

 United States Railway Association

***Final  
System Plan***

**September 1975**

**Supplemental Report**

**United States Railway Association  
SUPPLEMENTAL REPORT  
to the Final System Plan  
for restructuring  
Railroads in the Northeast and Midwest Region  
pursuant to the  
REGIONAL RAIL REORGANIZATION ACT OF 1973**

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**SEPTEMBER 1975**

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September 18, 1975

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Dear Sirs:

I am pleased to submit on behalf of the Board of Directors of the United States Railway Association this supplement to the Final System Plan submitted to you on July 26, 1975 in accordance with Section 208(a) of the Regional Rail Reorganization Act of 1973 (PL 93-236) enacted on January 2, 1974, as amended.

This Supplemental Report examines in more detail than the Final System Plan several issues which bear directly on the establishment of a profitable and efficient rail system in the Region.

Sincerely,



*Please address all inquiries to the United States Railway Association, Office of Public and Governmental Affairs, Room 2110,  
2100 Second Street, SW, Washington, D.C. 20595. Telephone (202) 426-4250.*

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# 1

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## Operations and Facilities Planning

*The Nation's railroads face severe economic difficulties stemming from multiple causes. As discussed in the United States Railway Association's (USRA) Preliminary and Final System plans, many different remedies must be found if the industry's health is to be restored. Improved, efficient operation of rail services over adequate, well-maintained physical facilities is among the most important factors in revitalizing railroads.*

*In enacting the Regional Rail Reorganization Act of 1973, Congress mandated establishment of a Consolidated Rail Corporation (ConRail) to provide service over certain properties of the Region's railroads in reorganization. ConRail has a charter to achieve financial self-sufficiency through reorganization under the terms of the Act. In developing its Final System Plan (FSP), USRA dedicated a significant portion of its planning resources to evaluating operations and facilities, identifying deficiencies in present operating practices and developing recommendations and plans for improvement.*

*This chapter describes the operations and facilities planning activities which underlie the FSP. The strategy and plans discussed do not represent commitments by or for ConRail, but rather the rationale on which the FSP financial and manpower projections were based. It does not represent the only possible operations and facil-*

*ities plan by which ConRail could achieve successful results, but it does represent a significant operations planning effort. ConRail's management can build on these findings but must accept final responsibility for developing and refining its own plans for operations; these plans must be consistent with the overall objectives stated in the Act and the Final System Plan.*

*This chapter outlines the objectives of USRA's operations and facilities planning efforts, the approach used to develop the plans and the basic planning assumptions. It details operating strategies, equipment and facilities requirements and rehabilitation and maintenance plans pertaining to the properties of the eight railroads in reorganization, large portions of which will be restructured into and operated by ConRail. The several interrelated sections making up the chapter are:*

- *Freight Operating Plan, which describes proposed changes in blocking, routing, main lines, yards and terminals and discusses capital improvements, labor productivity and rail safety,*
- *Intermodal Planning, which discusses possible strategies for ConRail, the role of trucking subsidiaries and the operations of REA,*
- *Equipment, which discusses ConRail's projected car and locomotive acquisition, repair and utilization programs and*
- *Maintenance and Rehabilitation of Physical Facilities, which discusses needs in that area.*

Operations and facilities planning covers most of the activities of a railroad which are related directly to moving freight cars and trains. This includes locomotive, crew and equipment costs for line haul and switching operations, all track work (new and maintenance), costs of dispatching, signaling, billing, advertising, overseeing rail operations and the like. Many opportunities exist for improving these operations and thus for contributing to the health of the carriers. While much has been written on the causes of the collapse of the railroads in reorganization, it is useful to reiterate three key problems and to outline ways in which USRA's operations and facilities planning activities relate to these problems.

#### **Declining Traffic—Surplus Plant**

Declining volumes have an unfavorable effect on the profits of any business. This is especially true for rail-

roads because overhead and plant normally cannot be trimmed back as rapidly or as completely as in other businesses. This operating leverage works in reverse when business increases.

Over the last 20 years, the railroads in reorganization have not reduced the size of their physical plant as fast as their traffic has declined. As shown in Table 1, gross ton miles of the railroads in reorganization declined 30.4 percent from 1953 to 1972. During the same period main track miles also declined, but only 21.4 percent. In contrast, the major railroads in the South experienced a 47.3 percent growth in ton miles while reducing their main track miles by 5.8 percent. The railroads in the West also had positive operating leverage. These trends are shown in greater detail in Figure 1.

Many reasons exist for the decline of rail traffic in the Region, including growing competition from heavy trucks because of the short distance to and between mar-

FIGURE 1.—Gross ton miles vs. main track miles 1933 to 1972

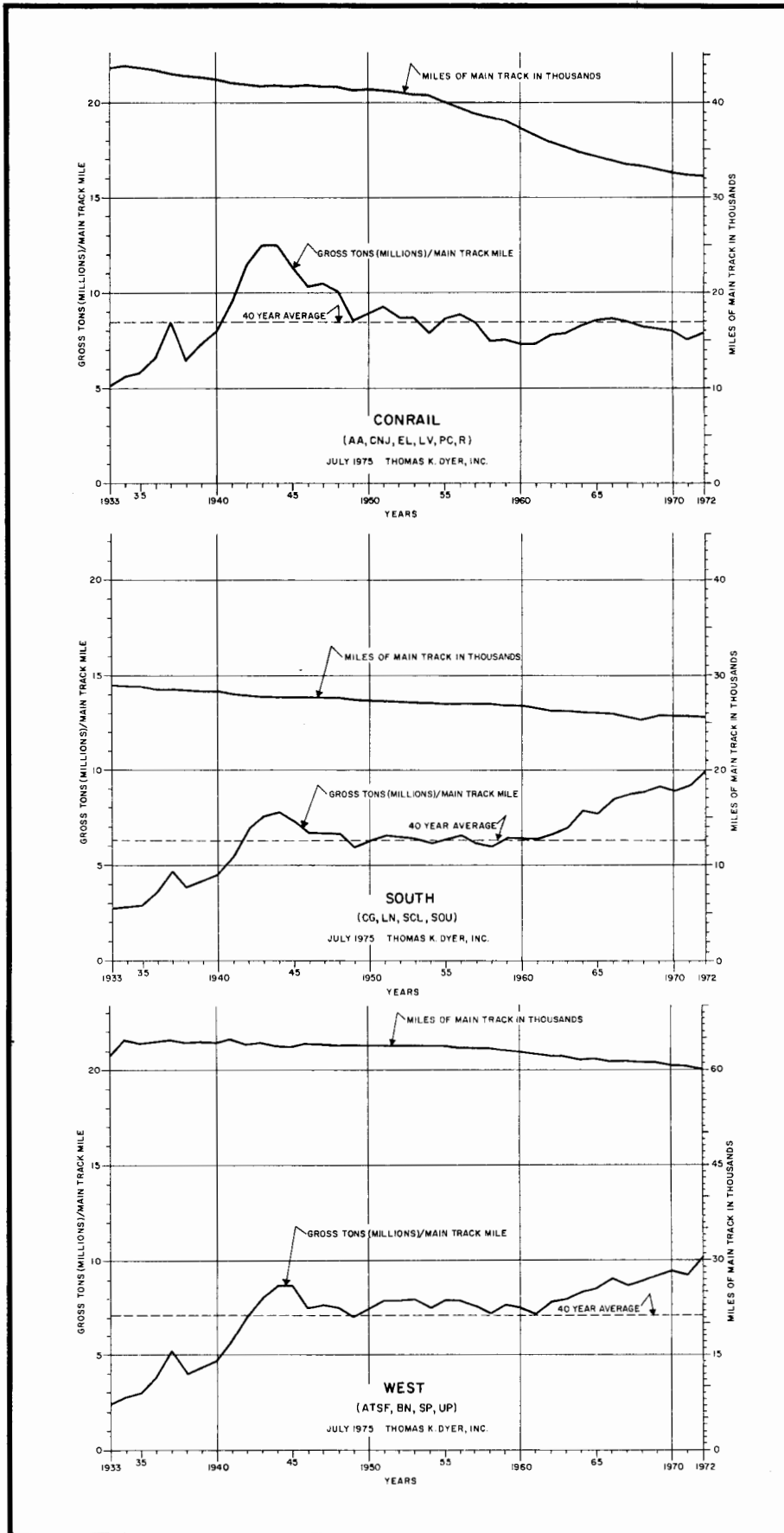


TABLE 1.—Gross ton miles vs. main track miles 1953 to 1973

	Percent change	
	Gross ton miles	Main track miles
Railroads in reorganization	-30.4	-21.4
South (Central of Georgia, Louisville & Nashville, Seaboard Coast Line, Southern Railway System)	+47.3	-5.8
West (Atchison, Topeka & Santa Fe, Burlington Northern, Southern Pacific, Union Pacific)	+19.3	-6.2

kets, the change in the nature of economic development in the Region to favor motor carriers and the relatively slow economic growth in rail-type commodities compared with the South and West.

As described in Chapter 7 of the FSP, USRA commissioned the preparation of rail traffic projections by commodity groups for the period 1976-85. These projections, based on national economic forecasts, have been updated to reflect current economic conditions and the Nation's developing energy policy and as such are believed to be reasonable estimates of future rail volumes. They indicate that ConRail's traffic levels will remain depressed through 1980 and then will show substantial growth.

USRA's operating plan focuses both on reducing the plant to match the needs of reduced traffic levels and on improving operating efficiency throughout the 10-year period covered in the FSP projections. ConRail can be expected to use planning techniques and tools such as those developed by USRA in tailoring the new railroad company's operations to fit prevailing levels of business. In doing so, by 1980, ConRail should have improved its operating leverage (i.e. reduced the size of its plant to match more closely existing traffic levels) and be in a position to take full advantage of the growth projected from 1980 to 1985.

The Association's approach to reducing the size of the rail plant of the railroads in reorganization was two-pronged. First, each branch and other light density line was examined in detail; if there was no projection of profitability the line generally was not recommended for inclusion in ConRail. Second, the Association identified duplicate main lines and yards. The network analyses and capacity studies as described in the freight operating plan section of this chapter were used for this analysis. It was important that the Association concentrate on identifying ways for ConRail to reduce its rail lines and yards not only because of the basic ownership and operating costs associated with them but also the requirement to maintain and possibly rehabilitate them.

#### Excessive Yard Costs

The railroads to be included in ConRail have been spending in excess of \$250 million per year on various aspects of yard operations. In addition, national sta-

tistics indicate that the average freight car spends 62 percent of its time standing in yards or sidings.

As shown in Table 2, Penn Central has unusually high yard costs per million gross ton miles compared with other major railroads. In 1974, PC's yard costs were 14.1 percent of revenues compared to 6.2 percent on the Santa Fe and 7.4 percent on the Southern.<sup>1</sup> Given PC's shorter hauls and the density of urban centers in the Region, it is reasonable to expect more yard activity, although it appears that many of its industrial support yards are obsolete and in poor condition. Further, the magnitude of the problem indicates that the railroads in reorganization have not evolved through the years into an optimum operation.

The Association, therefore, studied in detail the yard and related main-line operations of the railroads in reorganization. A man-machine interactive planning approach was used to permit detailed and realistic operations planning of the large, complex system in several configurations. With this approach, an operating plan was developed that reduces the requirements for intermediate switching of cars by 25 percent in a rail system whose major component, Penn Central, already has a blocking and train operating plan well above average in the industry. As improved operating plans are implemented, customer service should be improved

TABLE 2.—Operating statistics

Railroad	Revenue dollars per million GTM	Transportation cost/ million GTM		Percent yard cost to revenue	Percent road cost to revenue	Percent yard and road cost to revenue
		Yards ICC Account Nos. 377-389	Road ICC Account Nos. 392-402			
RAILROADS IN REORGANIZATION						
EL.....	8,059	994	1,781	12.3	22.1	34.4
PC.....	8,943	1,260	1,724	14.1	19.3	33.4
OTHER EASTERN RAILROADS						
B&O.....	9,164	949	1,413	10.4	15.4	25.8
C&O.....	9,280	1,101	1,286	11.9	13.9	25.8
N&W.....	8,048	748	1,294	9.3	16.1	25.4
SOUTHERN RAILROADS						
L&N.....	7,273	730	1,383	10.0	19.0	29.0
SCL.....	7,541	729	1,398	9.7	18.5	28.2
SOU.....	7,901	586	1,175	7.4	14.9	22.3
WESTERN RAILROADS						
AT&SF.....	6,497	405	1,502	6.2	23.1	29.3
SP.....	6,984	527	1,423	7.5	20.4	27.9
UP.....	6,282	408	1,247	6.5	19.9	26.4

SOURCE: 1974 Reports to the ICC.

<sup>1</sup> To place this problem in perspective, 1 percent of Penn Central revenue was more than \$20 million in 1974.

substantially in terms of both reduced transit time and increased reliability while operating costs are reduced.

As traffic flows and operating conditions change, the planning approach and simulation models used by the Association can be used by ConRail to determine future operating changes such as analyzing the impact of closing or opening yards, downgrading or upgrading particular line segments and revising basic operating policies. They also could be used on a regular basis—perhaps monthly or even weekly—to assess the implications of short-term fluctuations in traffic flows.

Ultimately, the simulation models might be enhanced to operate on an on-line basis using current data about traffic movements. In this environment, based on daily traffic flows, the models could support dynamic changes in blocking policies at individual yards, revisions in planned train operations and changes in the actual routing of certain origin-destination flows.

The models and planning techniques developed and used in preparing the FSP enabled USRA to deal with the complexities of planning a large rail network and convinced the Association that such a large and complex system could in fact be managed and operating economies realized. These models do not solve the yard problem, but they provide management with one means of coming to grips with it. Effectiveness of terminal operations also can be improved through development and implementation of site-specific terminal operating plans, volume variable budgets and physical rehabilitation of facilities. These approaches to improving terminal operations are described in some detail in the section on freight operations planning.

The simulation models used by the Association are available to other railroads and it is reasonable to expect that their application on other rail systems would produce similar results.

#### **Deteriorated Plant**

During and following World War II, nearly all of the railroads made major investments in rehabilitating their plants. These large rehabilitation programs in the late '40's and early '50's reduced the need for investment in the rail industry's physical plant until the '60's, when the improvements of the '40's and '50's had begun to deteriorate. Railroads, however, were reluctant to make the needed investments at that time because funds were in short supply and the prospective return on the required investment was quite low. Faced with this situation, most railroads began deferring maintenance, a practice which leads to accelerating plant deterioration and eventually an inoperable physical plant. To complicate this problem, railroad rate levels were becoming depressed during this period, partially resulting from understated costs due to deferrals of maintenance.

The net impact of the deferred maintenance problem is that at present, a significant portion of the physical

plant of many railroads is in poor condition, with the railroads in reorganization suffering more acutely from this problem due to their financial constraints in recent years.

Recognizing the present physical state of the railroads in reorganization and their inability to rehabilitate themselves, the Act required the Association to include in the FSP a plan to rehabilitate the plant of the railroads in reorganization. This plan is discussed in detail in a following section on maintenance and rehabilitation of physical facilities.

#### **Summary of Findings and Recommendations**

The Final System Plan projects that income from freight operations (in constant 1973 dollars) will improve from a consolidated loss by the railroads to comprise ConRail of \$161 million in 1973 to a profit of \$355 million for ConRail in 1985. During the same period, tonnage is projected to grow by 15.5 percent.

To realize this \$516 million improvement, ConRail should:

- Improve loadings per car. It is expected that average loadings per car will continue to grow, reflecting the higher capacity of cars being added to the fleet relative to the older, smaller cars retired. While it is anticipated that the maximum car sizes will not exceed present levels, the capacity mix in the fleet will increase. It also is anticipated that the rate structure will encourage heavier loadings. The rehabilitation program reflects the track requirements to handle the heavier loadings.
- Improve physical plant. The rehabilitation of physical facilities should be carried out to the extent economically justified and should encompass track, structures, freight cars and locomotives.
- Improve rolling stock utilization. Car and locomotive utilization should be improved through better planning, installation of centralized equipment control systems and improvements in facilities.
- Improve road and terminal facility utilization. Main-line road operations should be concentrated to the extent possible, allowing the downgrading or elimination of duplicative main-line routes. Terminal use can be improved through development and implementation of site-specific operating plans and performance measurement and control systems.
- Improve revenue yield. As mentioned in Chapter 7 of the FSP, a detailed cost system should be installed which provides the relevant information required on a timely basis to carry out an improved market research program. ConRail should begin to increase selectively the rates on noncompensatory traffic, increase selectively the rates on compensatory traffic to improve profits from various markets,

withdraw from markets that cannot be served profitably and expand into profitable new markets.

- Improve management effectiveness. Management direction and goals should be clarified and strengthened, with profit objectives superseding primary reliance on traditional cost and/or production objectives. Supervisory compensation and working conditions should be improved with compensation more directly tied to operating performance. In addition, training programs for supervisors should be started.

ConRail's projected 1973-1985 profit improvement includes the following.

*Improvement in profit from freight operations<sup>1</sup> 1973-85*

[Figures in parentheses are extra costs rather than improvements]

	Millions	Millions
Increased revenues.....		\$325
Reduction in:		
Interest, leased line expenses, and other miscellaneous costs.....	\$97	
Net per diem.....	27	
Transportation expense.....	147	
Other expenses.....	1	
Increase in:		
Maintenance-of-way expense.....	(61)	
Maintenance-of-equipment expense.....	(20)	191
Total net improvement.....		\$516

<sup>1</sup> Before taxes and extraordinary items and interest on the 7.5% Debentures, expressed in constant 1973 dollars. The 1973 financial results of freight operations include those railroads in reorganization comprising ConRail.

The impact of these financial projects on standard railroad cost ratios is reflected as follows.

	1973 average of all class I railroads	1973 Railroads in reorganization	1976 ConRail	1985 ConRail
Transportation ratio <sup>1</sup> .....	40.3	48.6	48.5	33.9
Maintenance-of-way ratio <sup>2</sup> .....	14.2	13.6	17.2	13.3
Maintenance-of-equipment ratio <sup>3</sup> .....	17.2	16.7	16.5	11.5

<sup>1</sup> Transportation expenses as a percent of operating revenues.

<sup>2</sup> Maintenance-of-way expenses as a percent of operating revenues.

<sup>3</sup> Maintenance-of-equipment expenses as a percent of operating revenues.

