 7.0 million gross tons miles per route mile in 1979, or 68 percent of the average density for U.S. Class I railroads. The premise of ICG's abandonment planning was that a significant percentage of the railroad's track miles could be excised from the system without severely affecting revenues because 47 percent of ICG-owned trackage produces only about 13 percent of ICG revenues.

Now that ICG has largely completed abandonment plans for the lowest density trackage, the question of how much further to carry the rationalization program has become more complex. Additional large-scale reductions in trackage will involve lines still carrying appreciable traffic volume. These reductions will therefore substantially reduce ICG gross tons miles on some parts of the remaining system while, at the same time, freeing significant numbers of cars and locomotives for redeployment.

As long as abandonment of a line will have only a marginal effect on the balance of the system, conventional analysis utilizing variations on the Interstate Commerce Commission's Rail Form A approach, such as ICG's off-branch costing system, may be adequate for determining if reduced expenses exceed lost revenues. But the conventional Form A assumption of a fixed percentage change in off-branch cost with changes in volume is inappropriate when line abandonments will cause large reductions in volume on some remaining parts of the system. It is also inappropriate when there is the possibility of large increases in volume where cars and locomotives are redeployed.

The consequences of an error in predicting the effects of large-scale abandonment can be severe. Once a line rationalization decision is implemented, there is seldom any turning back, even though small percentage differences between actual results and predicted results can sharply affect net income when the forecasted numbers involve large revenue or expense totals, as they must in major rationalization studies.

Without studying the railroad segment by segment, there is no reliable way to determine if a large change in volume will cause costs to change: (1) substantially in proportion to the volume change, (2) at a rate much greater than the change in volume, or (3) at a rate less than the change in volume. Without this detailed information, even the best available data about rehabilitation costs and operating expenses on the line considered for abandonment will be inadequate to measure the financial impact of the abandonment on the system as a whole. Large-scale elimination of lines still carrying appreciable traffic therefore requires analysis of complex trade-offs that interrelate savings in rehabilitation costs, savings in on-branch expenses, reductions in on-branch revenue, and a myriad of off-branch impacts on both revenues and costs.

A study was defined by ICG to provide assistance in analyzing the complex trade-offs required. A team composed of Peat, Marwick, Mitchell & Co., DNS Associates, Inc., and Thomas K. Dyer, Inc. was selected to undertake the study. The study's primary purpose to make these economic trade-offs. The scope of the study was to determine if large-scale elimination of ICG trackage, going well beyond the present abandonment program, would enhance ICG's viability. The discipline of the computer techniques required that the study team attempt to utilize data covering almost all significant elements of ICG costs and revenues and relate these elements to the railroad's aggregate financial performance. Furthermore, the requirements of the model developed by DNS, provide a useful, comprehensive format for developing spin-offs from the main study that are proving useful to ICG management.

Unlike some other network applications in the railroad industry, the results of this study are being implemented in the context of a solvent enterprise that continues to have access to the normal financial markets but is also subject to

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constraints on line rationalization that can retard the process of implementation. The study therefore encompasses not only immediate recommendations on route structure, but also a flexible, computerized planning tool that ICG can use to update its route planning over the years that implementation will require. Also, the study team based the documentation of its recommendations on the premise that this methodology, although primarily a strategic planning tool for internal management decision-making, may also be incorporated by reference in regulatory proceedings undertaken in connection with line rationalization.

As the preceding paragraphs indicate, the study was oriented principally toward the development of a methodology for testing alternative route configurations. To avoid overstating mileage that should be retained over the long term, it was necessary for purposes of this model to charge maintenance-of-way costs that were sufficient to rehabilitate sub-standard track and to prevent accumulation of deferred maintenance on those miles slated for long-term retention. The financial results generated through this approach are therefore likely to differ from any management forecast of achievable net income, because management is not obligated over any 5-year period to conduct a full-line rehabilitation program nor to avoid accumulation of deferred maintenance on some segments.

OPERATIONS & COSTING METHODOLOGY

The modeling technique selected for this study was the Operations & Costing Methodology (OCM). The original OCM methodology was developed for the United States Railway Association, and was substantially enhanced for ICG by DNS Associates. It has been used for a number of other strategic planning efforts. Implementation of the methodology results in a computer model, comprised of about 50 individual programs.

At the ICG, the OCM process was principally implemented to analyze the benefits of various route rationalization alternatives. This process has since been extended to provide an analytical framework for widely varying applications. At ICG, OCM modeling techniques now play a role in the following on-going areas:

- train routings and blocking alternatives.
- locomotive utilization and locomotive fleet requirements.
- car fleet utilization and car fleet requirements.
- traffic routing and contribution studies.
- multi year financial planning analysis.
- operating data input for various corporate purposes.
- costing.

