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Development of Norfolk Southern's Model of CONRAIL—1985 to 1994

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ABSTRACT

This paper features the development by Norfolk Southern Corporation (NS) of an analysis of future CONRAIL viability. The focus centered on certain statistics, revenue forecasts, the calculation of operating expenses, and the computation of road and equipment depreciation expenses as derived from estimated capital expenditures. The centerpiece (a mathematical model for expenses) was developed on a TRS-80, Model II microcomputer using the "Supercalc" spreadsheet program.

I. INTRODUCTION

NS, in making its bid for CONRAIL, needed a model to project revenues, expenses, net income, and cash flow for CONRAIl under Morgan Stanley purchase and other scenarios, over the next ten years. The purpose of this paper is to show the techniques used in developing this model and will be divided into three areas of discussion: (1) Revenue forecasts, service unit projections, and indices, (2) Expense estimates, and (3) the development of capital expenditure needs and the concomitant depreciation write-offs with an accompanying income and flow of funds statement.

These projections were made in the fall of 1985 and will have been updated by the time this paper is published. However, the model depicted here is the most recent version. Needless to say, there were several renditions preceding this one.

II. THE ECONOMIC AND TRAFFIC FORECASTS

NS forecasts for Conrail results depended on a standard economic environment first of all. A thorough and consistent economic environment assumption was necessary if the entire process was to have integrity. Without consistency, any result was possible.

The economic environment sets the level of economic activity, as such, and the volume of potential traffic available over time. The levels of inflation and interest rates consistent with this traffic potential were obtained. These elements simultaneously affect traffic, expenses, and financing.

III. GETTING THE ECONOMIC ENVIRONMENT

NS has found it better to use a fully developed model solution for the economy than to piece one together from possibly inconsistent sources. The model may not call the business cycle right, but the various parts of the economy will at least be consistent. For the Conrail studies as well as its own work, NS generally selected among various solutions provided by Data Resources, Inc. For this version, a solution midway between the DRI long-term trend solution and the engineered cycles solution has been utilized. The full cyclical solution has artificial and somewhat excessive business cycles. The trend solution has excessive growth rates and low interest rates since growth is not impeded by cyclical shocks.

From our selected standard solution, consistent forecasts were obtained for some 50 variables. These range from production measures to inflation and interest rates to foreign exchange. Exhibit 1 shows some of the variables.

IV. COST INDICES

It is critical that costs and revenues be absolutely consistent. The inflation factors for both costs and revenues were developed as a function of the standard rail cost recovery index and its components. This index was prescribed as a part of the Staggers Act. The index is described in detail in Interstate Commerce Commission Ex Parte 290 proceedings and in various AAR publications.

For forecasting purposes, the index was disaggregated into these major components parts: wages, supplements, fuel, materials/supplies, and other. Each part was specifically forecast and used in the expense model separately. The wages and supplements were forecast based on current national wage settlement patterns evaluated using inflation in the consumer price index from the standard environment above. Fuel was based on fuel prices in the standard environment. Similarly, the materials/supplies and others components were based on the outlook for relevant materials price indices in the economic environment. The component forecasts were weighted together to get the whole. A modest (about 0.5 percent per year) productivity assumption was incorporated after 1986.

In the end, there resulted a forecast of the rail cost index and its consistent component parts as shown in Exhibit II. The sum total of the index was an ingredient in the revenue forecast, while the component parts were inflation factors used in the cost model.

V. TRAFFIC VOLUME—SERVICE UNITS

The traffic volume was based on the economic environment. First, a simple mathematical model was constructed for each major commodity component. Fifteen commodities were separately modeled including intermodal taken separately. The model linked production measures in the historical economic environment with the historical traffic actually obtained. Allowance was explicitly made for share losses (or gains) over time. Simple multivariate regression was the normal process.