The improvement in the transportation ratio results from the combination of major reductions in expenses coupled with substantially greater revenues resulting from the projected 15.5 percent tonnage growth, rate increases and diversions from the solvents offset somewhat by projected light density line abandonments and transfer of certain markets to solvents. The 1985 transportation ratio compares favorably to the 1973 performance of solvent carriers. The Association anticipates, however, that by 1985, solvent carriers also will have been able to improve their performance, especially

if they make capital improvements equivalent to those planned for ConRail.

The decline of \$97 million in interest, leased-line costs and other miscellaneous costs results from the anticipated terms of conveyance. These items are discussed in greater detail in Chapter 3 of the FSP.

Net *per diem* payments are projected to decline as ConRail implements its centralized car-distribution system in the 1979-1981 period, with an expected 28 percent improvement in car utilization, and as equipment lease payments decline, reflecting the assumption that ConRail would acquire rather than lease all new equipment.

The decline in transportation costs includes the following elements.

*Change in freight transportation expenses 1973-85*

	Millions
Savings from capital improvement program.....	\$25
Expense reduction due to deletion of markets <sup>1</sup> .....	21
Expense increase due to diversion of traffic from solvents.....	(16)
Other expense reductions:	
Terminal operations.....	61
Train operations.....	38
Other.....	18
Total improvement.....	147

<sup>1</sup> As part of the recommended industry structure, Charleston, W. Va. would be served by the Chessie; Saginaw-Bay City-Midland, Mich. would be served by the Grand Trunk Western, and the Delmarva Peninsula would be served by the Southern Railway.

The capital improvement program is discussed later in this Chapter. The profit impact resulting from the deletion of certain markets and the increase in traffic diverted from the solvents is reflected in the revenue changes associated with these two items as well as expenses, as indicated above.

The projected reduction in yard operating expenses results from plant and facility rehabilitation, more effective management planning and reduced switching requirements made possible by improved blocking. The reduction in train operating costs is primarily a result of rehabilitation. Reductions in other transportation expenses result from an overall improvement in operating efficiency.

The increase in maintenance-of-way expenses reflects the expanded ConRail maintenance program. The reported level of maintenance-of-way expenses relative to historic levels is depressed because of the use of depreciation accounting, which USRA believes more fairly reflects the effect of the massive rehabilitation program on ConRail's financial statements.

The increase in maintenance-of-way equipment expenses reflects the additional costs associated with ConRail's expanded equipment repair program, which is projected to reduce ConRail's out-of-service equipment from 13 percent today to 5 percent by 1985.

## FREIGHT OPERATING PLAN

The railroads in reorganization that will comprise ConRail are expected to spend nearly \$1.5 billion on freight operations in 1975, more than 40 percent of which will go to picking up and delivering cars from and to customers and other railroads, classifying or grouping cars and operating trains. Accordingly, the Association's operations planning effort contained an evaluation of these railroads' terminals, classification yards and train operations and development of alternative proposed operating plans for ConRail, including recommendations for improvement of existing operations.

The primary objectives in developing these plans were to make it possible to compare the various strategic options evaluated by the Association, to provide inputs to be used in projecting operating expenses, to determine yard and main line requirements and to define required rehabilitation and capital improvement projects for the recommended option.

By including details concerning train routing and yard use in this supplement to the Final System Plan, the Association intends to provide an indication of the train routing decisions and facilities utilization upon which the FSP financial projections and property designations are based. The Association has not intended to limit the operating flexibility of ConRail management in responding to future requirements.

Through a detailed planning process, the Association developed a car sorting or blocking plan for the FSP strategic option recommended by the Association which, including revisions recommended by personnel knowledgeable in the existing operations of the railroads in reorganization, reduces the requirement for intermediate switching<sup>2</sup> of cars by 25 percent. The Association also developed a recommended capital-improvement program, a plant-rehabilitation program and suggested operating changes to improve terminal operating effectiveness which, when implemented along with the blocking plan, should enable ConRail to reduce its freight transportation expenses by \$147 million in 1985, compared to 1973, while at the same time handling the projected 15.5 percent increase in tonnage.

The remainder of this section of the Final System Plan Supplement covers

- Road Freight Operations,
- Terminal Operations,

- Road Capital Program,
- Labor Productivity and
- Rail Safety.

### Road Freight Operations

In a system as complex as that of the railroads in reorganization, decisions concerning routing, blocking, line capacity, terminal workloads and train scheduling would be difficult to analyze even if they could be treated separately; however, since these functions had to be analyzed simultaneously to account for their interrelationships, existing planning techniques have proved to be inadequate. Recognizing this, the Association, prior to developing ConRail's proposed operating plan, had to develop a new operations planning approach.

#### Planning Approach

The Association's planning approach is described in this section.

*Traffic Flow Data Base Development.*—The initial step in studying the existing operations of the railroads in reorganization was for USRA to develop an origin-destination traffic flow data base. Data obtained from the eight carriers in reorganization were found to contain inaccuracies. To improve the accuracy of the data, a series of editing programs was developed. In addition, to avoid counting each carload more than once as it passed over several railroads in reorganization, the data were merged. The resulting data base is superior to the original source data. This data base subsequently was used in a series of analytical steps which provided the basis for the FSP financial statements and definition of facility requirements for ConRail.

The data base included, for each origin-destination traffic flow, a consistent location coding system based upon sound railroad operating logic. USRA developed such a coding system (see below), unique in its design, to permit combining logically the traffic flows of the railroads in reorganization, making it possible to simulate traffic rerouting and diversion quickly in studying each of the various strategic network options evaluated. With the flexibility of the coding system, each of the 494 gathering points or nodes included within the Association's schematic representation of the operations of the railroads in reorganization, as well as individual stations within gathering points, can be aggregated or redefined to determine present and future traffic flows, as well as revenues and costs for any alternate strategic option.

<sup>2</sup> Intermediate switchings are defined here as all switchings in excess of two switchings per car, one for origin and one for destination.

## LOCATION CODING

The eight railroads in reorganization move more than 42,000 cars per day among more than 7,200 stations and 800 interchange locations. To analyze a network of this complexity, a geographic location code structure based on railroad operating logic was required to permit the Association either to consolidate or split apart traffic flows in the same manner that a railroad combines and sorts traffic, or realistically could do so following a merger of operations.

The USRA location code structure that resulted was designed to allow analysis of traffic flows based on the way cars are distributed to their ultimate destinations. All of the "gathering points" in the network were identified through extensive analysis of local operations and discussions with railroad operating officials. A gathering point or node is the yard or siding which is either the final location where a car is switched prior to delivery to a customer or an interchange, or the initial location where a car is handled upon receipt from a customer or an interchange. This includes any point where a local or industrial switch engine drops cars for switching or picks up cars after switching for movement by a road train. Studies identified 494 such standard gathering points, including many major interchange locations. In addition, 35 multiple gathering point nodes were identified.<sup>3</sup>

<sup>3</sup> In many cases, local stations on a line between gathering points are served by more than one gathering point, depending on the origin or

The USRA location codes therefore include 529 gathering points. For planning purposes, however, traffic for the 35 multiple gathering points was assigned to an adjacent standard gathering point based on the direction of movement of traffic. To handle a system of this size, a 10-digit code was used, including three digits which have been reserved for future expansion. In addition to providing a coding system for car movement, other codes were included to allow assignment of stations and line segments to the various networks being considered during the USRA planning process and to allow classification of each line segment's future status under the criteria for possible branch line abandonments.

With each gathering point serving as a base, an operationally logical and unique code number appropriately related to the serving gathering point was assigned to each of the more than 8,000 freight station accounting codes (FSAC) and interchange locations included within the ConRail network. The code structure has been designed to incorporate future changes. The gathering points are based on present operational patterns, but as changes and consolidations are made in the gathering services, the code can be modified to reflect the changes.

destination of a car. To handle these situations, the USRA location code structure includes "Multiple Gathering Points." A subprogram was designed to assign individual cars destined to a station served by a multiple gathering point to the gathering point at either end of the line segment, depending on the direction of movement of the car.

*Network Definition.*—The second step in USRA's planning approach was the development, with the assistance of Stanford Research Institute (SRI), of a computer representation or model of the ConRail network. This network consists of nodes (yards, junctions, interchanges) and links (line segments connecting nodes) that were inputs to the computer model. Initially, the planning consisted of a network of 147 "super nodes" representing an aggregation of the 494 gathering points into major traffic centers. This network was used in developing the blocking and train formation and routing plans that were used in deriving the basis for the FSP financial statements. Subsequently, the model was expanded to include the full 494-node ConRail network. The model was then used to refine the routing and blocking plans so that the Association's recommendations for yard and main-line requirements could be defined. At major interchange locations, specific nodes were provided for the connecting roads.

For each line segment (link) in the network, actual distance and normal travel time were developed. Normal link travel times were developed from dispatchers' records, current speed limits and information on the present condition of links. Travel times for rehabilitated links were estimated with computerized Train

Performance Calculator (TPC) runs developed by T. K. Dyer, Inc. for USRA in cooperation with the Federal Rail Administration (FRA) and the Rail Services Planning Office (RSPO). The TPC developed running times based on link characteristics, the type of train (reflecting the locomotive horsepower-to-weight-of-train ratio) and anticipated speed limits after rehabilitation. TPC runs also were made with operating speeds constrained by existing slow orders.

Each node was classified according to its switching capabilities. Two kinds were identified, transit and nontransit. Nontransit nodes handled traffic originating or terminating at a single point. Transit nodes included two types, those that did major car classification work and those smaller facilities that performed a more limited classification role.

*Block Formation and Routing.*—Traffic flows and network identification were the basic inputs for the first program—block formation and routing (blocking) in the SRI model. Additional inputs included the choices between short time or short distance routing and the minimum size block that could bypass a transit yard or node.

As a further improvement to the model, using experience gained in manual and preliminary computer

simulations, the Association developed and incorporated into the model a decision logic to prepare blocking strategies automatically. This made it possible to concentrate on improving a blocking plan, rather than on the enormous detail involved in the manual development of each new blocking plan for the 494-node network.

Various blocking philosophies<sup>4</sup> were tested to determine the one which best matched ConRail's network and traffic flows. The blocking philosophy which evolved from this approach subsequently was used as a starting point from which to develop the ConRail blocking plan. In developing the recommended plan, alternate strategies were tested under varying traffic conditions by changing traffic flows and measuring the relative effectiveness of each strategy (Table 3) through the model's print-out handling of cars.

To insure that the planning process was more than an academic exercise, a number of railroad managers, experienced in freight operations, developed and used the blocking plans. The process also was reviewed by the team of railroad vice presidents experienced in operations which had carried out the overview studies for USRA described in the PSP.

Output reports from the blocking program summarized traffic flows according to specific blocking and routing decisions. These reports summarized for each iteration of this model:

- The number of blocks prepared at each node and the number of cars in each block (Table 4),
- The number of cars handled at each node in the network,
- The number of times each flow was handled moving from origin to destination (Table 5) and
- The number of cars in transit at each yard, their final destination and next node at which they were handled.

Using this output, blocking and routing strategies were modified and reentered into the model. This approach continued until a satisfactory blocking and routing plan was developed with the basic objectives

<sup>4</sup> A blocking philosophy refers to the general approach of sorting cars into groups or "blocks" that is followed in preparing a specific blocking plan. Examples of varying blocking philosophies would include:

- At the yard where cars originate, sorting or classifying cars to the furthest yard toward destination that still permits the economically justifiable formation of a block or
- Moving cars unsorted to a larger classification yard where, with the availability of more cars to sort, cars can be grouped to points further toward destination than is possible by refined sorting of cars at origin, etc.

being to improve services and reduce operating expenses by minimizing car handlings on a systemwide basis. During the analytical process, however, it was essential to weigh carefully the impact of blocking and routing decisions and to review continuously yard car handling figures to spot potential overloads in terms of cars switched per day or the number of distinct classifications required.

To estimate transportation expenses for the FSP financial projections, the Association compared the reduction in car handlings and the resulting yard cost reductions in the proposed ConRail blocking plan with blocking plans currently in use on the railroads in reorganization. The extent of improvement was determined by running the existing blocking plans through the SRI blocking program. This method of comparing existing operations with the proposed operation yields a more realistic difference in system car handlings than comparing a simulation developed plan against actual operating statistics, a comparison which invariably overstates potential improvements.

Implementation of the proposed blocking strategy would provide ConRail with a way to reduce its operating costs by reducing significantly the number of system-wide car switchings required to handle a given traffic volume. Analyses by the Association and by others indicate that achieving the minimum rchandling of cars en route:

- Reduces car delays and thereby improves car utilization and transit times on shipments,
- Improves dependability,
- Reduces yard congestion and workloads and therefore crew requirements and costs and
- Reduces exposure to loss and damage.

The Association's operating plan includes blocking to bypass as many intermediate terminals as possible, to avoid traffic cascading from one yard to the next and to minimize traffic backhauling unless absolutely required. The plan also handles loaded and empty cars with the same movement priority. This benefits loaded as well as empty cars, because with larger flows additional bypass blocks can be prepared which would not be economical to prepare if the sorting of loads was separated from empties. This policy also reduces the percent of system yard capacity presently required to handle cascading empty equipment.

*Train Formation, Routing and Scheduling.*—Once the blocking plan was determined, output of that pro-

TABLE 3.—Sample computer print-out: alternate strategies

CAP HANDLINGS FOR CONRAIL IV - 4 MONTHS (CASE 19C) 494 NODE 1973 FROM W15566 75/06/25. 12.21.10.							
TOTAL CARS HANDLED 1,2,3 TIMES	6347	11599	12311	4770	898	62	3
TOTAL HANDLINGS =	90441						
TOTAL EXCESS HANDLINGS =	24808						

SOURCE: SRI model.

TABLE 4.—Sample computer print-out: number of blocks

BLOCKS AT EACH ORIGIN FOR CONRAIL IV - 4 MONTHS (CASE 19C) 494 MODE 1973 FROM W15566 75/08/25, 12.21.10.

ORIGIN	DESTINATION	CARS	TONS	LOADS	EMPTYIES
74 THREERIVRS	75 ELKHART	11	538	8	3
	74 THREERIVRS	18	1172	11	7
	75 KALAMAZOO	3	120	1	2
75 KALAMAZOO	30 AVON	8	326	4	4
	72 ELKHART	59	2400	21	38
	74 THREERIVRS	3	124	1	2
	75 KALAMAZOO	134	7736	67	67
	76 GRANDRAPDS	38	1606	9	29
	77 BATTLECRK	14	951	12	2
	79 JACKSON	30	1479	25	5
	90 DETROITJCT	40	1680	23	17
110 STANLEY	30	1386	21	9	
76 GRANDRAPDS	30 AVON	28	1251	24	4
	72 ELKHART	65	2649	32	33
	75 KALAMAZOO	62	3162	50	12
	76 GRANDRAPDS	177	7939	71	106
77 BATTLECRK	30 AVON	29	1041	8	21
	72 ELKHART	37	1582	21	16
	75 KALAMAZOO	15	442	1	14
	77 BATTLECRK	77	3123	15	62
	78 BATCRKGTW	21	1158	13	8
	79 JACKSON	40	1815	28	12
78 BATCRKGTW	77 BATTLECRK	31	1057	3	28
	78 BATCRKGTW	40	2056	37	3
79 JACKSON	30 AVON	16	790	9	7
	72 ELKHART	39	1492	11	28
	75 KALAMAZOO	36	1587	10	26
	77 BATTLECRK	29	1033	3	26
	79 JACKSON	113	4629	27	86
	80 LANSING	45	2451	37	8
	85 ANN ARBOR	3	100	1	2
	86 DIANN	2	52	0	2
	87 WILLOW RUN	10	525	9	1
	88 WAYNE	8	378	5	3
	90 DETROITJCT	26	1349	15	13
	109 AIRLINE	41	1237	1	40
	110 STANLEY	30	1342	13	17
	140 SHARONVILL	13	496	4	9
	160 BUCKEYE	5	196	2	3
230 CONWAYEAST	38	2181	34	4	
460 SELKIRK	15	814	14	1	
80 LANSING	79 JACKSON	45	2496	29	16
	80 LANSING	99	5717	79	20
85 ANN ARBOR	79 JACKSON	2	222	1	1
	85 ANN ARBOR	47	2501	20	27
	86 DIANN	12	935	9	3
	110 STANLEY	7	675	6	1
	113 TOLEDO AA	11	383	1	10

SOURCE: SRI model.

gram was used as input to the second program in the SRI model—train formation, routing and scheduling (train formation). This program allowed for the definition of trains, e.g., the blocks carried, where they were picked up or set off, the route, when trains left their points of origin and type of train. Using this input, the program assigned cars to trains, outlined schedules and calculated the tonnage moving over each line segment. The program also computed such statistics as train miles and hours, car miles and hours, gross ton miles and numbers of cars and tons and trains by direction on each segment of the network.

Trailer-on-flat-car (TOFC) and unit-train traffic

that would not be operated in regular freight trains was excluded in aspects of the program that normally would not be applicable, such as the count of cars being classified in a switching yard. All unit trains as well as TOFC trains, however, were included in computing the trains and gross tons operated over each line segment.