The key to introducing the OCM process into the on-going management of the railroad is to insure creditability of the results. This task is accomplished in good measure during the annual physical unit output calibration phase. This phase of the model process simulates railroad operations for a base time period for which both production and expense statistics were known. Exhibit I illustrates OCM results vs. OSA results for 1980 for train miles and locomotive unit miles. For all practical purposes, the OCM results and the OSA results are the same.

Inputs that are critical to obtaining physical simulation results of this quality are no better than the data and effort that go into creating them. Many critical input factors are fed into the process through the blocking and train information. Exhibit II illustrates OCM output and the detailed efforts taken to properly reflect actual operations (blocking) patterns. It consists of 3 parts, all of which represent traffic moving between Baton Rouge and St. Louis. As indicated, the trip distance for general freight service (GF) is 752 miles northbound and 714 miles southbound. Intermediate switching northbound is at Geismar and Carbondale vs. switching southbound at Memphis and South McComb. In a railroad operating sense, Baton Rouge to St. Louis is farther than St. Louis to Baton Rouge for general freight service. Part 3 illustrates that TOFC service is only available to Baton Rouge via the highway from Stuyvesant Dock Yard in New Orleans. The net result is the model has routed the traffic properly over the actual route of movement on the proper trains. When this is accomplished, reasonably accurate car mile and trainloading information is assured.

The physical calibration phase is one small step in the overall OCM process, but in terms of man hour effort, it is frequently the most intensive.

MOVEMENT GROUPS

A movement group is an aggregation of loaded car moves that have a number of common attributes. During the movement group conversion, the 1,558,110

EXHIBIT I

OCM STATISTICS (1980)

	OSA	OCM "Raw"	OCM Adjusted
A. Train Miles			
General Freight		7,897,254	8,353,484
TOFC		1,438,965	1,441,573
Subtotal	10,477,202	9,336,219	9,795,057
Unit Coal		705,036	748,391
Unit Grain		1,005,145	1,066,953
Subtotal	1,248,484	1,710,171	1,815,344
Total — Road Trains	11,725,686	11,046,400	11,610,401
Local & Switch	3,457,654	4,608,587	4,615,490
OSA Missing Portion of Switch Opns	1,150,933	—	—
Total	16,334,273	15,654,987	16,225,891

	OSA	OCM
B. Loco Unit Miles		
General Freight	33,280,208	29,192,108
TOFC	1,073,679	3,433,647
Subtotal	34,353,886	32,625,755
Unit Coal		2,511,534
Unit Grain		3,496,713
Subtotal	4,161,680	6,008,247
Total — Road Trains	38,515,567	38,634,002
Local & Switch	7,722,777	8,022,193
Total	46,238,344	46,656,195

traffic records that were accepted were consolidated into 197,865 movement groups with ICG revenue of $804,875,-674. R-1 freight revenue in 1979 was $780,804,000, which is the net of $18,-334,000 reciprocal switching paid by the ICG, so that total freight revenue was $799,138,000. Pre-calibration model revenue is therefore high by less than 1 percent.

The net tonnage in the movement groups totalled 93,647,228 compared with the net tonnage in the R-1 report of 95,262,637. Here the model is low by 1.7 percent before calibration.

For individual movement records to be consolidated into a movement group, they must have in common the following attributes:

- origin station on the ICG;
- destination station on the ICG;
- original origin state;
- final destination state;
- from railroad;
- to railroad;
- car ownership;
- car type;
- commodity group;
- van plan;
- van type; and
- rack ownership.

For each movement group, the net tons, revenue, composite, average car hire rates, and tare weight are maintained.

The car ownership maintained in the movement group is one of six types:

- pool;
- railbox;
- private;
- clearinghouse;
- system (ICG); and
- foreign.

The car types are the standard 31 car type groups used in the ICG management information system.

EXHIBIT II

SAMPLE ROUTES

GF Route from:
436 BtnRouge to 239 EStL A

Mileages:
0.0 Local, 752.0 Road, 752.0 Total

Intermediate switching:

OR	at 436	BtnRouge	(100.0%)
CL	at 436	BtnRouge	(100.0%)
CL	at 439	Geismar	(100.0%)
BP	at 37	Carbondl	(100.0%)
CL	at 239	EStL A	(100.0%)
DS	at 239	EStL A	(100.0%)

GF Route from:
239 EStL A to 436 BtnRouge

Mileages:
0.0 Local, 714.0 Road, 714.0 Total

Intermediate switching:

OR	at 239	EStL A	(100.0%)
CL	at 239	EStL A	(100.0%)
CL	at 365	MemphisC	(100.0%)
BP	at 86	SMcCmbYd	(50.0%)
BP	at 86	SMcCmbYd	(50.0%)
CL	at 436	BtnRouge	(100.0%)
DS	at 436	BtnRouge	(100.0%)

TC Route from:
719 StuyDock to 200 Venice

Mileages:
0.0 Local, 705.0 Road, 705.0 Total

Intermediate switching:

OR	at 719	StuyDock	(100.0%)
CL	at 719	StuyDock	(100.0%)
BP	at 365	MemphisC	(100.0%)
BP	at 35	Du Quoin	(100.0%)
CL	at 200	Venice	(100.0%)
DS	at 200	Venice	(100.0%)

The commodity groups used in the model are the standard 32 groups used by the ICG Marketing Department.