As originally done these results were adjusted by NS and Conrail marketing personnel. For each commodity an NS review group consisting of a Market Manager, Market Researcher, Economic Analyst and Pricing officer reviewed the math forecast and added into it allowances for real world effects the model couldn't anticipate. Then the NS group reviewed and

EXHIBIT I

CONRAIL (AS SEEN NOVEMBER 1984) SELECTED INDICATORS OF ECONOMIC ENVIRONMENT AND TRAFFIC

Year	Index of Industrial Production*	Domestic Auto Sales	Housing Starts	Index Steel Output*	Annual Change In CPI	Prime Rate	Conrail Net Ton-Miles
1978	146	9.2 mil.	2.0 mil.	114	7.6%	9.1%	87.1 bil.
1981	151	6.2	1.1	102	6.0	18.9	75.0
1984	163	8.0	1.8	81	4.1	12.0	69.3
1985	167	8.1	1.9	85	3.6	9.9	65.9
1986	172	7.5	2.0	87	4.1	9.0	64.9
1987	180	7.4	1.9	90	4.8	10.4	63.6
1988	190	7.6	1.7	97	5.7	11.6	63.5
1989	192	7.4	1.7	92	5.8	10.7	60.9
1990	196	7.7	1.7	92	5.9	9.6	59.5
1991	208	8.1	1.9	97	5.5	9.0	60.0
1992	220	8.7	1.8	106	5.6	10.1	60.6
1993	226	8.4	1.5	107	6.6	10.8	59.9
1994	223	7.7	1.5	96	6.6	9.2	57.8

*At 1967 = 100.

Exhibit II

OPERATING EXPENSE INFLATION FACTORS

Year	Labor	Fuel	Materials & Supplies	Other	Fringes	Total
1984	1.000	1.000	1.000	1.000	1.000	1.000
1985	1.035*	.916	1.039	.995	.980	.983
1986	1.096	.945	1.056	1.011	1.038	1.023
1987	1.135	.923	1.117	1.043	1.075	1.055
1988	1.188	.995	1.161	1.085	1.125	1.104
1989	1.251	1.093	1.208	1.129	1.185	1.161
1990	1.318	1.168	1.258	1.167	1.248	1.220
1991	1.386	1.274	1.314	1.228	1.312	1.283
1992	1.457	1.393	1.366	1.277	1.379	1.348
1993	1.543	1.580	1.429	1.335	1.461	1.430
1994	1.641	1.769	1.508	1.409	1.554	1.524

*Includes wage give-ups regained plus inflation.

revised these results in person with their Conrail counterparts who were even more familiar with the situation. There were strict limits on information actually exchanged to preclude conveying privileged information, and legal counsel was always present.

The models and reviews covered tons, cars, trailers, miles per ton and ton-miles. Summation produced the service units. (See Exhibit III.)

Subsequent revisions have involved recalibrating the models to use more recent observation of production and actual traffic achieved, the substitution of more recent economic environment forecasts, and repetition of the review steps. Later reviews have not involved Conrail personnel. Unavailability of updated ton-mile data by commodity have focused review work on tons.

VI. REVENUES

The revenue projection was perhaps the most sensitive aspect of the entire process. Different assumptions about rate level erosion due to competitive factors (or the "carry through" of inflation as it is often termed) can produce almost any desired operating ratio and hence profitability.

Revenues were projected as the product of ton-miles and revenue per ton mile. The ton-mile forecast was described above. Revenue per ton-mile was forecast for each commodity as a function of its historical trend versus inflation as measured by the rail cost index. Specific modal competitive variables were used when relevant. Each model combined within-commodity mix effects and erosion due to

Exhibit III

CONRAIL SERVICE UNITS

Year	Tons	Carloads*	Rev T/M	Train Miles#	Ld. Car Ld Car+	Loco Unit-Miles**
1984	192.1	3,358	69,282	35	1,354	103
1985	182.5	3,202	65,624	33	1,290	97
1986	180.5	3,123	64,640	33	1,259	97
1987	177.0	3,020	63,452	32	1,217	94
1988	176.3	2,968	63,295	32	1,196	94
1989	168.6	2,801	60,746	31	1,129	91
1990	165.3	2,710	59,416	30	1,092	88
1991	166.2	2,707	59,839	30	1,091	88
1992	167.8	2,715	60,568	31	1,094	91
1993	165.8	2,666	59,927	30	1,074	88
1994	160.2	2,559	57,724	29	1,031	85

* Tons per car assumed by Year: 57.2, 57.0, 57.8, 58.6, 59.4, 60.2, 61.0, 61.4, 61.8, 62.2, and 62.6

\# Assumes 1979.5 Rev. tons per Train: 69282 -- 35 = 1979.5

\+ Loaded Car Miles Calculated: 1,354,000 Ld. Car Miles -- Carloads of 3358 = 403 Ld. Miles per Carload

**Assumes 2.94 Locos per Train: 102,999 Locomotive Unit Miles Divided by 35,045 Train Miles competitive pricing for its commodity. Mix effects generally reflected greater use of larger cars at lower rates plus long term trends toward handling lower valued materials. Competitive pricing covered the rate reductions necessary to attract and retain business from competing modes. Deregulation has intensified this pricing; new tools like contracts have marked results on rate levels even as they lock in traffic.