Train operating decisions were based on such transportation considerations as train length (normally 80-120 cars), grades, meeting points and crew change locations. To maximize blocking effectiveness, long distance trains bypassing intermediate terminals were scheduled whenever blocking and traffic flows allowed. In the

TABLE 5.—Sample computer print-out: handling of traffic flow

FLOW HANDLINGS FOR CONPAIL IV - 4 MONTHS (CASE 19C) 494 NODE 1973 FROM W15566 75/08/25. 12.21.10.						
DESTINATION	ORIGIN	LOADS	EMPTIES	CARS	CARS*HANDLINGS	---INTERMEDIATE YARDS---
209 SALEM	209 SALEM	0	2	2	2	
210 MINERVA	210 MINERVA	1	2	3	3	
212 NILES	212 NILES	1	12	13	13	
214 GOODMAN	9 MPEXRMTHAD 214 GOODMAN	2 0	9 16	11 16	44 16	160 231 212
215 GATEWAY	102 MONROE MI 215 GATEWAY 247 WELANDTHB 446 HENSMINES	0 0 20 42	91 1 0 0	91 1 20 42	182 1 40 168	260 444 260
217 HASELTON	187 GIBSONBURG 217 HASELTON 219 WHEATLAND 257 XENMORE	10 1 38 0	0 41 5 17	10 42 43 17	40 42 129 51	230 231 231 260
218 NEW CASTLE	218 NEW CASTLE	0	2	2	2	
219 WHEATLAND	189 ROCKPORT 212 NILES 215 GATEWAY 217 HASELTON 219 WHEATLAND 228 WIERTON 273 KISKI	0 1 0 1 8 10 16	19 18 37 35 65 6 0	19 19 37 36 73 16 16	57 57 74 108 73 48 48	200 215 215 231 231
223 STONEBORO	101 TRENTON 200 ASHTABULA 223 STONEBORO	0 0 0	13 30 20	13 30 20	52 60 20	110 200
224 OIL CITY	224 OIL CITY	1	9	10	10	
226 MINGO	102 MONROE MI 110 STANLEY 226 MINGO 265 BLACKPK CN	0 0 13 10	47 55 49 0	47 55 62 10	94 110 62 40	260 230 231
227 MRTNSFERRY	226 MINGO 227 MRTNSFERRY	0 6	99 11	99 17	198 17	
228 WIERION	97 RIVERROUGE 130 KENTON 177 RUCYRUS 228 WIERION	19 18 14 9	0 0 1 95	19 18 15 104	57 54 60 104	230 160 207 226
229 MIDLAND	229 MIDLAND	1	18	19	19	
230 CONWAYEAST	6 SSWALLYJC 51 PROVISOCNW 187 GIBSONBURG 230 CONWAYEAST 305 HARRISBURG	1 0 22 6 0	0 1 0 52 35	1 1 22 58 35	1 1 44 58 105	300

SOURCE : SRI model.

planning process, it was noted that the greater the aggregation of traffic, the more refined the blocking and the more cars that could bypass intermediate yards.

To provide complete operating statistics, local trains and interchange transfer runs were introduced into this process. The train planning process also provided insights concerning the value of building new route connections, increasing main-line capacity and constructing efficient bypass routes around yards. USRA investigated the economics of operating smaller through-blocked trains but generally found this was not advantageous due to existing crew agreements.

*Yard and Line Capacity Constraints.*—The output of the train formation program (Table 6) served as input for two additional simulation models used by the Association to evaluate potential capacity constraints included in the blocking and train operating plans. They are as follows.

- Yard Simulation Model. This model, also developed by SRI, simulates the movement of cars through a yard, calculates utilization rates for physical and human resources and determines the time cars spend in each portion of the classifica-

tion process. Other basic inputs are a physical description of the terminal, the rate at which each work segment can be accomplished, train schedules, the blocking policy and traffic flows. The model was used to determine the utilization impact of varying critical resources and to determine maximum yard capacity, given a particular traffic mix. (See box below.)

- Dispatch Simulation Model. This model, developed by Peat, Marwick, Mitchell & Co. (PMM) for the Federal Railroad Administration, simulates train movements over a given line segment and calculates delays caused by interactions between trains moving on the same line segment. Inputs to the model also include a physical description of the segment and the trains anticipated to operate over that line segment, including scheduled departure

time and type of train. With this model, the capacity of high density line segments was determined with the present physical configuration and with improvements in track and signalling. (See box below.)

Both of these models were used to check the proposed blocking and train service plans. If, in running these models, capacity constraints were indicated either in terminals or on main line segments, changes were made to eliminate the constraints. In determining the required revision, the adverse impact on operations and traffic movement was weighed against the capital cost of eliminating the capacity constraint. USRA's final recommendations for capital improvements reflect those cases where it is economically preferred to relieve a constraint through capital improvements rather than revising the recommended blocking and train service plan.

TABLE 6.—Sample computer print-out: portion of link statistics output

LINK	MILES	TRAINS	LINK LOADINGS									TRAIN HOURS	CAR HOURS		
			CARS			TONS			TRAIN MILES				L	E	T
			L	E	T	L	E	T	L	E	T	L	E	T	
28 - 26	4	2	31	57	88	3865	6	124	228	352	2.00	31.00	57.00	88.00	
27 - 28	4	1	8	17	25	1107	4	32	68	100	1.00	8.00	17.00	25.00	
28 - 27	4	1	10	1	11	690	4	40	4	44	1.00	10.00	1.00	11.00	
28 - 29	69	2	115	93	208	10478	138	7935	6417	14352	7.07	406.33	328.60	734.93	
29 - 28	69	2	107	115	222	11099	136	7383	7935	15318	7.07	378.07	406.33	784.40	
29 - 30	48	2	131	190	231	11525	96	6288	4800	11088	4.93	323.13	246.67	569.80	
30 - 29	48	2	114	128	242	12139	96	5472	6144	11616	4.93	281.20	246.67	596.93	
30 - 31	0	1	4	7	11	548	0	0	0	0	1.00	4.00	7.00	11.00	
31 - 30	0	1	15	61	76	3204	0	0	0	0	1.00	15.00	61.00	76.00	
30 - 32	12	7	189	316	565	24447	84	2268	3792	6060	4.67	126.00	210.67	336.67	
32 - 30	12	9	341	389	770	37239	108	4572	4668	9240	6.00	254.00	259.33	513.33	
30 - 601	13	12	774	463	1237	73126	156	10062	6019	16081	6.80	438.60	262.37	700.97	
601 - 30	13	9	450	517	967	43068	117	5850	6721	12571	5.10	255.00	292.97	547.97	
30 - 602	22	2	154	68	222	13794	44	3388	1496	4884	4.10	315.70	139.40	455.10	
602 - 30	22	3	117	222	339	16749	66	2574	4884	7458	6.15	239.85	455.10	694.95	
32 - 133	50	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	
133 - 32	50	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	
32 - 135	45	3	66	160	226	9416	135	2970	7200	10170	6.10	134.20	325.33	459.53	
135 - 32	45	2	70	51	121	6815	90	3150	2295	5445	4.07	142.33	103.70	246.03	
32 - 601	7	2	50	66	116	5725	14	350	462	812	.50	12.50	16.50	29.00	
601 - 32	7	5	229	259	488	22387	35	1603	1813	3416	1.25	57.25	64.75	122.00	
33 - 35	37	1	41	12	53	3854	37	1517	444	1961	1.33	54.67	16.00	70.67	
35 - 33	37	1	49	43	92	5702	37	1813	1591	3404	1.33	65.33	57.33	122.67	
33 - 602	18	1	51	44	95	5902	18	918	792	1710	.83	42.50	36.67	79.17	
602 - 33	18	1	42	14	56	4015	18	756	252	1008	.83	35.00	11.67	46.67	
34 - 602	36	2	56	178	244	10847	72	2376	6408	8784	6.70	221.10	596.30	817.40	
602 - 34	36	1	112	54	166	9779	36	4032	1944	5976	3.35	375.20	180.90	556.10	
34 - 603	37	1	108	45	153	9272	37	3996	1665	5661	3.43	370.80	154.50	525.30	
603 - 34	37	2	45	173	218	8579	74	1665	6401	8066	6.87	154.50	593.97	748.47	
35 - 36	0	1	47	74	121	5860	0	0	0	0	.50	23.50	37.00	60.50	
36 - 35	0	1	104	9	113	8549	0	0	0	0	.50	52.00	4.50	56.50	
35 - 40	39	2	63	90	153	6779	78	2457	3510	5967	2.83	89.25	127.50	216.75	
40 - 35	39	2	91	84	175	10039	78	3549	3276	6825	2.83	128.92	119.00	247.92	
35 - 120	41	2	161	60	221	14857	82	6601	2460	9061	5.00	402.50	150.00	552.50	
120 - 35	41	2	91	153	244	10462	82	3731	6273	10004	5.00	227.50	362.50	610.00	
37 - 38	33	1	13	18	31	1876	33	429	594	1023	3.05	39.65	54.90	94.55	
38 - 37	33	1	3	4	7	470	33	99	132	231	3.05	9.15	12.20	21.35	
38 - 39	49	2	61	18	79	5503	48	2989	882	3871	3.50	106.75	31.50	138.25	
39 - 38	49	3	158	84	242	11485	147	7742	4116	11858	5.25	276.50	147.00	423.50	
39 - 605	25	2	113	132	245	12682	50	2825	3300	6125	2.17	122.42	143.00	265.42	
605 - 39	25	3	191	129	320	15361	75	4775	3225	8000	3.25	206.92	139.75	346.67	
40 - 41	7	2	58	85	143	6270	14	406	595	1001	.40	11.60	17.00	28.60	
41 - 40	7	2	81	70	151	8941	14	567	490	1057	.40	16.20	14.00	30.20	
40 - 128	73	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	
128 - 40	73	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	
40 - 605	35	3	160	108	268	12511	105	5600	3780	9380	4.50	240.00	162.00	402.00	
605 - 40	35	2	100	105	205	10808	70	3500	3675	7175	3.00	150.00	157.50	307.50	
40 - 607	16	2	90	91	181	9710	32	1440	1456	2896	1.33	60.00	60.67	120.67	
607 - 40	16	3	155	103	258	12002	48	2480	1648	4128	2.00	103.33	68.67	172.00	
41 - 44	38	2	58	85	143	6270	76	2204	3230	5434	2.17	62.83	92.08	154.92	
44 - 41	38	2	81	70	151	8941	76	3078	2660	5738	2.17	67.75	75.83	163.58	
42 - 44	5	2	81	70	151	8941	10	405	350	755	.33	13.50	11.67	25.17	
44 - 42	5	2	58	85	143	6270	10	290	425	715	.33	4.67	14.17	23.83	
42 - 45	7	3	123	150	273	14816	21	861	1050	1911	1.45	59.45	72.50	131.95	
45 - 42	7	3	171	103	274	18990	21	1197	721	1918	1.45	82.65	49.78	132.43	
42 - 47	10	5	298	93	391	25179	50	2980	930	3010	2.00	119.20	37.20	156.40	
47 - 42	10	4	118	221	339	14138	40	1180	2210	3390	1.60	47.20	88.40	135.60	

SOURCE: SRI model.

## YARD SIMULATION MODEL

The yard simulation model was used to confirm the proposed blocking plan in system yards where significant changes are being recommended, to insure that the plan could in fact be implemented.

The model also is being used to calibrate the existing operation in major yards, making it possible to determine the extent to which existing manpower levels could be reduced in terms of both the proposed plan and existing operations.

To simulate yard operations, the model uses output from the blocking and train formation programs based on the 494-node network. The model simulates the receipt of inbound trains, switching them in the priority order specified, classifies cars into specified outbound blocks based on their final ConRail destinations and makes up outbound trains according to their priorities and departure times. The model also simulates in detail the interaction between yard resources and yard work requirements to determine the ability of a yard to carry

out the work assigned with a given amount of manpower. Specifically, the model simulates, in 15 minute increments for several days, the use of individual receiving, classification and departure tracks, the switching or hump lead, inbound and outbound inspection and classification and train make-up crews. It simulates each individual facility and crew, making it possible to determine the utilization of resources and the impact of changing these resources. For example, the model can measure the effect of adding or reducing crews or car inspectors and changing the assignment of classification tracks. Physical changes in the yard also can be tested, such as including crossovers or providing a second switching or hump lead or another lead from the class yard. The model determines whether the schedules for inbound and outbound trains as planned are met, given the resources assumed, and provides a summary of average car detention time and a report of the use of key resources.

*Line Capacity Determinants.*—The dispatch simulation model identified several key determinants of line capacity.

The first was physical constraints. The effective capacity of a line segment is generally constrained by bottlenecks, including:

- Sections of single track in a double track line,
- Interlocking plant restrictions (at the intersection of routes or locations where trains can change tracks),
- Yard entrance and exit configurations, governing the ability to move trains quickly to and from the main line and
- Other conditions which limit normal track speed, such as grades, excessive curvature, slow orders and municipal speed restrictions.

The second was signalling systems. An effective signalling system that minimizes train delays is particularly important on high density single-track lines and multiple-track lines handling trains moving at varying speeds (e.g., passenger, merchandise-freight and mineral-freight trains).

The third was the operating plan. The operating plan over a particular route can have a major impact in terms of reduced line capacity when:

- Schedules lead to a concentration of train movements during a short period of time, especially when fleets of trains meet,
- Average train speeds are reduced (due, for ex-

ample, to slow orders or lower horsepower-per-ton ratios),

- Trains are assigned relative priorities in avoiding delays on line segments (such as meeting opposing trains) and
- Trains move at substantially different speeds.

These findings have two major implications for ConRail. First, the benefits of line rehabilitation may not improve capacity materially if physical bottlenecks, signal system deficiencies and operating constraints are not also corrected. Second, several operational options for reducing congestion on high density lines may limit the need for major capital expenditures or, on the other hand, operating decisions may reduce capacity and require major capital commitments. Operating policies, therefore, cannot be separated in the planning process from financial policies.

Implementation of the FSP will require construction of some new connections and it is important that these track and signal facilities be designed and built to allow uninterrupted movement at moderately high speeds. In addition, many bottlenecks now exist that were created by the failure of the railroads in reorganization to repair damage to interlockings caused by derailments. These situations should be identified and analyzed and interlockings that should handle heavy traffic restored to their design capacity.

### Route Selection

Primary route selections were based upon:

- Traffic flow volumes,



## DISPATCH SIMULATION MODEL

To test line capacity and define main line (link) constraints, USRA used a dispatch simulation model developed by PMM.

The model was used to simulate existing and anticipated traffic and track configurations on 7,525 road miles of line, including 12,775 miles of track, to identify capacity or scheduling problems. In essence, the model simulates the dispatching of trains at a level of detail that includes block signal spacing and specific track and crossover configurations. The model produces statistical output as well as a computer generated "stringline" or time-distance graph of the section of line simulated. (See Figure 2.)

To provide inputs to the model, T. K. Dyer, Inc. used its train performance calculator (TPC) to simulate train running times, delineating transit times for various types of trains in terms of horsepower per ton over each of the line segments tested. In addition to providing running times, the output of the TPC was useful in providing fuel consumption information over each main-line segment. With this information, USRA could make trade-off decisions between incurring incremental operating costs associated with a rationalized plant and resulting increased train miles or acquiring and subsequently rehabilitating additional main-line segments.

In addition to TPC output, the dispatch simulation model also used as inputs for each line segment:

- Track Arrangement—number of tracks, location of sidings or crossovers, length of sidings, location of stations, yards and junctions;
- Signal System—available aspects, direction of movement and block spacing;
- Schedules—consisting of starting time, origin and destination points and work required enroute and

- Trains—assigned to the five priority groups of passenger, TOFC and preferred merchandise, general merchandise, loaded and empty unit trains and local and transfer movements.

To verify the accuracy of input and to calibrate the model to allow comparisons with later runs, each line first was simulated with the existing track configuration and existing traffic, with the model generating for each train the time required to move on or across the line segment, including running times and delays. Once the program was validated for a segment, variations were made in input to test the operating strategies of:

- Revising schedules and train operating routes,
- Changing running times to reflect increased slow orders or the removal of slow orders following rehabilitation,
- Taking tracks out of service for short periods to simulate maintenance-of-way work and
- Adding or removing tracks or sidings and revising the signal systems or signal spacing.

As mentioned earlier, the dispatch simulation model provides a tabular printout and a stringline diagram, or time-distance graph, for each line segment and each operating scenario simulated. The printout presents the detail of all delays incurred by each train, including programmed delays caused by interference from other trains or limitation of the physical plant. The stringline diagram portrays graphically all activity on a line segment during a specified period of time. (Activity between Harrisburg and Conway during a 48-hour period is shown in Figure 2.)

- Existing track conditions, grades, alignment, number of tracks, signaling and other line capacity considerations,
- Location of major terminal facilities,
- Opportunities to consolidate duplicate routes and terminal facilities,
- Operating costs, both line-haul and terminal, of alternative routes and
- Removal of traffic from high density passenger routes.

Generally, the primary route structure of ConRail consists of main lines presently used by the railroads in reorganization. By making certain changes in present routing, however, it is anticipated that ConRail would

consolidate some facilities of the separate railroads and therefore upgrade fewer line segments. The final selection of primary ConRail routes, where significant alternatives exist, is discussed below.

*Northeast Corridor.*—The structure of ConRail's routes in the Northeast Corridor has been determined by the desire to remove as much freight as possible from the passenger route and to make more effective use of the hump yards at Enola, Allentown, Oak Island and Selkirk. The final route structure also reflects suggestions by the ICC's Rail Services Planning Office (RSPO), with which the Association concurs, concerning possible capacity constraints on the following three line segments.

Line Segment	RSPO Comment	USRA Action
Allentown-Newark.....	Traffic volumes will exceed the capacity of Lehigh Valley (LV) route.	The Central of New Jersey (CNJ) line has been retained as a second route. Passenger traffic between Allentown and Newark might be rerouted via the CNJ to Elizabeth and the PC to Newark with a new connection being constructed between the CNJ and PC at Elizabeth.
Harrisburg-Reading.....	Capacity of the Reading (RDG) line will be exceeded if Philadelphia traffic uses this route.	Some Philadelphia traffic has been routed over former Penn Central (PC) lines.
Washington-Baltimore.....	Combined ConRail-Chessie traffic will exceed capacity of the Baltimore & Ohio (B&O) line.	A single track of the former PC corridor main line has been designated for freight service; through physical upgrading the capacity of the B&O main line will be increased.

The primary routes for ConRail in the Northeast Corridor area are discussed below and shown in Figure 3. This listing reflects the routing used in developing the operating plan. The changeover from existing routes on the Corridor to the by-pass routes requires the construction of several new track connections. It is expected that the physical changes will not be completed for at least 5 years. To the extent negotiations currently in progress with the Chessie System to acquire the Baltimore & Ohio (B&O) line from Philadelphia to Baltimore and to use the B&O line with trackage rights from Baltimore to Washington are at this time incomplete, these plans are subject to change.

- Potomac Yard—Northern New Jersey. Between Anacostia (Washington) and Bay View Yard (Baltimore), traffic would be routed over both the former PC (one track) and the B&O line, with the B&O route being preferred and one track of the former PC being used when train movements exceed line capacity on the B&O. North of Baltimore, traffic would operate on the former B&O to

Philadelphia and via trackage rights on the Chessie System (former RDG) to Manville, N.J. Oak Island-Elizabethport traffic would use the former LV from Manville to Newark, N.J.