OPERATIONS DATA INPUT

To properly simulate the operation of the railroad and accurately produce the required output statistics, a large volume of operations data must be input to the model. Because the objective of this project was to allocate the operating costs as precisely as possible to the individual line segment and movement group, an even larger amount of detailed operating information was used.

Specifically, the following general categories of operations input data are used by the model:

- through trains;
- local trains;
- TOFC, unit coal, and unit grain trains;
- car time at stations and yards;
- fuel consumption;
- empty return ratios; and
- classification times by yard.

A large amount of information was coded for each through and local train. Approximately 118 through trains were input to the model. For each train the following information was prepared:

- blocks carried;
- scheduled running time;
- gross tonnage per train by line segment; and
- locomotive units required.

In addition, the routes and commodities carried were specified for each unit coal train and each unit grain train. Approximately 223 local trains were coded. For each local train, the following information was provided:

- frequency of operation;
- stations served;
- locomotive requirements; and
- cost per run.

To properly estimate car hire and fleet size, a great deal of information about car time was provided to the model on a site specific basis drawing on records from ICG's Terminal Management Information System and ICG's list of reclaim days allowed at various terminals.

Fuel consumption data were input to the model by train type and by characteristics of the terrain. In the process, it was learned that fuel consumption per gross ton mile for an empty unit coal train is higher than for a loaded train. This occurs largely because of the additional wind resistance created by the air around and inside the empty open hopper. The fuel consumed per thousand gross ton miles for an empty coal train is 2.702 gallons while the rate for a loaded train is 1.112 gallons. Total fuel consumption, however, is much higher for a loaded train because it is pulling much more tonnage. The fuel consumption for a road train over flat terrain is 1.694 gallons per thousand gross ton miles. The consumption over hilly territory is 2.867 gallons per thousand gross ton miles—69 percent higher than the rate for a train on flat terrain. This illustrates the tremendous effect grades have on fuel consumption.

In previous applications of OCM, empty return ratios had been provided by car type only. For this project, empty return ratios were further differentiated by car ownership (system, and foreign, private and railbox). This was desired because car ownership can have a significant effect on fleet size and car hire payments. These ratios were obtained from the ICG Marketing Department.

The key factor in determining switch engine hours and, hence, yard costs is the amount of time per car it takes a switch engine to perform each major type of yard work. The major types of work that a switch engine performs are the following:

- classification;
- yard to interchange;
- interchange to yard;
- yard to industry;
- industry to yard; and
- block pass.

It was originally planned to use the ICG yard data as the source for the switch engine minutes to perform these functions at each yard. Unfortunately, after a great deal of effort was spent to develop these data using ICG records, it was found that the total yard engine hours generated were substantially different from the actual yard engine hours. A total of 51 yards were studied and in 21 cases there was at least a 20 percent difference between ICG reports and actual hours. Differences ranged from 33 percent of actual to 178 percent of actual. Because the ICG data reports were so erratic, they were used for only eight yards. For all other yards, the switch engine times developed through Rail Form A were calculated to actual hours for that yard.

COST EQUATIONS

One of the principal functions of the model is to translate the output or production statistics into expense estimates for use in the pro forma income statements. This is accomplished through the use of cost equations. In this project, over 1,000 separate cost equations are used.

In its simplest form, a cost equation has the following components:

- expense item being computed;
- model output statistic;
- unit cost factor;
- index factor; and
- efficiency factor.

An equation takes the following format:

Expense item = model output statistic × unit cost × calibration factor × index factor × efficiency factor.

A cost equation is used to estimate the value of an expense item. An expense item is a component of the income statement. At the most aggregated level, it could be total maintenance-of-way expense and at the most detailed level, it could be trailer pickup and delivery expense at one station.

In this application, the objective was to make the cost equations as precise as possible. To that end, wherever feasible, the expense items were set equal to line numbers in Schedule 410, Railway Operating Expense, of the Form R-1. The goal was to have separate cost equations for most line items in Schedule 410, and this was achieved for most of the transportation accounts. In a few areas, it was infeasible to write separate equations for each separate account, but lack of such detail in these cases will not reduce the accuracy of the costing process.