The math forecast was intensively reviewed on a commodity basis by the review group as described in the service unit section. Because of its importance a thorough review was also conducted at the total level.

Recent revisions have varied because ton-mile data by commodify have not been available. To counter this, the tons revised as described above were summed by category (coal, intermodal, general carload) of traffic. The recent hauls per ton were then estimated. Knowing category revenue, tons and prior haul plus total ton-miles over all three categories permits close estimation. The revenue/ton-mile was then modeled by category as before with the model estimating each category's revenue per ton-mile as a function of time and the cost inflation index. The expected cost inflation was inserted and the forecasted revenue per ton-mile developed. The rate level progression was then reviewed against known and expected competitive developments. After any adjustments the revenues for each category were obtained; summation over the categories gave the whole.

This work could alternately proceed entirely using revenue per ton. But that would reduce the ability of the reviewing groups to see and review the effects of changing haul and tons/car on revenue per ton.

As mentioned earlier, even small inconsistencies between the revenue inflation factors and the cost factors would have extreme results on profitability and can lead to spurious results. For example, if revenues are one percent optimistic relative to costs, the operating ratio, of in the range of 90%, would be one percent point less, and profits would be ten percent higher. The accumulation of cash balances over time will be markedly altered.

VII. EXPENSES

In developing our expense model, a formula was needed which would be responsive to fluctuations in traffic levels, sensitive to expenses trends, and would be consistent with the projection of revenue and service units. We also wanted to reflect Norfolk Southern's management anticipation of increased efficiency.

The basis for the model was CONRAIL's 1984 R-1 Schedule 410 expenses using the functional breakdowns. We used broad expense groups rather than individual expense lines to simplify the calculation. Incidentally, this project was just the thing to try on one of the "spread sheet" programs. At the time, we didn't have a PC in our office so it was put on a TRS-80 home computer. The program used was "Supercalc" which runs on CPM. The basic formula used in this model was:

$$CE\ (BE) - (BSU - CSU)*(BE/BSU)*V*I$$

Where:

CE = Calculated Expense
BE = Base Year Expense
BSU = Base Year Service Unit
CSU = Calculation Year Service Unit
V = URCS Variability Ratio
I = Index

You can see that these are really array variables by looking at Exhibits I and II and the tables on pages 9 and 10. Certain variables contain two subscripts which represent matrix variables while some represent vector variables.

In analyzing this abridged formula, it can be ascertained that only the *changes* in traffic statistics were measured and the change in expenses was calculated, then the indices were applied to the base expense plus the change.

The table below illustrates the expense/service unit relationship used throughout the projected life of this model. Of course, new service units were supplied for each new pro forma year (see Exhibit I). Remember tons and revenue ton-miles were furnished by the Economics Department. We developed the number of carloads by dividing total tons by the projected average tons per carload. Projected train miles were calculated by deriving the most current period average revenue tons per train then dividing the projected ton-miles by this number. Projected locomotive unit miles (LUM) were derived by dividing the most current LUM's by most current train miles (TM), then imputing this number to the projected train miles. We ran these relationships against a statistical analysis program and found that they are statistically valid. However, a check for multicolinearity was not done.

Description	*Service Unit*	*1984 Value*
WAY & STRUCTURES:		
Administrative	Revenue Ton-miles	69,282
Repairs & Maint.	Revenue Ton-miles	69,282
EQUIPMENT:		
Locomotives	Locomotive Unit Miles	103,000
Freight Cars	Loaded Car Miles	1,354
Other Equip.	Carloads	3,358
Equip. Rents	Loaded Car Miles	1,354
TRANSPORTATION:		
Train Operations	Train Miles	35,000
Yard Operations	Carloads	3,358
Other Transp.	Train Miles	35,000
Admin. Support	Train Miles	35,000
Fuel	Revenue Ton-miles	69,282
GENERAL & ADMIN.	NONE	1.00

This table is 1984 CONRAIL expense excluding property taxes and depreciation expenses and the base for the 1985 through 1994 expense projections. The service unit and index input amounts are shown in Exhibits I and III. Naturally, right hand totals and departmental subtotals are sums of the functional expense calculations.