- Potomac Yard—New England/New York City. Traffic would route as above to Philadelphia. North of Philadelphia, Chessie trackage (former RDG) would be used to Allentown, thence to Maybrook, N.Y. via the former LV-Lehigh & Hudson River (LHR)-PC Route. From Maybrook, traffic to New Haven-Bridgeport would route over the Poughkeepsie Bridge via Danbury, Conn. to New Haven. Traffic for the rest of New England and New York City would route from Maybrook via Kingston, N.Y. to Selkirk Yard near Albany. New York City traffic then would move down the Hudson line via Harmon, N.Y. In addition, two alternate routes will exist between Allentown and Selkirk Yard. One involves trackage rights over the Delaware & Hudson (D&H) between Wilkes-Barre, Pa., and Voorheesville, N.Y. The other uses the former RDG-LV to Newark and then the former PC via National Junction (Jersey City) and the West Shore Line to Selkirk. The latter route would use a new connection between Oak Island and Meadows Yards in the Newark area, a ConRail capital improvement scheduled for completion in 1976.

- Harrisburg—East Coast. Traffic from Harrisburg and west for the Linden, Trenton and Metuchen areas, would move from Enola via Morrisville, Pa. on former PC lines; traffic to Baltimore/Potomac Yard would move via Perryville, Md. and Baltimore; and Philadelphia traffic would move on the former PC freight main line via Columbia, Pa. and on Chessie trackage (former RDG) through Reading and the Belmont connection in Philadelphia.

Traffic for the Northern New Jersey and New England areas would move from Harrisburg to Allentown via Chessie trackage (former RDG). From Allentown, Northern New Jersey traffic would be routed over the former LV to Oak Island. Port Reading traffic would leave the former LV at

FIGURE 3.—Principal rail routes in the Northeast



Manville, N.J., and operate over Chessie (former RDG) to Port Reading, N.J. The alternative routing to Oak Island would be to use the former LV to Phillipsburg, N.J., thence former CNJ to Aldene, N.J. and former LV from Aldene to Oak Island. From Allentown, Bridgeport and New Haven traffic would be routed via the LHR to Maybrook and over the Poughkeepsie Bridge. Other New England and New York City traffic would move via the LHR and former PC to Selkirk Yard.

- Buffalo/Syracuse—New Jersey and South. Traffic from Buffalo destined for Baltimore and Potomac Yard would be routed over former PC lines via Olean, N.Y., Renovo, Pa. and Enola to Perryville, thence over the B&O. Traffic from Syracuse and Niagara Falls to Baltimore and Potomac Yard would move over former PC lines via Lyons, N.Y., Corning, N.Y., Newberry, Pa. and Enola. Traffic from Buffalo to Northern New Jersey and Philadelphia would route over Chessie trackage rights via Corning to Waverly, N.Y., thence by former LV to Allentown and by former RDG, CNJ or LV to destination. Traffic from Syracuse and Niagara Falls would join the route at Corning.
- Northern New Jersey—New England and Upstate New York. Traffic between these points would route from Oak Island and Weehawken over the former PC's West Shore Line to Selkirk Yard.
- Traffic remaining on the Corridor. As a result of this routing structure, which still is subject to negotiation, nearly all through freight service would be removed from the Washington-Boston passenger corridor. Local freight and yard service would continue on the corridor to the extent required. When the restructuring is completed, through freight traffic remaining on the corridor is projected to consist of:

- Substantial through traffic between Landover, Md., and Bayview (Baltimore), using one track of the former PC.
- One high priority train a day each way between Trenton (Morrisville) and the automobile plants at Metuchen and Linden, N.J.
- Three trains per day each way between Oak Island, Morrisville and Philadelphia. Two of these trains would provide service to intermediate points. The other train, a Selkirk-Potomac Yard train via the West Shore route, would handle traffic to and from Northern New Jersey, Trenton, Philadelphia, Wilmington and Baltimore.
- A daily train each way via the Poughkeepsie Bridge Route, traversing 12 miles of the Corridor between Devon and New Haven, Conn. Two additional trains per day, operating between

Selkirk and New Haven, also would move over this portion of the Corridor.

- Two trains per day each way entering the Corridor at Mansfield, Mass., one moving the 19 miles to Providence, R.I., the other the 7 miles to Attleboro, Mass.

*Northern New Jersey-Cleveland-Chicago.*—Studies of the operational cost of the two principal main-line routes of the ConRail system between Northern New Jersey and the Cleveland-Chicago areas show that the route via Selkirk and Buffalo has slightly lower operating costs<sup>5</sup> for the movement of common origin-destination traffic than the route via Enola and Pittsburgh. Given this, the routing decision should be based on changes in traffic flows over time, the capacity of the lines and traffic aggregation and consolidation opportunities which either routing may make possible in the future. New York State is in the process of negotiating with Penn Central to make certain improvements in the West Shore route from Newark to Selkirk Yard, which would alleviate some of the existing capacity problems on that line. Consistent with USRA overall policy that future routing should rest with Conrail management, USRA recommends that ConRail and the State of New York continue these negotiations regarding the West Shore route.

*Johnstown-Pittsburgh.*—Between Johnstown and Pittsburgh, two former PC routes are available—the main line via Greensburg and the longer but more level river grade Conemaugh line via Kiski Junction. After rehabilitation of the Conemaugh line, additional freight traffic would be transferred to this route from the present main-line route.

*Niagara Falls-Detroit.*—The Canada Southern line of the former PC is the shortest route between New England and upstate New York to Detroit, Elkhart and Chicago. The route is restricted, however, by clearances in the Detroit River Tunnel, which limit the movement of loaded trilevel and high-cube cars. Until the tunnel clearance restriction is eliminated (a project included in ConRail's capital improvement budget), most traffic should be routed via Buffalo and Cleveland to avoid split flows and imbalanced movements.

*Indianapolis-East St. Louis.*—The primary route between Indianapolis and East St. Louis should be the northern line west from Indianapolis to Terre Haute, thence the southern route to East St. Louis via Marshall, Ill. Until capacity is increased west of Terre Haute, the northern route from Terre Haute to East St. Louis via Mattoon, Ill., should be retained as a

<sup>5</sup> The flows which possibly could be handled via either route averaged 487 cars per day during the October 1973 sample month or 5.4 additional trains per day (both directions). Total annual savings in direct operating cost that would result from routing via Buffalo was approximately \$500,000. The capital cost of necessary physical improvements to increase line capacity between Weehawken and Selkirk to handle these additional trains would be about \$1,600,000.

through freight route, generally handling westbound traffic.

*Indianapolis-Columbus-Cincinnati.*—Between Indianapolis and Columbus, traffic should be routed via Union City, Ind. and Bradford, Ohio. This route allows ConRail to consolidate the Indianapolis-Columbus and Indianapolis-Cleveland routes for 97 miles between Indianapolis and Union City, making it unnecessary for ConRail to upgrade Indianapolis to Richmond, Ind. as a through-freight route.

Between Indianapolis and Cincinnati, the primary route is via Union City-West Manchester-Middletown to Sharonville Yard. Other high priority traffic would use the route via Greensburg, although the utility of this route is somewhat limited by the congestion encountered on the B&O between Riverside and Ivorydale in the Cincinnati area.

Between Cincinnati and Columbus, traffic could be routed via both Xenia and Springfield. Neither line has the capacity to handle all traffic over this route; however, as traffic via Springfield moves along streets through the middle of town, this route generally should not be used unless the Xenia route is overloaded.

*Indianapolis-Chicago.*—Several routes involving ConRail trackage rights are under consideration as the primary route between Indianapolis and Chicago. At present, principal flows of ConRail traffic move via Frankfort and Logansport. If current negotiations with the Louisville & Nashville (L&N), Grand Trunk Western (GTW), Chicago & Eastern Illinois (C&EI) and Chicago & Western Indiana (C&WI) are consummated, ConRail traffic would be routed over ConRail from Indianapolis to Lafayette, thence over L&N, GTW, C&EI and C&WI trackage to Chicago, with the line to Logansport not upgraded to be a primary freight route. The rerouting at Lafayette would be implemented in a fashion consistent with current rail relocation plans.

*Chicago-Southern Illinois and Southern Indiana.*—At present, traffic from southern Illinois comes to Chicago via Paris and Danville, Ill. Traffic from the coal fields of southern Indiana comes to Indianapolis via the Petersburg Secondary Track. If negotiations currently in process with the L&N, Chessie, C&EI and C&WI can be completed, ConRail traffic from both these areas would come north to the B&O's east-west main line at Lawrenceville and Washington respectively, thence over B&O trackage to Vincennes, and north to Chicago via the L&N, C&EI and C&WI using trackage rights.

*Chicago-Conway.*—Two former PC routes are available between Chicago and Conway—the route via Valparaiso and Fort Wayne and the route via Elkhart, Toledo and Cleveland. Both routes will be retained as will the connecting lines from Fort Wayne to Kendallville, Toledo to Bucyrus, and Cleveland to Alliance. As

traffic patterns dictate, some traffic may change routes. Use of the northern route provides the opportunity to increase the concentration of westbound Chicago traffic at Elkhart Yard. Under existing labor agreements, however, the northern route requires two more crews each direction for each train than does the southern route, although due to the mileage basis of pay, the cost consequences are not as significant as this might seem to indicate.

*Youngstown-Ashtabula.*—Traffic volumes on the preferred route via Mann exceed acceptable levels for this single-track route. Consequently, a second route via Sharon and Jamestown has been retained to handle a portion of this traffic.

### Classification Yard Requirements

Principal ConRail system classification yards are shown in Table 7 and Figure 4, with existing car switching capacity and projected 1985 volumes in terms of cars switched per day, as developed on the basis of the blocking simulations. These 20 yards, with a combined capacity of 41,900 cars per day, are projected to handle 43 percent of ConRail's total system classification volume by 1985, the same percent as in 1973. Although some yards will require major upgrading and capital improvements to handle projected workloads, no major new classification yards will be necessary, and some existing yards eventually may be closed. Given ConRail's existing yards and since major new system

TABLE 7.—Principal ConRail yards

Yard name and location	Existing car switching capacity/day	1985 projected car switching requirement/day
Allentown, <sup>1</sup> Allentown, Pa. ....	1,400	1,700
Avon, Indianapolis, Ind. ....	2,700	2,600
Bayview, Baltimore, Md. ....	1,400	900
Blue Island, <sup>2</sup> Chicago, Ill. ....	1,600	1,800
Buckeye, Columbus, Ohio. ....	2,700	2,500
Conway-East, Conway-West, Conway, Pa. ....	6,000	5,000
DeWitt, Syracuse, N. Y. ....	1,600	1,100
Elkhart, Elkhart, Ind. ....	3,000	2,900
Enola, Harrisburg, Pa. ....	5,000	3,500
Frontier, Buffalo, N. Y. ....	2,600	2,500
Greenwich, Philadelphia, Pa. ....	700	700
Junction, Detroit, Mich. ....	1,800	1,400
Morrisville, Trenton, N.J. ....	1,200	900
Oak Island, <sup>3</sup> Newark, N.J. ....	1,000	1,500
Potomac, <sup>4</sup> Alexandria, Va. ....	1,600	1,600
Rockport, Cleveland, Ohio. ....	1,000	900
Selkirk, Albany, N. Y. ....	3,000	2,800
Sharonville, Cincinnati, Ohio. ....	1,800	1,400
Stanley, Toledo, Ohio. ....	1,800	2,500
	41,900	38,200

<sup>1</sup> ConRail's projected loadings only.

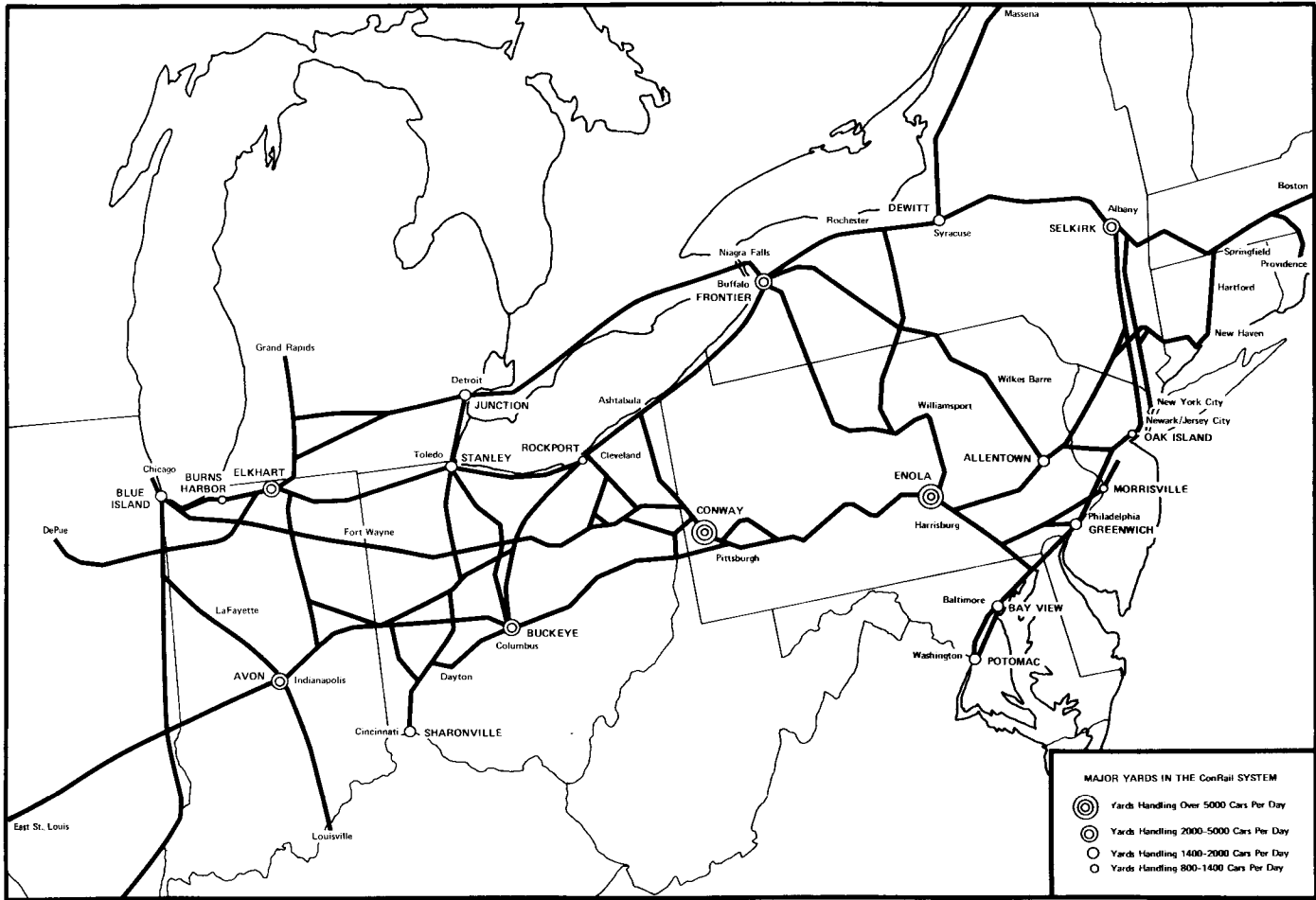
<sup>2</sup> ConRail's projected loadings only—operated by Indiana Harbor Belt.

<sup>3</sup> Includes all Northern New Jersey traffic in 1978 projected loading.

<sup>4</sup> ConRail's projected loadings only—operated by R.F. & P.

SOURCE: USRA staff analysis.

FIGURE 4.—Major yards in the ConRail System



classification yards now cost about \$60 million each, it is important that ConRail management emphasize improving utilization of existing yards rather than construction of new ones.

Several existing TOFC terminals should be consolidated and capacity increased where necessary to handle future combined volumes. As discussed in a following section which describes the intermodal operating plan, a new TOFC block switching terminal is proposed for Crestline, Ohio.

To handle ConRail's projected car switching requirements, there is a need for expansion or significant rehabilitation of the following major yards.

<i>Yard</i>	<i>Location</i>
Allentown .....	Allentown, Pa.
Blue Island .....	Chicago, Ill.
Oak Island .....	Newark, N.J.
Stanley .....	Toledo, Ohio

In addition to these yards, which must have their capacities increased to handle more cars per day than at present, there are eight other yards that, although they are able to handle the projected 1985 daily volume of

cars, require rehabilitation or physical improvements to expand their capability to sort cars in a more refined fashion—i.e. to prepare more blocks.

<i>Yard</i>	<i>Location</i>
Avon .....	Indianapolis, Ind.
Buckeye .....	Columbus, Ohio
DeWitt .....	Syracuse, N.Y.
Elkhart .....	Elkhart, Ind.
Frontier .....	Buffalo, N.Y.
Greenwich .....	Philadelphia, Pa.
Junction .....	Detroit, Mich.
Selkirk .....	Albany, N.Y.

These yard projects are included in ConRail's 1976-80 road capital improvement budget. Additional modernization and expansion projects, while not so extensive, are contemplated for the 1981-85 period. These projects would focus primarily on operating efficiency improvements and local support activities. Yard rehabilitation projects are included in the rehabilitation program described in the last section of this Chapter.

The proposed ConRail operating plan would downgrade or eliminate the system role of the following

yards compared to the existing operations of the railroads in reorganization.

<i>Yard</i>	<i>Location</i>
59th Street -----	Chicago, Ill.
Hawthorne -----	Indianapolis, Ind.
Airline -----	Toledo, Ohio
Marion (EL) -----	Marion, Ohio
Grandview -----	Columbus, Ohio
Tift -----	Buffalo, N.Y.
Elizabethport -----	Elizabeth, N.J.
Waverly -----	Newark, N.J.

These changes result from the consolidation of facilities as the railroads in reorganization are merged into ConRail and due to reallocation of system classification workloads to handle most effectively the traffic flows of the merged railroads.

The projected system classification role of each of ConRail's major yards is shown in Table 8. The volume of cars required to be switched at most of these facilities would decline, reflecting an overall reduction in intermediate switchings resulting from the Association's blocking plan for ConRail. In some yards, however, the blocking plan assumed that more classifications would be prepared than at present. Significant potential yard overloads were evaluated in detail, using the SRI yard capacity simulation model and, where it was concluded that the number of classifications required of a facility was too great and it was not economical to expand capacity to the extent required, the blocking strategy was adjusted until an acceptable workload was reached.

### Terminal Operations

In 1973, terminal operations and directly related expenses accounted for \$268 million, or 29 percent, of the total freight transportation expenses of the railroads in reorganization included in ConRail. Adding terminal-related car-hire costs raises this to nearly 40 percent. Given this level of expenditure, the relative effectiveness with which ConRail's terminals are operated will have a significant impact upon ConRail's operating expenses and hence its financial viability.