The output statistic from the model chosen for each equation is that unit of output that is most closely related to the expense item being measured. For example, road crew wages vary principally with train miles, and fuel consumption is most closely related to gross ton miles.

Model output statistics in the cost equations also include car miles, car days, net tons, locomotive hours, locomotive miles, car classified, track miles, and route miles, as well as others.

Most unit cost factors in the equations were derived by dividing an expense item shown in Annual Report Form R-1 by the actual production statistic to which it is functionally related. This produces a cost per unit of output, e.g., a cost per train mile or cost per ton mile.

Because the OCM is a simulation model, it does not always produce expense estimates that exactly equal the expense items shown in the R-1. It is often necessary to apply a calibration factor to the cost equation to equalize the model results with the actual figures. This cost calibration factor is then used in all subsequent simulations.

Because the model is to simulate operations over a long period of time, 5 years in this application, an index factor has been included for each equation. The index factor adjusts costs to reflect compounded inflation in prices over time. Because not all prices change at the same rate, this method allows different indices to be used for different cost components. The alternative of indexing all costs equally would be much less accurate.

Just as costs tend to rise over time, there are certain efficiencies that can be expected as a result of track and equipment rehabilitation programs and improved management techniques. For this reason, an efficiency index has been included in most equations. However, to be conservative, the efficiency index was not used in this application. It was set to 1 for all equations and held constant through each simulation. The reason for this is that it is extremely difficult to accurately estimate improvement in productivity or efficiency on the basis of system-wide formulas and the support for such estimates is generally lacking. Rather than use undocumented numbers, it was deemed more reasonable not to use the efficiency factors.

This is not to say, however, that the model denies ICG improvements in efficiency over the forecast period; efficiencies from such identifiable changes as branch-line abandonments and a continuing shift to unit trains are automatically reflected in the operations simulation.

A substantial effort was made to make the cost equations as precise and detailed as possible. For the major accounts, labor costs were separated from material and other costs. The distinction between road and yard costs was maintained in all cases. The unit costs were made as site specific or function specific as the base data would allow. Listed below are the principal cost areas for which unit costs were developed in great detail:

- crew costs for each local train, and for other trains by line segment;
- TOFC pickup and delivery costs differentiated by plan and terminal;
- loss and damage costs for each major commodity group;
- TOFC loading and unloading costs for each ramp;
- shuttle expense for each "paper" TOFC ramp;
- car cleaning expense allocated by car type (applicable principally to box cars);
- load adjusting expense allocated by car type (applicable principally to general service flats);
- joint facility expenses payable and receivable for specific sites;
- switching by type of work differentiated for 8 major yards; and
- taxes separated by state.

OCM CALIBRATION

The purpose of the calibration process was to insure that the OCM model was accurately simulating the operating activities and costs of the railroad. During calibration, the model simulated railroad operations for a base time period (1979) for which both production and expense statistics were known. Differences between simulated and actual results for this base time period were eliminated by adjusting the cost equations and by correcting discrepancies in the data base. Once calibrated to replicate base case conditions, the model was then ready to simulate alternative operating and network scenarios.

The calibration process had two principal phases. During the first phase, the model was adjusted to produce operating statistics replicating as closely as possible the actual results that occurred during the base year. By comparing the simulated operating statistics to the known activities in the base year, the accuracy of the modeling process was determined. Discrepancies can occur because of inaccurate input data, problems with the modeling process, and errors in the base statistics that OCM was to replicate. By adjusting the modeling process, and correcting data errors, the two operating results are made reasonably close. These adjustments help to insure a proper basis for the final cost equations.

The second phase of the calibration process involved adjusting the operating cost equations as needed to replicate the operating expense items for the base year listed in the Annual Report Form R-1 to the Interstate Commerce Commission. As discussed above, the cost equations developed for the ICG are quite detailed, distinguishing between, road, local, and yard activities, labor and nonlabor expenses, and time and mileage-related expenses. The unit cost for each equation is developed from actual 1979 operating and expense statistics. Any remaining differences between the R-1 expenses and the OCM-produced expenses for the base year are eliminated by calibrating the cost equations by the ratio of these two amounts. This process also compensates for any remaining discrepancies in the operating statistics.

Once calibrated, the model can simulate the railroad under differing assumptions in order to measure the impact of various changes on the railroad's operating activities and expenses. The first such simulation was to produce the base case for 1985. The base case consisted of the present rail network, adjusted for anticipated line abandonments, a market forecast through 1985, and operating practices pertaining to the year 1979. The model was then used to simulate alternative scenarios, defined by new traffic and system configuration assumptions. As discussed previously, these alternative networks call for reducing the size of the ICG rail system and, therefore, its traffic base. The differences between the base case and the alternative scenarios define the impacts of the changes being considered.