CONRAIL EXPENSES—BASE YEAR 1984

Description	*Salaries & Wages*	*Mtls,Sup Fuel, Lub*	*Purch Serv*	*Payroll Fringes*	*Other*	*Total Frt Exp*
REVENUES WAY & STRUCTURES:						
Administrative	36	2	11	0	1	50
Repairs & Maint	146	63	59	57	24	349
Total W&S	182	65	70	57	25	399
EQUIPMENT:						
Locomotives	48	74	3	17	7	149
Freight Cars	49	40	2	16	9	116
Other Equip	3	3	12	1	2	21
Equip Rents	—	—	313	—	—	313
Tot Equip	100	117	330	34	18	599
TRANSPORTATION:						
Train Opr.	360	20	22	109	57	568
Yard Opr.	218	6	17	65	19	325
Other Transp	8	1	74	3	9	95
Admin Support	64	2	31	20	7	124
Fuel	—	247	—	—	—	247
Total Transp	650	276	144	197	92	1,359
GENERAL & ADMIN (Excl Taxes)	134	4	56	44	15	253
GR TOT OPR EXP (Excl Depr & Taxes)	1,066	462	600	332	150	2,610

Variability ratios were taken from supporting data to the ICC's 1980 study titled "Uniform Railroad Costing System." This table illustrates the cost variability factors used in projecting CONRAIL expenses for 1985 through 1994.

Expense	Variability Ratio
Roadway Maintenance-Overhead	.733120
Roadway Maintenance	.486045
Locomotives	.917577
Freight Cars	.818905
Other Equipment	.615711
Equipment Rents	1.000000
Train Operations	.796559
Yard Operations	.945631
Other Transportation	.766108
Administrative Support	.766108
Fuel	1.000000
General & Administrative	1.000000

In addition to treating the difference in expenses with variability ratios, the Corporate Planning Department furnished additional operating efficiency gains throughout the years of the study, taken from the 1985 CONRAIL budget and their 1985-1989 five-year plan. These were applied to each expense item and accumulated for the projected life of the model.

VIII. CAPITAL EXPENDITURES AND DEPRECIATION

After careful review, it became apparent that Conrail's own projections of capital expenditures contained in their 5-year plan were a reasonable base upon which we could construct our own 10-year projections. A number of adjustments were required, however. Where feasible, we started with Conrail's projections for physical units of work to be performed or assets to be acquired. For example, to derive estimates for roadway maintenance expenditures, we started with Conrail's estimates of normalized rail, tie and ballast installations. Our Engineering Department independently derived normalized maintenance estimates which confirmed Conrail's estimates. Conrail's estimates were then adjusted for certain known variations, such as Conrail's existing relay rail inventory, Conrail's known abandonment plans, etc. These estimates of physical units of maintenance work were then costed using existing Conrail costs. The costs thus derived were then adjusted for projected efficiencies and for cost inflation.

Locomotive and freight car acquisitions were developed in a similar manner. Other types of capital expenditures were developed primarily from Conrail's projected expenditures, but adjusted for our inflation estimates, projected efficiencies, and, in a few cases, known inadequacies of excesses in Conrail's expenditures.

IX. A NEW FINANCIAL MODELING PACKAGE

It was then necessary to convert these capital expenditure projections into projections of book and tax depreciation, investment tax credits, and financing costs. We had available an existing computer program called FINDEP. This model, together with a companion model called FINMOD, had been developed by Southern Railway in 1971 and had subsequently been sold to several other Class I railroads. (Conveniently, one of the railroads that purchased this modeling package from Southern was the Norfolk and Western. This greatly simplified consolidation of long-range financial modeling efforts after the 1982 merger of SR and NW.) These models were written in FORTRAN and were installed on a time-sharing service. The models had been regularly updated during the intervening 13 years but the advent of personal computers and powerful spreadsheet packages made it increasingly clear that these models were due for replacement. In addition, it became clear early in the Conrail project that we should develop the capability to perform accounting consolidations within the model.