As discussed in the previous section, improved system blocking and routing strategies will reduce system switching requirements and thereby reduce terminal operating costs. Rehabilitation of terminal facilities also will lead to a reduction in operating costs and provide the foundation for a normalized future operation. The major improvements in terminal efficiency, however, will result from a terminal-by-terminal analysis of operating effectiveness and the development and implementation of changes, plans and controls to correct identified deficiencies at each specific terminal.

### Planning Approach

To understand existing terminal operations and to define the order of magnitude of improvements that

could be realized through the implementation of site specific changes, plans and controls, the Association, assisted by several contractors, studied in detail the operations of selected terminals operated by the railroads in reorganization. These studies augmented prior efforts described in the Preliminary System Plan. The objectives of these more intensive studies were to:

- Evaluate management effectiveness and identify opportunities for improvement,
- Determine labor effectiveness and identify opportunities for improving methods and procedures,
- Develop procedures for planning terminal operations and for measuring performance,
- Develop the criteria for a variable budget and a terminal control system and
- Quantify short and long term profit improvement opportunities.

The approach used in these studies included the use of multidisciplinary project teams consisting of rail operations specialists, industrial engineers, maintenance engineers, system analysts and financial and accounting personnel. To evaluate present operating and control problems and labor utilization, the contractors carried out field observations, interviews, time studies and work measurement. The terminal studies encompassed industrial switching, local and transfer train operations, yard and agency clerical activities, maintenance-of-equipment and maintenance-of-way functions in the terminals studied. As explained previously, classification yard activities were evaluated in separate studies in support of the blocking and train operations planning activities.

### Existing Terminal Operations

The Association's contractors, after intensively studying several terminals, and the Association staff, after reviewing more than 50 terminals during the past year, reached similar general conclusions about why terminals of the railroads in reorganization were not being operated effectively. First, the studies found that effectiveness of terminal management was reduced by:

- A lack of clearly stated and interrelated management goals and objectives,
- A fragmented organizational structure that reduces coordination among functional areas and between system, regions and divisions,
- A lack of coordination among connecting railroads,
- A debilitated physical plant that causes continuing operating difficulties and preoccupies management,
- Insufficient number of first-line supervisors,
- Inadequately paid and motivated supervisory and management personnel and
- Ineffective management planning, performance and cost control, resulting from inadequate infor-

TABLE 8.—*ConRail System classification function*

Yard	Eastbound	Westbound	Northbound	Southbound
Conway (Pittsburgh).....	Enola, Allentown and most points between Oak Island and Potomac Yard.	All major points, including through interchange blocks for E. St. Louis and Chicago.	Cleveland, Youngstown, Ash-tabula and Buffalo.	
Buckeye (Columbus).....	All major yards; all points between Columbus and Pittsburgh and Columbus and Rockport.	Elkhart, Logansport and Avon....	Stanley and Detroit.....	Sharonville; including blocks for selected points on L&N and Southern.
Sharonville (Cincinnati).....	Buckeye, Cleveland, Frontier, Selkirk, Conway and Allentown.	Avon, Elkhart and Chicago.....	Stanley and most Michigan points.	
Avon (Indianapolis).....	All major points; also all points between Indianapolis and Bellefontaine and Indianapolis and Dayton.	All connections at E. St. Louis— all local points to Terre Haute, Paris, P&E points, Crawfordsville, Danville, Urbana and Peoria.	Chicago, Elkhart, Logansport and Marion.	Louisville; Cincinnati and all points between.
Rose Lake (E. St. Louis).....	Avon, Buckeye, Conway, Allentown, Stanley, Cleveland, DeWitt and Selkirk.	All interchange points in E. St. Louis.	Elkhart and Chicago.	
Blue Island (Chicago—IHB).....	All major points on the system except E. St. Louis which moves via Avon.			
Elkhart.....	All major points including several subblocks for Detroit.	All major Chicago connections and industrial yards.	All points to Jackson, Grand Rapids and Lansing.	Buckeye, Avon and Cincinnati.
Stanley (Toledo).....	Cleveland, Frontier and Selkirk...	Elkhart.....	All major points in Detroit area and west of Detroit to Jackson.	Columbus, Cincinnati, Avon and Conway.
Junction (Detroit).....	Niagara, Rochester, DeWitt and Selkirk.	Jackson and Elkhart.....		Stanley, Bedford, Conway, Avon, Sharonville and connections.
Frontier (Buffalo).....	Rochester, DeWitt, and Selkirk....	All major points.....	Black Rock, Niagara and connections.	Conway, Enola, Allentown, and local points. Sayre, Allentown and Renovo.
DeWitt (Syracuse).....	Selkirk and local points in between.	All major points.....	All major points to Montreal.....	Sayre, Allentown, Newberry, Enola and local points.
Selkirk (Albany).....	All major points in New England as well as New York City.	All major terminals except Conway which moves via Enola.		Oak Island, Philadelphia, Baltimore and Potomac Yard.
Oak Island (Newark).....		Allentown, Buffalo, Enola, Conway, Avon and Elkhart.	Selkirk and short points.....	Points between Oak Island and Philadelphia and Wilmington, Baltimore and Potomac Yard.
Allentown.....	All northern New Jersey points, Selkirk and Maybrook.	Enola and Conway.....	Buffalo, Niagara and DeWitt.	
Greenwich (Philadelphia).....		Allentown, Enola, Conway, Avon and Elkhart.	Points between Philadelphia and Oak Island and to Selkirk.	Baltimore, Wilmington and Potomac Yard <sup>d</sup>
Bayview (Baltimore).....		Allentown, Enola, Conway, Avon and Elkhart.	All points Baltimore to Northern New Jersey and Selkirk.	Potomac Yard.
Enola (Harrisburg).....	All major points between Newark and Potomac Yard and to Selkirk.	Conway, Avon and Elkhart.....	Buffalo, Niagara, DeWitt and intermediate points.	All major points, Thurlow to Potomac Yard.

SOURCE: USRA staff analysis.

mation and control systems to support these functions.

Second, the studies showed that labor productivity suffered from :

- Inadequate management supervision,
- Inefficient work methods and procedures and
- A lack of flexibility in work rules and practices.

These problem areas are discussed below, followed by the Association's recommendations for improving terminal efficiency and the expected operating improvements that should be realized as these improvements are implemented.

*Reduced Terminal Management Effectiveness.*—Terminal management generally has lacked adequate direction resulting in unclear goals and objectives. Consequently, it has concentrated on maintaining the status quo to the extent possible. In addition, uncertain of what to change and operating in a highly dynamic environment characterized by poorly maintained facilities, derailments and inadequate funds to make even minor improvements, terminal management often has become crisis-oriented. This management approach has led to a lack of planning and control, an ineffective use of labor, a failure to respond quickly to changes in workload and excessive car detention time. The recent economic downturn was illustrative of this problem. There was considerable delay in responding to the volume changes; crew reductions, when made, were large—so impressive, in fact, that it appears there must have been a significant excess of crews in the pre-downturn operations in relation to volume.

This terminal management ineffectiveness does not necessarily reflect on the capabilities of the individual managers. Rather, it means that those in management roles have not had a sufficiently well-defined framework within which to make business decisions. This condition, combined with the fact that supervisors have been preoccupied with "fire fighting" and have not known the cost and revenue consequences of their decisions because of inadequate information, has led to decisions that frequently are not in the best financial interest of the railroads, although well intended.

Supervisory effectiveness also has suffered because of :

- Unequal levels of responsibility and volume of detailed tasks assigned to supervisors at approximately equal levels of title and compensation,
- Employees covered by labor agreements frequently receiving greater compensation than their immediate management supervisors,
- Residual feelings with respect to premerger loyalties and
- A general feeling of insecurity and hopelessness due to problems considered to be beyond local control, as well as a top management attitude often

directed at liquidation, rather than progress toward the future.

In spite of these problems, a base on which improvements can be made and measured presently exists. The Penn Central has the organization structure and computer capability to support several terminal management information needs. For example, comprehensive cost-center budgets are prepared for the entire system; switch engine work standards have been developed (and were in use at one time) for most terminals and the existing demurrage control and transportation and billing systems provide the capability to measure car detention and connection performance. These reports and computer capabilities, however, rarely are used at the terminal level because of a lack of realism in budgets that are not volume variable and do not reflect the debilitated physical plant and, most importantly, because of a lack of management emphasis on local accountability.

*Reduced Manpower Utilization.*—As observed during the past year by the Association and its contractors, there is a clear potential for improvement in the amount of rail services produced per employee. Significant improvements can be realized by more effective attention to this aspect of operations, even without facilities improvements or basic changes in labor agreements. Yard rehabilitation, while not a direct prerequisite for achieving much of this improvement, would allow more normalized operations, alleviate management's "crisis" orientation and thereby act as a catalyst for change. Examples of the impact of inadequate planning on the productivity of each major category of terminal manpower are summarized below.

- **Switch Crews.** Yard switch crews were delayed regularly in beginning their assignments while awaiting instructions, locomotives or incomplete or late switch lists. Local yard-to-yard transfer crews often waited for their trains to be assembled and regularly encountered delays on main-line tracks due to the priority given through trains. Industrial switching crews incurred delays at shipper sidings while awaiting switching instructions or waiting for loading or unloading to be completed. While delays such as these are inevitable, better coordination could lead to a significant reduction in both their frequency of occurrence and magnitude.
- **Clerical Employees.** The number of clerical positions in each terminal appeared to reflect needs during peak traffic demands. There was little evidence of adjustments in total positions as traffic volumes fluctuated, however, even on a seasonal basis. In addition, most clerical personnel were assigned specific yard or agency tasks which, when combined with a highly variable workload by specific type of clerical work, resulted in work imbal-

ances and delays in the completion of time-sensitive activities. In this case, the design of the clerical procedures appears to introduce a fixed element to normally variable costs.

- **Maintenance-of-Equipment Employees.** Maintenance activities had a wide range in labor utilization depending on the type of work being performed. Car inspector productivity was especially low because of poor coordination between departments, resulting in some cases in a low supply of inspectors when cars and trains were available for inspection, and in other cases an excess, sometimes on the next shift at the same location.

Utilization of equipment repair and servicing employees suffered due to inadequate work planning, inefficient facility layouts and cumbersome material requisition procedures. Delays in moving locomotives from yards for servicing resulted in nonproductive lost time in terms of locomotive utilization and created peak workloads, requiring excessive manning and overtime work to catch up.

- **Maintenance-of-Way Employees.** Observed maintenance-of-way labor utilization was low due to delays incurred awaiting authority to occupy a track for maintenance work, excessive manning for many jobs due to fixed gang sizes and inadequate work planning done just prior to dispatching gangs to their assignments.

In addition to the benefits to be realized from more effective planning and coordination, revisions in local work agreements and standard practices could improve labor productivity. Rather than exercising its full flexibility under the agreements, management frequently accepts local labor methods and practices, assuming they are required, and seeks only those solutions to problems and operating effectiveness which traditionally fall within this framework. Management personnel, dealing with a variety of local labor agreements dating prior to mergers, often do not understand what they can or cannot do under the agreements. Often they view agreements as constraining their actions when, in fact, the agreements do not constrain them to that extent. Also, traditional operating practices often inhibit management flexibility. These practices generally have been introduced through the years at the local level in the form of unofficial "vest pocket agreements" to resolve local labor disputes. When implemented, they were designed to provide an incentive (e.g. an "early quit") to operate more effectively; now, these local practices have ceased to be incentives and have become standard expectations for normal performance.

#### **Recommendations for Improvement**

Improving terminal operating efficiency should be a priority goal of ConRail management. The following

actions are recommended to achieve this goal in conjunction with the recommended system operating plan.

*Improve Terminal Planning and Control.*—As soon as possible, ConRail should begin, on a terminal-by-terminal basis, to develop and implement operating plans and controls. Through field observation and analysis of historic data, ConRail should determine for each terminal the:

- Terminal work requirements, including industrial switching, classification switching and train make-up, transfer and interchange movements, as reflected in the system operating plan.
- Average time required to perform work tasks; for example, the transit time between yards within a terminal, the switching time to serve an industrial park, the time required to make up a train, etc. The individual time requirements should be volume related, assume no change in pace or productivity and allow for normal observed delays.
- Operating constraints, including train schedules per the operating plan, shipper service requirements, local work rules and understandings, municipal noise and speed restrictions, etc.

With these data, work programs should be developed by simulating principal terminal work elements. Each work program should include the total of those work elements that reasonably can be performed by a yard crew within a normal work shift. When all the terminal's work requirements have been included in a work program, the total number of work programs should define a terminal's normal requirement for crews. Similar programs should be developed for other terminal resources such as car inspectors, hostlers, etc. Much of the basic data gathering and preliminary analysis can be carried out in parallel with ConRail's development of its system implementation plan. Revisions and adjustments can be made as necessary.

Through a terminal planning process such as this, it is generally possible to improve terminal efficiency by 10–20 percent. It also provides a normalized method of operations, which leads to more reliable customer service, less crisis-oriented management and a base from which to measure performance, making it easier to control operations on a meaningful and realistic basis.

*Develop Terminal Management Information and Control Systems.*—In addition to and as an outgrowth of the terminal planning system described above, effective terminal management requires additional information to measure performance and evaluate changes in operations. In particular, the following systems are desirable.

- **Volume Variable Budgets.** Effective terminal management requires a realistic operating budget, allowing comparison of actual to planned expenses

as reflected in the terminal programs. The budgeting process should include expense projections that reflect not only forecasted workloads, but also the anticipated impact on costs if actual volumes deviate substantially from forecast. This can be projected accurately by developing programs for alternative volumes and measuring sensitivity. In addition, the entire budgeting process should be based on the principal that terminal managers are ultimately responsible for developing their own work programs and setting their own performance objectives once the process has been established and reasonable standards accepted by both local and system management.

- **Performance Reports.** Control of operating performance requires the comparison of actual performance with planned performance. Actual performance can be compared against the terminal work programs to measure crew performance. Car transit time standards also should be developed from the programming process so that industry service and car detention performance can be measured against a plan.
- **Workload Projection Reports.** With accurate specific projections of short-term future workloads (e.g., cars enroute to the terminal to classify, to be interchanged, to be delivered to industrial customers, etc.), management can adjust work programs and resource requirements to handle the anticipated workload effectively on a daily basis.

*Improve Physical Facilities.*—Terminal rehabilitation is essential if terminal management is to have the time and energy to analyze present operations and implement new strategies. Under present conditions, terminal management devotes much of its attention to operating crises. The gradual consolidation of terminal facilities in urban areas also should simplify operations and increase management's control.

*Initiate a Supervisory and Management Development Program.*—A primary building block upon which all projected operating improvements will be made is a dedicated and well-trained team of management and supervisory personnel. Formal training and management development programs should aid ConRail in developing the high-quality personnel needed to improve terminal efficiency and performance levels. These programs should cover company goals, "hands on" use of planning and analysis techniques and computer support capabilities available to terminal personnel. First line supervisors (yardmasters, foremen, etc.), trainmasters and terminal superintendents should receive this training. In addition to formal training, supervisors and managers should be principal participants in the development of yard work programs and plans so they understand and have confidence in the process and are satisfied with the programs for work in their

terminals; these programs not only constitute the plan for that operation but also the basis upon which performance should be measured.

*Improve Labor Productivity.*—An ongoing labor management program to modernize and streamline local work agreements would contribute to improved productivity. Changes in local agreements, however, must be addressed in context with employee compensation practices so that adjustments can be made which would benefit both labor and management.

An important goal at this time is to reduce the number and complexity of these agreements so that local management can devote more time to managing and less to agreement interpretation.

**Expected Improvement in Terminal Operations**

Improvements in terminal operating effectiveness are expected from rehabilitation, blocking improvements, improved terminal management, merger consolidation and yard expansion and improvement projects. The following summarizes the benefits in reduced terminal operating expense projected in preparing the Final System Plan *pro forma* financial projections for ConRail.

Improvement area	Percent improvement					
	1976	1977	1978	1979	1980	1985
Rehabilitation.....	(3)	0	4	5	5	5
Capital improvements.....	0	0	1	1	1	1
Improved blocking and other efficiencies.....	(4)	(2)	1	2	4	7
Total.....	(7)	(2)	6	8	10	13

The negative improvement in ConRail's 1976 projections due to rehabilitation reflects the fact that ConRail's rehabilitation programs do not include the completion of sufficient yard rehabilitation projects to reverse the impact of a continually deteriorating plant until 1977. During the 1977-79 period, the most significant yard rehabilitation projects are scheduled for completion. ConRail's recommended road capital improvement program is discussed below.

The relative inefficiencies in blocking and terminal operations projected for ConRail during 1976-77 are caused by projected ConRail "start-up" costs as railroads are merged, management systems are developed and installed, etc., which more than offset early blocking improvements. Benefits to be realized from improved terminal management will begin to materialize in 1978, and, when combined with blocking improvements, are projected to result in a 7 percent improvement by 1985. Additional improvements potentially are attainable, but have not been projected in the ConRail *pro forma* statements because ConRail operating management may not have the time to realize fully the potential improvement in yard operations since they will be involved simultane-

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80

ously with rehabilitating ConRail's facilities, developing and implementing additional new management systems and carrying out ConRail's road capital improvement program.

The financial statements do not reflect any savings resulting from the improvements that could be realized through revisions in national or local labor agreements.

### Road Capital Program

In recent years, capital investment for plant additions and improvements on the railroads in reorganization has been limited mainly to safety items and those projects started in earlier years, requiring several years to complete. Because capital investments have been deferred, ConRail requires an investment of more than \$1,100 million between 1976 and 1985 (as summarized in Table 9), to realize safety, service and efficiency improvements proposed in the operating plan.

### Development of the Program

The process of developing ConRail's road capital program began with the applications made by the carriers in reorganization for the use of funds made available under section 215 of the Act. These applications detailed specific recommended projects without regard to the availability of funds. In addition, the Association developed a list of desired capital projects.

A project evaluation and selection process was made for the 1976-80 planning period by grouping the projects into the three general categories of:

- Projects required for physical consolidation of ConRail's operation and implementation of the operating and rehabilitation plan,
- Safety and environmental projects and
- Projects selected because of financial return.

Upon selection, priorities and timing of the projects were determined by:

- Establishing the operational, safety, environmental and financial merit of each project,
- Developing manpower, material and operational constraints by type of project (i.e. yard improvements, signaling, workshop improvements, etc.), recognizing the resource requirements and operational constraints of the Association's projected ConRail rehabilitation program and
- Scheduling for each of the 5 years a balanced mix of projects having the best operational, safety and financial impact on ConRail.

### Recommended Capital Projects

Specific road capital projects planned to support and implement the operations plan during 1970-80 fall into the following eight areas and are illustrated in Table 10.

TABLE 9.—ConRail annual road capital program by project (1976-80)

	1976	1977	1978	1979	1980	5-year total	Estimated 1981-85	10-year total
[Dollars in millions]								
<b>Yard and terminal:</b>								
Number of projects .....	13	13	7	6	4	43		
Investment .....	\$12	\$22	\$7	\$6	\$9	\$56		
<b>Communications and signaling:</b>								
Number of projects .....	13	30	15	3	3	62		
Investment .....	\$4	\$3	\$5	\$3	\$3	\$18		
<b>Safety and environmental:</b>								
Number of projects .....	16	7	4		1	28		
Investment .....	\$7	\$1				\$8		
<b>Service and operating:</b>								
Number of projects .....	8	11	8	5	4	36		
Investment .....	\$4	\$6	\$6	\$7	\$3	\$26		
<b>Workshops and machinery:</b>								
Number of projects .....	35	26	26	19	16	122		
Investment .....	\$10	\$13	\$13	\$11	\$10	\$57		
<b>Intermodal facilities:</b>								
Number of projects .....	6	4	6	3	5	24		
Investment .....	\$2	\$6	\$6	\$3	\$9	\$26		
<b>Bridges, buildings and other:</b>								
Number of projects .....	14	4	3	3	1	25		
Investment .....	\$3	\$2	\$6	\$11	\$7	\$29		
<b>1981-85 total .....</b>							138	
<b>Track rail weight improvements .....</b>	8	7	10	12	16	53	81	
<b>Road additions associated with removing freight service from electrified Northeast Corridor .....</b>	6	22	19	22	32	101		
<b>Total:</b>								
Number of projects .....	105	95	67	39	34	340		
Investment (1973 dollars) .....	\$56	\$82	\$72	\$75	\$89	\$374	\$220	\$594
Investment (inflated) .....	\$75	\$120	\$115	\$129	\$164	\$602	\$497	\$1,100

SOURCE: USRA staff analysis.

TABLE 10.—Percentage of ConRail road capital investments, first 5 years

	1976	1977	1978	1979	1980
Yards and terminals.....	21.4	26.8	9.7	8.0	10.1
Communication and signals.....	7.1	3.7	7.0	4.0	3.4
Safety and environment.....	12.5	1.2			
Service and operations.....	7.1	7.3	8.3	9.3	3.4
Workshops and machinery.....	17.9	15.9	18.1	14.7	11.2
Intermodal facilities.....	3.6	7.3	8.3	4.0	10.1
Bridges and buildings.....	5.4	2.4	8.3	14.7	7.9
Rail weight improvements.....	14.3	8.6	13.9	16.0	18.0
Road additions—Northeast Corridor.....	10.7	26.8	26.4	29.3	35.9
Total.....	100.0	100.0	100.0	100.0	100.0

SOURCE: USRA Staff Analysis.

- Forty-three yard and terminal projects were selected. These expenditures are necessary to consolidate the yard and terminal operations of the predecessor railroads to operate according to the operating plan and, when completed, to operate more efficiently.
- Sixty-two communications and signaling projects are planned which should facilitate efficiency improvements in the handling of projected traffic levels for Conrail.
- Twenty-eight safety and environmental projects are planned. These projects are required to comply with federal and local regulations. The environmental project requirements are discussed in a subsequent chapter of this Supplemental Report.
- Thirty-six projects are included to construct or upgrade the connections and sidings necessary to implement the operating plan and to consolidate facilities.
- One hundred twenty-two shop and machinery projects are planned to facilitate the track and equipment rehabilitation program and to improve shop effectiveness, thereby increasing the availability of locomotives and freight cars.
- Twenty-four intermodal facility projects are planned to support the improved level of TOFC service anticipated in the FSP.
- Twenty-five projects for bridges, buildings and other categories are necessary to rationalize the reorganized rail system and to improve operating efficiency.
- The track rehabilitation program developed by the Association calls for replacing some of the rail in the high density lines with heavier rail weight. The portion of the rehabilitation costs attributed to the improvement of rail weight is estimated at \$187 million.
- In order to remove freight service from the Northeast Corridor, an estimated \$101 million investment in new track connections, clearance improvements, signaling, etc., is required.

The specific road capital projects summarized above are proposed for ConRail for the 1976–80 period. Like any investment plan, continuing review of this project list by ConRail management is required and the ultimate priorities and magnitude of projects should be adjusted for future developments.

Because of uncertainty regarding future traffic patterns, operating strategy, technology, etc., the Association did not delineate specific recommended projects for the 1981–85 period. Instead, for the purpose of financial projection, a total road capital investment for required capital projects was made for the second 5-year period. In addition, ConRail's management no doubt will consider discretionary investment projects during this period that will lead to further operating efficiencies and an acceptable return on investment. The Association assumes that these projects would be funded from future operating profits.

### Labor Productivity

Improved facilities and operating procedures as recommended in the Final System Plan will have a significant impact upon the productivity of transportation employees. Further improvements in productivity, however, can accrue through changes in current labor practices.

Significant changes in transportation labor agreements to permit more flexible operation have not occurred rapidly. As a result, to improve short-term economic returns, carriers often have engaged in operating policies that are not necessarily optimal in the long run. For example, railroads have operated longer trains, which minimizes crew cost per train and has been made possible by the multiple unit capability of diesel locomotives. The operation of long trains, however, has some serious drawbacks. The physical operation of excessively long trains is cumbersome and the time lag inherent in the accumulation of the large number of freight cars often can result in less than ideal service to shippers. Operation of fewer long trains in lieu of a greater number of average length trains also contributes to higher switching and yard expense in most instances.

### Impact Upon ConRail Operations and Market Share

The potential savings through productivity improvement could alter dramatically ConRail's competitive position vis-a-vis other transportation modes.

- The short-haul market (distances up to 400 miles) represents a huge market (two-thirds of all containerizable tonnage shipped) in which trucks have a cost and service edge over rail. A major reduction in ConRail's cost to provide competitive service would allow significant penetration into this market, increasing both revenue and car loadings.
- Current mediocre service levels have resulted, in

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part, because it is not presently economical to operate shorter-than-average direct trains between traffic origins and destinations. Inadequate service levels have been a significant factor in the shift of freight from rail to truck. Reduced rail unit costs of operation could lead to a further major restructuring in rail operations, yielding significantly higher service levels and recapturing some rail traffic now moving by truck.

- Reductions in rail costs could eliminate the cost-competitive advantage of barges over rail on some routes.

### Recommendations

The Association recommends strongly that ConRail management and labor work together through negotiation prior to conveyance to change and simplify existing agreements and operating practices, enabling ConRail to operate more efficiently. The Association also stresses the urgency of implementing meaningful changes in a timely fashion.

In the last few years, railway labor and management have been working together on a national basis to improve railroad productivity. In a series of joint projects, the objective has been to evaluate potential changes through experimentation and reasoning rather than rhetoric. The Association agrees with this approach but believes that its momentum must be accelerated. To this end, the analytical tools developed by the Association and used in the development of the Final System Plan could facilitate and expedite on a broader scale such joint labor management efforts. The Association stands ready to assist such efforts in any way possible to ensure that no opportunity is missed to identify and capitalize upon mutually beneficial means of improving railroad productivity.

### Rail Safety

The nature of transportation safety makes it of vital interest to every segment of society; the immediate and long term implications of the Final System Plan can affect transportation safety significantly in the Region. After publication of the Preliminary System Plan, the National Transportation Safety Board (NTSB) suggested that the Association "define and delineate the safety consequences of its Final System Plan." NTSB also recommended that the Association's analysis "should be a separate section of the Final System Plan when it is submitted to Congress."<sup>6</sup>

As a result, the Battelle Memorial Institute, under contract to the Association, evaluated rail safety for the FSP. In addition, the Association has carried out its own evaluation of ConRail employee, passenger, rail

shipment, and intermodal safety considerations such as rail/highway crossings at grade.<sup>7</sup>

### Modal Comparisons

Statistical data concerning the safety of transportation modes have been recorded for many years, but detailed statistics regarding the substitution of one mode for another, or rail/highway accidents at grade crossings, have just begun to be gathered and studied in detail. An area of concern in evaluating the Final System Plan is the possible implication on safety benefits to be derived from a stronger rail system in the east, which may cause the modal transfer of traffic from highway to the revitalized rail system.

### Passenger Safety

Analysis of the several modes of passenger transport indicates a relatively consistent safety record for the 20-year period through 1973; Table 11 illustrates that in terms of passengers transported, railroads have been approximately 3 times as safe as domestic airline travel and more than 20 times as safe as travel by automobile.

The combined passenger fatality rate and the combined injury rate for the railroads in reorganization have remained consistently good. The carriers have instituted slow orders where track conditions have deteriorated resulting in a consistently safe (in terms of serious accidents), albeit slow operation on some lines.<sup>8</sup> Implementation of the Final System Plan will provide funds for the normalization of these lines, allowing faster passenger train times while maintaining the safe operation.

The Association believes that separating Northeast Corridor high-speed passenger from freight operations as much as possible will contribute to safety, especially as passenger train speeds are increased in future years. This is a significant part of the rationale in recommending a modified route for Corridor freight operations in the Final System Plan.

### Freight Safety

Rail freight safety has been a topic of concern for several years resulting mainly from a series of derailments leading to spectacular fires. The relative safety record of rail and highway freight carriage between 1961 and 1968 listed in Table 12, however, shows the rail fatality rate at 2.5 per billion ton miles compared with the highway regulated carrier rate of 10.9 per billion ton miles. As shown in Table 13, truck freight transportation injury rates are also higher than those of rail. With respect to the Final System Plan, rail and truck are the prime substitutable modes in the ConRail network.

<sup>6</sup> National Transportation Safety Board, Washington, D.C., Safety Recommendations I-75-1, Apr. 13, 1975.

<sup>7</sup> Final Report on a Limited Analysis of the Safety Implications of the Preliminary System Plan for Railroad Consolidation, June 6, 1975.

<sup>8</sup> Battelle Safety Study, Ibid.

TABLE 11.—Twenty-year trend in passenger fatality rates for alternative modes of U.S. intercity passenger transportation (passenger fatalities per 100,000,000 passenger miles)

Calendar year	Railroad passenger		Intercity buses		Domestic passenger planes		Automobiles		General aviation <sup>1</sup>	
	Annual rate	3-year average rate	Annual rate	3-year average rate	Annual rate	3-year average rate	Annual rate	3-year average rate	Annual rate	3-year average rate
1953.....	0.16				0.56		2.9			
1954.....	0.08	0.12			0.09	0.33	2.7	2.8		
1955.....	0.07				0.76		2.7			32 (1953-57)
1956.....	0.20		0.05		0.62		2.7			
1957.....	0.07	0.11	0.10	0.09 (1956-58)	0.12	0.50	2.6	2.7		
1958.....	0.27		0.12		0.43		2.3		23	
1959.....	0.05		0.13		0.69		2.3		26	
1960.....	0.16	0.16	0.05	0.10	0.93	0.69	2.2	2.3	24	24
1961.....	0.10		0.09		0.38		2.1		22	
1962.....	0.14		0.10		0.34		2.2		23	
1963.....	0.07	0.10	0.21	0.14	0.12	0.28	2.3	2.2	23	23
1964.....	0.05		0.10		0.14		2.4		24	
1965.....	0.07		0.23		0.38		2.4		21	
1966.....	0.16	0.09	0.06	0.13	0.09	0.20	2.5	2.4	17	21
1967.....	0.09		0.11		0.29		2.4		18	
1968.....	0.10		0.16		0.28		2.4		19	
1969.....	0.07	0.09	0.05	0.11	0.13	0.23	2.3	2.4	16	18
1970.....	0.09		0.02		0.00		2.1		20	
1971.....	0.19		0.08		0.15		1.9		21	
1972.....	2 0.56	2 0.27	0.18	0.10	0.13	0.10	1.9	2.0	20	20
1973.....	0.07		0.17		0.10		1.7		18	

<sup>1</sup> Total fatality rates shown for general aviation; however, they are very similar to passenger fatality rates.

<sup>2</sup> Uncharacteristically high rate for passenger railroad in 1972 is due to a single collision between two Illinois Central Gulf Railroad commuter trains in Chicago, Ill., which killed 45 passengers. Subtracting the fatalities from this one accident from the total 1970 through 1972 passenger fatalities will result in an average rate of 0.11 for this 3-year period.

SOURCES: *Accident Facts*, National Safety Council, 1973 edition.

*Bus Facts*, National Association of Motor Bus Owners, 1973 edition.

*A Preliminary Statistical Analysis of Aircraft Accident Data—U.S. Civil Aviation 1975*, National Transportation Safety Board, Report No. NTSB-APA-74-1.

Department of Transportation and Related Agencies Appropriations—1975, Part 4, 93d Congress, 2d Session, hearings before a subcommittee of the Committee on Appropriations, House of Representatives, U.S. Government Printing Office, 32-580 O, 1974.

*Yearbook of Railroad Facts*, 1973 edition, Association of American Railroads, April 1972, L.C. Card No. A66-7305.

*1974 Motor Truck Facts*, Motor Vehicle Manufacturers Association of the U.S., Inc. 1971-1972 Accidents of Large Motor Carriers of Property, U.S. DOT/FHWA, Bureau of Motor Carrier Safety, May 1974.

TABLE 12.—Comparison of nonpassenger railroad and highway fatalities

	1963	1964	1965	1966	1967	1968	6-Year totals and rates
<b>Railroad:</b>							
Ton-miles (in billions).....	629.3	666.2	708.7	750.8	731.2	756.8	4,243.0
Total killed, all accidents.....	2,141	2,423	2,399	2,694	2,433	2,359	14,489.0
Less: Killed in accidents involving passenger trains only.....	634	669	670	710	604	506	3,793.0
Net: Killed in freight or maintenance service.....	1,507	1,754	1,729	1,974	1,879	1,853	10,696.0
Deaths per billion ton-miles.....	2.4	2.6	2.4	2.6	2.6	2.4	2.5
<b>Highway (Federally regulated carriers only):</b>							
Ton-miles (in billions).....	120.6	126.4	140.3	143.1	139.9	155.4	825.7
Deaths, all persons.....	1,451	1,492	1,603	1,472	1,489	1,482	8,989
Deaths per billion ton-miles.....	12.0	11.8	11.4	10.3	10.6	9.5	10.9

SOURCES: See Table 11.

In spite of the well publicized track problems of Penn Central, its train accident record is better than the average for major (Class I) line haul railroads. The explanation relates to the increased number of slow orders which compensate for the increased possibility of derailments due to poor track. Implementation of

the Final System Plan should allow significant improvements to the track structure and maintain or improve this safety record, while moving freight at higher speeds and providing greater reliability for ConRail freight customers.<sup>9</sup>

<sup>9</sup> Battelle Safety Study, Ibid.

TABLE 13.—Calculation of freight transportation accident injury rates

Mode and statistics	1967	1968	1969	1970	1971	1972	1973
<b>Railroad:</b>							
Ton-miles (billions).....	731.2	756.8	767.8	764.8	739.4	776.7	851.6
Injuries (less passengers).....			22,494	20,838	18,436	17,607	17,540
Injuries per billion-ton miles.....	Information not available		29.5	27.3	28.0	22.7	20.6
Property damage (millions).....							146.0
<b>Federal Regulation Carriers (Trucks):</b>							
Ton-miles (billions).....	388.5	396.3	404.0	412.0	430.0	445.0	
Injuries.....	14,882	16,124	16,232	15,793	12,825	14,528	
Injuries per billion-ton miles.....	38.0	40.7	40.3	38.3	29.8	32.7	
Property damage (millions).....	55.99	66.87	72.191	76.242	72.606	84.182	

SOURCES: Department of Transportation and Related Agencies Appropriations—1975, Part 4, 93rd Congress, 2nd Session, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, U.S. Government Printing Office, 32-880 O, 1974. *Yearbook of Railroad Facts*, 1973 Edition, Association of American Railroads, April 1972, L.C. Card No. A66-7305. *1974 Motor Truck Facts*, Motor Vehicle Manufacturers Association of the U.S., Inc. 1971-72 Accidents of Large Motor Carriers of Property, U.S. DOT/FHWA, Bureau of Motor Carrier Safety, May 1974.

### Intermodal Shifts

In its safety recommendations to the Association, NTSB pointed out that intermodal shifts as a result of the Final System Plan implementation could have significant safety implications. For example, the shift of freight from truck to rail as a result of a rehabilitated ConRail System could prevent a significant number of deaths and injuries per year.<sup>10</sup> NTSB also noted that "if the railroad could substantially improve the reliability of their service, they could obtain an additional 40 percent of the present intercity highway truck traffic. The study suggests institutional changes that would make this improved service possible. If this prediction is correct, an internal institutional change—new employee work rules in the railroad industry—could yield a substantial net safety benefit for the society as a whole, 1,239 lives saved and 16,331 injuries avoided per year."<sup>11</sup>

The NTSB release also stressed that if branch lines available for subsidy were not subsidized, rail traffic would be diverted to truck. It pointed out that if a complete truck haul was substituted for a complete rail haul, less overall transportation safety could result. The significance of this change is difficult to quantify because, for example, a significant portion of rail traffic now involves transloading from truck to rail or rail to truck at one or both ends of the rail journey. If the final transloading to truck added 15 or 20 miles to the present truck haul, the implications for safety would be small. The Battelle Report suggests that "if freight is diverted only from the abandoned branch lines' origins to the corresponding railheads, the increase in the annual casualty rate totals approximately one fatality and three injuries. If instead the diverted freight travels from origin to final destination entirely by truck then the annual increase in casualties is 45 to 60 fatalities and 60 to 80 injuries. In either case no change in the

annual property damage total should be discernable."<sup>12</sup> Since 75 percent of the lines available for subsidy are less than 25 miles long, substituted truck service from the origin of the branch line would be less than 25 miles on three-fourths of the lines.<sup>13</sup>

An environmental assessment of the FSP indicates that "the rail lines of concern (light density rail lines) already are abandoned or little used, with freight presently being handled by other modes."<sup>14</sup> This indicates that the intermodal shift would be small for many unsubsidized light density lines, thereby having little impact on safety.