The decision was made to develop a new, enhanced, more flexible modeling package. Our existing IBM personal computer received several hardware upgrades and a contract was placed with Peat, Marwick, Mitchell and Company for assistance in jointly developing a new modeling package. The result of this effort is a package of two large Lotus 1 2 3 spreadsheets together with a number of smaller spreadsheets that serve as data files for the large spreadsheets. An extensive group of Lotus macro instructions serve to load data into the spreadsheets, select from various tax, finance, and other assumptions, and format and print various statements. All macro instructions are selected from custom menus. After more than a year of refinement and extension, we now have a far more powerful modeling package. By eliminating time-sharing charges, the package has already more than paid for itself.

X. DEVELOPMENT OF PROJECTED FINANCIAL STATEMENTS

Projected capital expenditures, depreciation rates and financing assumptions were fed into the new FINDEP model which calculated book and tax depreciation, investment tax credits, and debt and/or lease costs. These outputs from the FINDEP model are placed in a small spreadsheet that serves as a data file for the FINMOD model. Other inputs to FINMOD include revenue and operating expense projections, tax assumptions, projected depreciation on existing assets, projected interest and principal payments on existing debt and leases, latest available calendar year income statement, balance sheet and source and use of funds statements, dividend assumptions, etc.

FINMOD first calculates an income statement, next calculates the resulting source and use of funds statement to develop a year end cash balance, and then calculates the balance sheet. Iteration becomes necessary because interest income is dependent on cash level, which in turn is, in part, dependent upon interest income. Thus, the model iterates until these figures converge. A macro instruction controls this iteration and terminates when successive calculations no longer produce significant changes in projected year end cash. A typical run will converge within $50,000 in about ten iterations. The model prepares four sets of financial statements: one for each of two railroads (e.g., NS and Conrail), one set of statements of consolidating adjustments, and one set of consolidated financial statements. It also produces both consolidated and unconsolidated tax statements for each of the two railroad companies. Of course, either railroad can be projected on an unconsolidated basis as well.

XI. SUMMARY

Our primary goal is to achieve a complete model consistent in its economic, traffic, finance, and expense sectors. This consistency is the single most important factor in developing reliable results in these highly leveraged calculations.

Exhibit IV shows the end result of one of the uses of this model. This is the 1985-1989 pro forma abbreviated income and cash flow statement of CONRAIL under the Morgan Stanley purchase plan, as projected by Norfolk Southern Corporation. This model reflects the impact of a gradual erosion of traffic levels, deterioration of net income, interest income shrinkage because of declining cash reserves, and a more realistic picture of capital expenditures in view of the adverse long-term drain on cash balance.

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ENDNOTE

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Exhibit IV

NORFOLK SOUTHERN ESTIMATES CONRAIL UNDER MORGAN STANLEY ($ Millions)

Summary Income Statement	1985	1986	1987	1988	1989
Revenues (Mil.)	$3,206	$3,141	$3,122	$3,213	$3,178
Expenses (Mil.)	($2,817)	($2,854)	($2,859)	($2,923)	($2,935)
Operating Income (Mil.)	$ 389	$ 287	$ 263	$ 290	$ 243
Operating Ratio (%)	87.9%	90.9%	91.6%	91.0%	92.4%
Other Income/Net	$52	($20)	($32)	($45)	($66)
Pretax Income	$441	$268	$231	$244	$177
Income Taxes	0	($38)	($23)	($30)	$3
Net Income	$441	$230	$208	$214	$180
Cash Flow Sources					
Net Income	$441	$230	$208	$214	$180
Depreciation	238	238	247	255	263
Deferred Taxes	0	38	23	30	(3)
Property Sales	74	40	41	41	42
Total	$753	$546	$519	$540	$482
Uses					
Capital Expenditures	($559)	($634)	($599)	($601)	($592)
Financing	103	168	148	139	139
Working Capital Change	(82)	(41)	(20)	(30)	(19)
Debt Repayment	(130)	(132)	(137)	(104)	(119)
Dividends	0	(89)	(118)	(118)	(118)
Cash Used in Transaction	(395)	0	0	0	0
Total	$753	$728	$726	$714	$709
Change in Cash	($316)	($184)	($209)	($174)	($229)
Cash Balance End of Period	$525	$341	$132	($42)	($271)