### Grade Crossing Safety

As mentioned above, while being quite spectacular, freight train accidents are not a significant part of the total rail related accident problem. For example, Table 14 reveals that in the period 1969-71, approximately 9 percent of rail related fatalities and 4 percent of injuries resulted from train accidents.<sup>15</sup>

Accidents between railroads and motor vehicles at street or highway grade crossings cause the largest number of rail related fatalities and injuries. As recorded in Table 14, from 1969 to 1971 grade crossing accidents resulted in 59 percent of the fatalities in rail related accidents.<sup>16</sup> and 2.5 percent of all highway related fatalities.<sup>17</sup> In most crossing accidents very little damage

<sup>10</sup> Battelle Safety Study, Ibid.

<sup>11</sup> Public Interest Economic Center (PIE-C). *The Impact on Communities Abandonment of Rail Service*, Final Report, June 1975, Prepared for the USRA.

<sup>12</sup> Battelle Columbus Laboratories, Final Report on the Environmental Assessments of the System Plan, for the United States Railway Association, April 30, 1975.

<sup>13</sup> Battelle Safety Study, Ibid. By definition the FRA defines the accident class "Train" as any accident arising in connection with the movement of trains, locomotives, or cars that results in damage to railroad equipment, track, or roadbed amounting to more than \$750, until Jan. 1, 1975, when it becomes \$1,750. It is noteworthy in this time of inflation that this amount has not been revised upward since 1957. This should be noted in making year-to-year accident comparisons.

<sup>14</sup> *Summary and Analysis of Accidents on Railroads in the United States, Calendar Year 1973*, Federal Railroad Administration, Office of Safety, Accident Bulletin No. 142.

<sup>15</sup> *Factors Influencing Safety at Highway Grade Crossing*, by Alan M. Voorhees and Associates, Inc., January 1967.

<sup>10</sup> NTSB, Ibid.

<sup>11</sup> NTSB, Ibid. *Competition Between Rail and Truck in Inter-City Freight Transportation*, Charles River Associates, Incorporated, Cambridge, Massachusetts, December 1969, Contract No. DOT-OS-A9-060, Office of Assistant Secretary for Policy and International Affairs.

TABLE 14.—*Rail related accidents*

Class of accident	Fatalities					
	Number killed			Percent of total		
	1969	1970	1971	1969	1970	1971
Total fatalities.....	2,299	2,225	2,010	100.0	100.0	100.0
Train.....	203	210	171	8.8	9.4	8.5
Train service.....	2,011	1,936	1,792	87.5	87.0	89.2
Grade crossing.....	1,353	1,281	1,233	58.9	57.8	61.3
Other classes.....	658	655	559	28.6	29.2	27.9
Nontrain.....	85	79	47	3.7	3.6	2.3

Class of accident	Injuries					
	Number injured			Percent of total		
	1969	1970	1971	1969	1970	1971
Total injuries.....	23,356	21,327	18,972	100.0	100.0	100.0
Train.....	1,173	627	694	5.0	2.9	3.7
Train service.....	14,986	13,878	12,171	64.2	65.1	64.2
Grade crossing.....	3,506	3,170	3,154	15.0	14.9	16.6
Other classes.....	11,480	10,708	9,017	49.2	50.2	47.6
Nontrain.....	7,197	6,822	6,107	30.8	32.0	32.1

SOURCE: *Risk Analysis of Joint Passenger-Freight Operations*, Battelle Memorial Institute, September 19, 1974.

is done to the train. The Battelle study indicates that 25 percent of grade crossing accidents involving trucks result in more than \$750 damage to the train, while fewer than 5 percent of accidents involving automobiles are so classified.

It is of interest that in a 1974 study of 6,875 accidents supplied by three railroads, 22 percent of the vehicles struck the side of the train.<sup>18</sup> Since ConRail will operate in one of the most congested parts of the United States, grade crossing safety is a very significant factor in its rail operations.

### Speed Restrictions

A widely used method to increase safety is the use of local speed restrictions on trains operating across highways. A U.S. Department of Transportation (DOT) report to Congress on railroad highway safety, however, indicates that "railroad operations . . . are hampered by lower speed limits and other operating restrictions often imposed on trains by local governmental regulations because of the existence of the grade crossings."<sup>19</sup> The study goes on to report that the estimated operating and delay costs nationwide to railroad companies for the speed restrictions are \$75-100 million per year. Because of the number of accidents in which vehicles run into the sides of trains, a train operating at slow speed probably is an increased hazard for collisions of this type.

<sup>18</sup> Paper by Janet Coleman and Gerald Stewart, Office of Research, Federal Highway Administration, proceedings, 1974 National Conference on Railroad-Highway Crossing Safety, August 1974, US Air Force Academy.

<sup>19</sup> Report to Congress, Railroad-Highway Safety, Part II: Recommendations for Resolving the Problem, U.S. Department of Transportation, August 1972.

In the Coleman and Stewart study, a total of 3,598 accidents of all kinds occurred at crossings where crossbucks or flashing lights were used as protection.<sup>20</sup> Of these accidents, 43 percent occurred where trains were running between zero and 12 miles per hour, 17 percent between 13 and 24 miles per hour, 22 percent between 25 and 36 miles per hour, 11 percent between 37 and 48 miles per hour and 6 percent at speeds greater than 48 miles per hour. This sample of crossing accidents contains no evidence that decreasing the speed of trains decreases the number of accidents. However, the study indicates that five times as many fatalities occurred in the accidents involving trains running faster than 48 miles per hour as compared with accidents in the lowest speed category.

The most effective way of eliminating vehicle-train collisions is to eliminate the crossing at grade. The DOT report explains that while the obvious way of eliminating the conflict, running the road over or under the railroad tracks, is the most effective, closing the crossing to vehicles is an alternative method.<sup>21</sup> In many urban areas, grade crossings occur at each block. Some communities have had very good results closing all but one of several closely spaced crossings and installing protection devices at the remaining crossing. The DOT crossing study also concludes that the most effective way to invest a fixed amount in reducing crossing accidents is to close crossings and protect the remaining crossing with lights and gates rather than to provide for grade separations. The study also reveals that gates are about four times as effective in reducing the number of accidents and fatalities as are flashers alone.<sup>22</sup>

In heavy volume areas, "active" warning systems such as gates, lights and bells appear to be two to three times as effective as passive warning devices such as crossbucks or stop signs. In light volume areas they provide about equal protection, as revealed in Table 15.<sup>22</sup>

An additional way the Final System Plan will assist in reducing fatalities is by consolidating more freight traffic on prime rail routes. This allows the placement of crossing protection at points where more traffic is concentrated, decreasing the exposure for accidents on other routes. In addition, any abandonment of light density rail lines will eliminate train/motor vehicle accidents on those lines.

### Conclusions

The Association recommends that ConRail management consider employee, passenger, freight commodity and grade crossing safety as an integral part of all preliminary planning so that the long term effect upon safety of all management decisions can be anticipated and considered carefully.

<sup>20</sup> Coleman and Stewart, *Ibid.*

<sup>21</sup> DOT Report to Congress, *Ibid.*

<sup>22</sup> DOT Report to Congress, *Ibid.*

TABLE 15.—Comparison of active warning devices and passive warning devices <sup>1</sup>

Railroad volume <sup>2</sup>	Highway volume <sup>3</sup>					
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Class 6 .....	0.159 2.36 0.067	0.435 2.90 0.150	0.910 3.24 0.281	1.777 2.98 0.598	2.593 2.76 0.940	3.750 2.44 1.538
Class 5 .....	0.056 1.82 0.030	0.170 2.04 0.063	0.353 2.15 0.164	0.655 2.11 0.311	1.233 3.00 0.414	1.455 2.31 0.629
Class 4 .....	0.035 1.49 0.023	0.103 1.76 0.059	0.209 1.76 0.119	0.380 1.72 0.220	0.586 1.93 0.304	0.818 1.74 0.470
Class 3 .....	0.021 1.17 0.018	0.062 1.38 0.045	0.124 1.30 0.096	0.224 1.34 0.167	0.328 1.41 0.232	0.469 1.38 0.340
Class 2 .....	0.016 1.07 0.015	0.046 1.16 0.039	0.092 1.08 0.085	0.164 1.15 0.142	0.241 1.27 0.189	0.353 1.32 0.267
Class 1 .....	0.012 0.96 0.012	0.035 1.06 0.033	0.071 0.98 0.072	0.126 1.05 0.120	0.180 1.13 0.159	0.261 1.23 0.213

<sup>1</sup> Sequence of numbers in each volume class indicates:

- Accidents per crossing (crossings with passive devices).
- Ratio of accidents per crossing with passive devices to accidents per crossing with active devices.
- Accidents per crossing (crossings with active devices).

<sup>2</sup> Range of Daily Volume in each Class:

Class	Trains	Highway vehicles
1	0 to 2 .....	0 to 500.
2	3 to 5 .....	501 to 1,000.
3	6 to 10 .....	1,001 to 5,000.
4	11 to 20 .....	5,001 to 10,000.
5	21 to 40 .....	10,001 to 20,000.
6	Over 40 .....	Over 20,000.

SOURCE: *Railroad Highway Safety*, U.S. Department of Transportation. Report to Congress August, 1972.

## INTERMODAL PLANNING

The development of an intermodal operating plan for ConRail had the three principal objectives of:

- Forming strategies to improve profitability of existing traffic,
- Penetrating new markets to generate additional revenues and
- Identifying assets to be acquired by ConRail.

USRA's intermodal marketing and pricing strategy for ConRail was discussed briefly in Chapter 7 of the Final System Plan. This section of the Supplemental Report focuses on the approaches used in evaluating intermodal operations, the basis of intermodal revenue and expense projections, opportunities to improve profitability and competitive posture and the management structure, systems and controls essential to attain the goals and objectives of the Association's plan.

These points are discussed under the headings of:

- Present Intermodal Services,
- Issues and Problems,
- Opportunities for Improvement,
- Present and Potential Markets,
- Development of an Intermodal Operating Plan,
- Other Intermodal Services and
- Conclusions and Recommendations.

### Present Intermodal Services

Piggyback traffic (TOFC and COFC) dominates the intermodal services of the railroads in reorganization. Other significant intermodal activities are rail-truck

bulk commodity distribution services and automobile loading/distribution services. The Penn Central Intermodal Department also has responsibility for foreign freight sales, although this discussion excludes bulk commodity export-import traffic.

The railroads proposed for inclusion in the ConRail system that provide piggyback service (Penn Central, Central of New Jersey and Lehigh Valley) account for about 46 percent of the total containerized freight and mail traffic handled by railroads in the Region.

The 673,800 trailers and containers handled by these roads in 1973 generated approximately 10 percent (\$183 million) of total freight revenues of the potential ConRail roads. Penn Central dominates this group, accounting for 85 percent of their combined intermodal traffic. Intermodal service in the Region is provided from 68 terminals operated by the railroads in reorganization (including the Reading and Erie Lackawanna), with 80 percent of the TOFC/COFC traffic handled in dedicated piggyback trains (trains which carry only trailers and containers). The railroads' TOFC/COFC volume increased at an average annual rate of 6 percent per year from 1964 to 1973, declined slightly in 1974 under the impact of the current recession and plummeted in early 1975.

The railroads' TOFC/COFC traffic consists primarily of wholesale service. This service is primarily terminal-to-terminal in nature, with the customer, freight forwarder, local trucking company (including rail subsidiaries) or agent performing the highway collection and delivery (retail service). Table 16 describes

TABLE 16.—Description of key commercial intermodal plans

Plan	Flat car provided by	Trailer provided by	Railcar loading and unloading provided by	Pick up/delivery provided by	Prices
I.—Coordinated Rail/Truck Services (Motor Carrier Authority).	Railroad	Motor carrier (RR will also provide at a charge).	Railroad	Motor carrier	Negotiated contract.
II.—Railroad Door-to-Door Services	Railroad	Railroad	Railroad	Railroad	Railroad and motor carrier agency tariffs.
II½.—Railroad Terminal-to-Terminal Service	Railroad	Railroad	Railroad	Shipper/forwarder	Railroad tariffs.
III.—Railroad Terminal-to-Terminal Service	Railroad	Shipper/forwarder	Railroad	Shipper/forwarder	Railroad tariffs.
IV.—Railroad Terminal-to-Terminal Service	Railroad (at tariff charge to shipper).	Railroad (at tariff charge to shipper).	Railroad (at tariff charge to shipper).	Shipper/forwarder	Railroad tariffs.
V.—Coordinated Rail/Truck Services	Railroad	Railroad or motor carrier.	Railroad	Railroad and/or motor carrier.	Railroad and motor carrier tariffs.
MULTIPLE TRAILER.—Railroad Terminal-to-Terminal Volume Services.	Railroad	Railroad	Railroad	Shipper/forwarder	Railroad tariffs (Official territory only).
LAND BRIDGE.—Railroad Terminal-to-Terminal Services of Steamship Line Containers.	Railroad	Railroad	Railroad	Steamship line	Negotiated division steamship line tariff publication.
U.S. MAIL.—Railroad Terminal-to-Terminal Services.	Railroad	Railroad	Railroad	U.S. Post Office	Negotiated contract.

SOURCE: USRA staff analysis.

TAB...  
 I.....  
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 III.....  
 V.....  
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TABLE 17.—Composition of Penn Central intermodal traffic—1974

Plan	Revenue loads	Percent of total loads
I.....	14,003	2.47
II.....	31,751	5.61
II½.....	380,098	67.15
III.....	47,827	8.45
V.....	9,432	1.67
Mail in freight service.....	23,921	4.23
Dedicated mail trains.....	57,164	10.10
Company business and express.....	1,821	2.32
Total.....	566,017	100.00

SOURCE: Data reported by PCTC.

the various TOFC/COFC plans and Table 17 shows the distribution of PC's 1974 loads by plan. Complete door-to-door piggyback service represents only a small segment of the traffic and is limited to trailer load shipments. Plan II highway services are provided by a rail subsidiary (in the case of PC) or contract motor carriers.

### Issues and Problems

During the Association's analysis of TOFC/COFC operations of the railroads in reorganization, several major problem areas were identified that contributed to marginal profitability and depressed market share. These points are discussed below.

### Over Expansion and Duplication of Service

Most city-pair markets in the Region do not generate the piggyback volume to justify service over more than one route; many economically do not justify any piggyback service at all. There are approximately 500 active terminal pairs in the present intermodal network operated by PC, LV and CNJ, with an average daily flow between terminals of approximately 4.8 loaded trailers. If flows averaging less than two loaded trailers per day are excluded,<sup>23</sup> the active number of terminal pairs remaining is reduced to approximately 200. The remaining flows average approximately 11.0 trailers per day and account for 85 percent of the combined 1973 traffic volumes. An implicit assumption that volume leads to profits has caused Eastern railroads to duplicate competitive services and expand routes into uneconomical areas. This problem has been compounded by an attempt to encourage new traffic through volume discount rates in 1972, which had the effect of shifting traffic between railroads, while generating very little real growth.

<sup>23</sup> TOFC/COFC flat cars are designed to carry two 40-foot trailers or containers. If less than two units on the average move between terminals, this requires that trailers be held to accumulate full cars, or that partially-loaded cars be dispatched.

### Pricing and Marketing

In recent years, a proliferation of rates has occurred. Table 18 illustrates the variety of ramp-to-ramp rates in effect in the New York-Chicago market, depending on trailer ownership and the volume tendered. It should be noted that while these rates range from a low of \$215 to a high of \$565, the cost to the railroad of providing line-haul service is approximately the same for all rate levels (with the exception of trailer ownership costs). In addition to these ramp-to-ramp rates, separate rates apply for door-to-door service, for particular commodities and for interline movements.

This proliferation of plans and rates has created a number of conditions that contribute to marginal intermodal profitability.

- Traffic moving on a ramp-to-ramp basis has resulted in an expanded role for third parties, who participate in and control profitable segments of the intermodal market.
- Pricing on a scale or mileage basis, such as that used by the Traffic Executive Association—Eastern

TABLE 18.—Ramp-to-ramp TOFC price level between New York and Chicago

(Expressed in dollars per trailer)

Plan	Railroad trailer	Shipper/motor/water carrier trailer	Explanation
Plan I.....	\$378.0	\$342.0	Single trailer (40,000 lbs. per trailer).
Ship-A-Train.....	368.0	.....	10 trailers (40,000 lbs. per trailer).
	360.0	.....	50 trailers (40,000 lbs. per trailer).
	355.0	.....	60 trailers (40,000 lbs. per trailer).
	349.0	(1)	60 trailers (40,000 lbs. per trailer).
Plan II½:	403.5	.....	2 trailers (45,000 lbs, 60/40 mix).
	378.0	.....	1 trailer (22,500 lbs., 5 or more commodities).
Group 1.....	458.0	.....	2 trailers (80,000 lbs).
	565.0	.....	1 trailer (40,000 lbs).
Group 2.....	.....	.....	403.0 2 trailers (45,000 lbs, 60/40 mix).
	.....	.....	385.0 1 trailer (22,500 lbs., 5 or more commodities).
Group 1.....	.....	.....	422.5 2 trailers (80,000 lbs.).
	.....	.....	531.0 1 trailer (40,000 lbs.).
Group 2.....	.....	.....	292.0 1 to 20 trailers (40,000 lbs. per container).
	.....	.....	276.0 21 to 40 trailers (40,000 lbs. per container).
Land Bridge: (Does not include any empty movement). Division of Trans-continental contract w/steamship line rate.	.....	.....	259.0 41 to 60 trailers (40,000 lbs. per container).
	.....	.....	236.0 61 and over trailers (40,000 lbs. per container).
	.....	.....	215.0 Volume (annual contract) (12,500 containers).

<sup>1</sup> Return rate.

NOTE: All of above are FAK (Freight-All Kinds) rates, no mixture requirement, except where noted—Groups 1 of Plans II 1/2 and III.

Source: PCTC Freight Tariff 26700-F.

Railroads, results in a number of unprofitable traffic lanes (origin-destination pairs) and terminals.

- Different pricing levels for specific segments has resulted in the cross-movement of empty trailers.
- Volume discount rates have increased terminal costs, mishandling of trailers and clerical effort while the new business generated in many cases has not been sufficient to offset the revenue loss compared to conventional TOFC/COFC service.

### Marginal Profitability

Conventional rail costing formulas often significantly

underestimate full economic costs of providing intermodal services, because they generally ignore equipment and facility replacement costs. The Association, therefore, developed a model to estimate intermodal profitability on a variable cost and a full economic cost basis (see box). This model, when applied to a sample of 1974 Penn Central piggyback data, indicated an annualized contribution above variable cost of \$9.1 million per year, but a \$46 million short-fall in covering the full economic costs required to justify intermodal expansion. This represents a significant improvement over 1973, due particularly to a significant increase in average revenue per load from \$285 to \$361.

## USRA INTERMODAL COST FORMULA

To assess the present level of intermodal profitability and to evaluate the impact of alternative operating systems, the Association developed a computerized traffic lane profit and loss model.<sup>24</sup> The cost formula used is a modification of conventional ICC Rail Form A costing techniques. It reflects the unique operating characteristics of intermodal operations (higher speeds, higher levels of fuel consumption, greater impact on on-line capacity, etc.). Costs were developed on both a variable and a full economic basis. The variable cost level reflects costs that are essentially volume-related. Full economic costs provide for these direct costs, an overhead burden allocated on a capacity basis, allowance for equipment replacement on a current-cost basis, normalized levels of roadway and terminal maintenance and the amortization of new investment in terminal facilities.

The use of full economic costs provides the proper basis for justifying future capital expenditures, consistent with the goals of long-term financial strength.

<sup>24</sup> Reebie Associates, *ConRail Bimodal and Intermodal Operations*, Greenwich, Conn., USRA Contract No. 50034.

A number of factors contribute to this marginal profitability.

- Several particularly low volume or short-haul movements do not cover even variable costs.
- Interline traffic, particularly shorter-haul north-south traffic, yields substantially lower revenue per load than local traffic, without a commensurate decrease in expenses.
- Imbalanced traffic flows result in excessive empty mileage. Empty trailers and containers accounted for approximately 25 percent additional trailer miles and 28 percent additional terminal lifts. The estimated variable cost to Penn Central of moving empty equipment in October 1974 was \$77 per revenue load, or approximately \$35 million per year.
- Terminal facilities are poorly designed or inadequate for present traffic volumes, resulting in

excessive costs and deteriorating service.

- The debilitated physical plant has increased running times and unreliability, limiting the service advantages of piggyback.

The Association's studies of profitability by market area and by traffic lane indicate a considerable amount of cross-subsidization. An equitable rate structure related to the actual costs of providing services will have not only a material effect on profits, but also will delay the need for future across-the-board increases and possibly allow selective reductions that could attract additional potentially profitable traffic presently moving via highway.<sup>25</sup>

<sup>25</sup> It has been estimated that an average "across the board" increase in rates of 5 percent would be necessary to eliminate all deficit traffic lanes on a variable cost basis. Although this would increase revenues per loaded trailer by approximately \$27 and improve net income by \$15.4 million, it could also divert profitable traffic to the highway.

### Projected Penn Central intermodal profit and loss—1974<sup>1</sup>

[In millions of 1974 dollars]

	ICC formula	USRA formula
Variable Cost.....	172.0	203.7
Full Cost.....	215.0	258.4
Revenue.....	212.8	212.8
Contribution:		
Variable .....	40.8	9.1
Full .....	(2.2)	(45.6)

<sup>1</sup> Annualized revenues and expenses based on October, 1974, excluding federal income taxes and interest on funded debt. These results are not representative of the year 1974 as a whole. Several uneconomic train services and terminals were discontinued earlier in the year. The impact of rate increases effective in late 1974 more than offset higher costs, especially fuel, contributing to improved profits toward the end of the year.

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### Inadequate Management and Information Control Systems

Control of intermodal costs and revenues requires detailed information on traffic lane and terminal revenues, operating costs and equipment utilization. This information generally is unavailable for the railroads in reorganization. Terminal operating budgets and profit and loss statements were not fully operational on the Penn Central in early 1975.

The tendency to segregate intermodal operations and sales activities contributes to the lack of an integrated intermodal management information system.

### Organizational Constraints

The intermodal business is in many significant ways different from the traditional railroad business. The needs of the intermodal business, therefore, must be recognized in a railroad oriented organization structure if intermodal service is to be competitive and profitable. Within the intermodal organization, there must be close coordination between sales, terminal operations, trucking operations, equipment leasing and maintenance, revenue accounting and transportation functions.

While Penn Central has organized intermodal activities as a profit center, which is unusual in the railroad industry, it has not integrated the trucking operations with the rest of the intermodal organization. This organizational split creates communications problems and hampers the decision-making process.

An accurate responsibility accounting system is necessary to insure that the intermodal function is held accountable for all costs and that other departments receive appropriate credit for services they provide.

An intermodal organization must be developed with responsibility for the entire transportation movement and charged with the task of assuring that all elements of the operation (pick-up and delivery, terminal activities, equipment leasing and line-haul) are properly integrated and marketed. The focus on a complete transportation service, rather than the railroad or highway elements, is the key to true, coordinated service, whether it be on a trailer load or less-than-truckload (LTL) basis.

Successful motor carriers have proven that a strong working relationship with customers is the key to profitable business. Highway components should be an integral part of ConRail's intermodal function to establish and maintain the close customer relationships essential at both shipment origin and destination.

### Opportunities for Improvement

Opportunities for improved profitability and increased market share depend on:

- Identification of relative strengths and weaknesses and concentration of resources in those markets where ConRail has a competitive edge,
- Development of a marketing strategy that focuses on improving profitability of existing traffic and the development of new profitable traffic,
- Modification and expansion of terminal facilities and supporting services to accommodate future growth and
- Installation of management information and control systems to monitor performance against objectives and to assist in the development of future plans and programs.

These factors formed the basis for the Association's intermodal planning studies. These studies covered six general areas and required staff and consultants to:

- Make an inventory of existing facilities, services and equipment,
- Assess current levels of use and efficiency,
- Forecast future traffic levels for alternative systems and marketing strategies,
- Review organizational structure, management and control systems,
- Develop an operating plan, including routes, terminals and operating schedules and
- Determine resource requirements, including rolling stock, terminal facilities, personnel and supporting systems.

A major intermodal planning study<sup>26</sup> formed the basis for many of the Association's recommendations concerning intermodal marketing and operating strategies. An evaluation of the role of the railroad highway subsidiaries<sup>27</sup> furnished guidelines relating to organizational structure and relationship of these subsidiaries to the intermodal function.

A limited survey of shipper attitudes and modal choice factors was conducted to identify key elements of an intermodal marketing plan. A computerized intermodal terminal and traffic lane profit and loss model was developed to analyze present and projected intermodal profitability.

Association staff and consultants inspected all principal intermodal terminals and conducted detailed studies of terminal operations and facilities to evaluate opportunities for improved operational efficiency.

Terminal requirements developed on the basis of traffic projections were incorporated in the Association's recommended capital budget for ConRail. Estimates of incremental maintenance-of-way costs incurred solely for the amount of intermodal services were developed and incorporated in the ConRail rehabilitation program.

<sup>26</sup> Reebie Associates, *ConRail Bimodal and Intermodal Operations*, Greenwich, Conn., USRA Contract No. 50034.

<sup>27</sup> Kearney: Management Consultants, *Highway Subsidiaries Study*, New York, N.Y., USRA Contract No. 50117.

## Present and Potential Markets

Three forecasts of 1976–1985 intermodal traffic volumes developed by the Association were:

- A base level forecast maintaining the current TOFC freight market share (2.8 percent annual growth from the 1973 base year)<sup>28</sup> which was incorporated in the Association's financial plan.
- An optimistic forecast assuming an increased market share for TOFC (4 percent annual growth) and
- A forecast based on the optimistic market share increase plus diversion of traffic from boxcar to piggyback (8.5 percent annual growth).<sup>29</sup>

These forecasts, which are compared in Figure 5 and related to 1973 volume levels, assume 1975 traffic will be approximately 18 percent below 1974 volumes, with a gradual recovery beginning in early 1976.

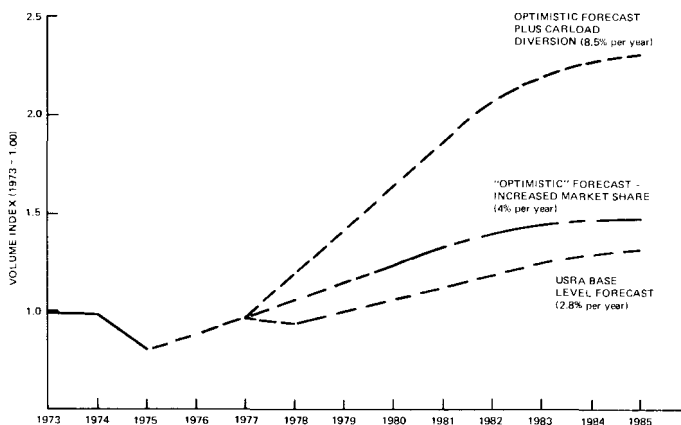
The Association has used the conservative market share forecast in developing plans for future ConRail piggyback operation. Major opportunities exist for increasing volume beyond this forecast. Improved market share would depend on a number of factors, such as:

- Expansion of motor carrier subsidiary operating authorities to facilitate intermodal gathering activities,
- Selective entrance into the less-than-truckload market,
- Significant improvement in service levels due to track rehabilitation and terminal modernization,
- Establishment of a National Intermodal Network, currently under review by the Federal Railroad Administration and
- Revision of the intermodal pricing structure to capture existing highway traffic.

<sup>28</sup> Temple, Barker & Sloane, Inc. *Forecast of Traffic and Revenues*, Wellesley Hills, Mass, USRA Contract No. C-5000.

<sup>29</sup> Reebie Associates, *Op. Cit.*

FIGURE 5.—ConRail Intermodal Traffic Forecasts



The principal opportunities to increase market shares fall into three general categories: carload diversions, motor carrier diversions and expanded less-than-truckload operations. These opportunities are discussed below.

### Carload Diversion

The Association has compared the total costs for sample Penn Central box car and piggyback movements. Based upon current equipment and replacement costs, TOFC often has lower costs than carload service because of its significantly higher level of equipment utilization. The major determinant of relative cost efficiency is the comparative cost of pick-up and delivery services by the two methods of service. Projected improvements in operating efficiency, including improved car use, reduced terminal expense and more reliable line-haul service will affect the comparative long-range costs of carload and TOFC service.

Service considerations also will affect the diversion of carload freight to piggyback. Piggyback service is currently faster and more reliable than carload service between most terminal pairs. In terms of total distribution costs, improved carload service may be satisfactory in certain markets; increased use of intermodal service, however, may be the only means the railroads have of retaining profitable traffic in other markets.

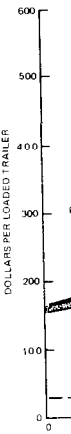
For ConRail, the trade-off between carload and TOFC cannot be resolved easily. It must consider a number of complex, interrelated factors, including the impact on interline traffic, balance, shipment size and frequency, customer locations and industrial switching productivity.

Situations in which piggyback has a clear advantage over rail carload generally involves traffic flows moving to and from dispersed origins and destinations in relatively small volumes. Thus, customers located in remote areas, such as light density branch lines and industrial spurs, often can be served more economically by piggyback than by rail carload service.

### Motor Carrier Diversion

The ConRail intermodal forecasts anticipate only modest diversions of existing and future motor carrier traffic to piggyback due to the recent increase of truck weight restrictions on the Interstate Highway System, the constraints posed by motor carrier labor agreements and the economic break-even point between rail and highway movement. Figure 6 compares the present Plan II $\frac{1}{2}$  average revenue per trailer, the Association's estimate of variable rail costs (with and without empty mileage costs) and comparative costs of several truck configurations. Several points should be noted.

FIGURE

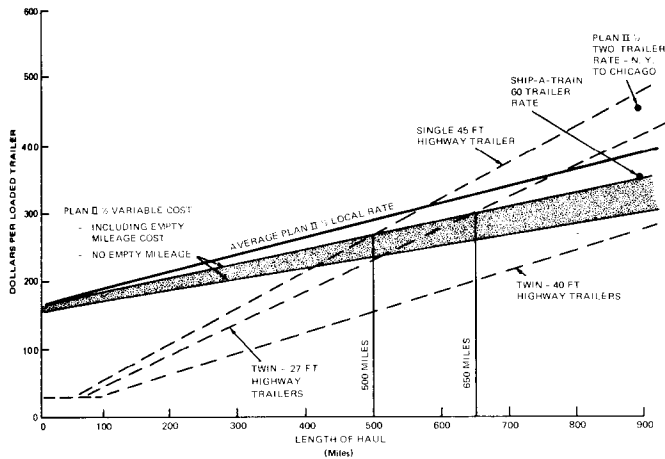


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FIGURE 6.—Comparison of piggyback and motor carrier costs



- High terminal and overhead costs at present preclude cost-competitive piggyback service in short or medium distance markets.
- If twin 40-foot highway trailers are permitted to operate between major eastern and midwestern markets, it is unlikely that ConRail could be cost competitive with present rail technology and labor work rules.
- Empty trailer mileage costs significantly affect piggyback's cost break-even point with motor carriers, limiting those markets in which piggyback is competitive. (The break-even point with single trailer truck costs is 400 miles with balanced flows, but increases to over 500 miles when allowance is made for empty movements.)<sup>30</sup>

As one approach to facilitate market penetration, ConRail could increase its traffic gathering area. While this expansion often would require additional regulatory authority, Pennsylvania Truck Lines' substituted service rights already permit expansion in many areas. For example, PTL's substituted service authority permits the Buffalo, N.Y., gathering area to extend as far east as Rochester, N.Y., and as far west as Cleveland, Ohio.

ConRail also could improve its penetration into the present highway market by adopting wholesale rate structures that would encourage private and for-hire motor carriers to increase their use of rail line-haul service for profitable, balanced flows, rather than the marginal imbalanced traffic which they already divert to piggyback. This approach would provide a positive incentive for the user to generate two-way movements

<sup>30</sup> Approximately two-thirds of all containerizable tonnage moves between points less than 400 miles apart, and is thus not suitable for movement by piggyback. Penn Central's current average length of haul on intermodal traffic is 720 miles.

to minimize costs, thereby alleviating the problems rail personnel must contend with concerning equipment distribution and positioning.

If motor carriers are successful in negotiating "changes of operations" with labor and obtaining greater management flexibility in the interpretation of labor agreements relating to use of piggyback, they then will be in a position to increase substantially their use of rail line-haul services, especially growth traffic.

#### Increased Share of the LTL-PTL Market

Reebee Associates estimated that by 1985 small shipment traffic could represent 16 percent of total ConRail intermodal traffic. This estimate includes the traditional LTL shipments (less-than-truckload, shipments under 10,000 pounds) as well as PTL (part-truckload, shipments between 10,000 and approximately 20,000 pounds).

Beginning in the 1950's, U.S. railroads abandoned the LCL (less-than-carload) market because of high platform and pick-up and delivery costs. Antiquated freight houses, high labor content, unreliable line-haul service and dependence on local drayage carriers coupled with a questionable price level led to the demise of this service. Consequently, the railroads relegated this market to freight forwarders, parcel post, REA, consolidators and highway motor carriers. In recent years, however, motor carriers and "third party" shipper associations, agents and consolidators have been increasing their position in this market. This trend has been difficult to quantify since some of these "third parties" are not regulated by the ICC and therefore do not report their operating results in a consistent form.

Table 19 shows the trend in volume and revenue for all regulated carriers of small shipment traffic. Regulated motor carriers now account for 85 percent of total LTL shipment volumes as reported to the ICC.

To determine the economic feasibility of an expanded LTL/PTL service, a complete operations simulation of the New York-Chicago market was performed,<sup>31</sup> including pick-up and delivery, dock handling, rating and billing and rail line haul. Operating costs were evaluated on both a variable and full economic basis. The results of this study are displayed in Table 20.

Kearney expanded this analysis to 60 key ConRail traffic lanes and concluded that with this market expansion, ConRail could handle 545 small shipment trailer loads per day by 1985, yielding annual potential revenues of \$140.1 million and net income of \$8 million. These revenues and income were not included in the FSP forecasts.

<sup>31</sup> A. T. Kearney, Inc., *Highway Subsidiary Study*, New York, N.Y., USRA Contract 50117.

TABLE 19.—Regulated intercity small shipments traffic (includes shipments under 10,000 pounds) (selected years)  
(Net tons—in thousands)

Year	Direct carriers											Indirect carriers								Index 1950 =100				
	Motor LTL <sup>1</sup>	Per- cent	Rail LCL	Per- cent	Bus ex- press <sup>2</sup>	Water Per- cent	Car- riers <sup>3</sup>	Per- cent	Air freight	Per- cent	United parcel <sup>4</sup>	Per- cent	REA Express		Freight for- ward- ers <sup>5</sup>		Parcel post		Air parcel post <sup>6</sup>		Total <sup>7</sup>			
													Sur- face	Per- cent	Air Per- cent	Per- cent	Per- cent	Per- cent	Per- cent			Per- cent		
1950.....	53,405	61	22,164	25.0	168	0.2	534	0.6	289	0.3	NA	-----	2,474	3.0	50	-----	4,204	5.0	3,475	4.0	11	-----	87,047	100.0
1955.....	54,132	69	14,045	18.0	183	0.2	268	0.3	389	0.5	112	0.1	1,995	3.0	66	-----	4,697	6.0	2,711	3.0	18	-----	78,616	90.3
1960.....	62,144	79	6,447	8.3	202	0.3	175	0.2	510	0.7	386	0.5	1,390	2.0	70	0.1	4,100	5.0	2,581	3.0	26	-----	78,031	89.6
1965.....	76,896	85	2,125	2.0	224	0.3	351	0.4	1,137	1.0	1,347	2.0	1,845	2.0	110	0.1	3,994	4.0	2,137	2.0	43	0.1	90,209	103.6
1970.....	78,099	85	1,177	1.0	248	0.3	197	0.2	2,478	2.7	3,014	3.0	847	1.0	117	0.1	4,203	5.0	1,640	2.0	185	0.2	92,205	105.9
1972 (p).....	82,800	85	969	1.0	259	0.3	161	0.2	2,934	3.0	4,021	4.0	585	0.6	98	0.1	4,255	4.0	1,448	2.0	206	0.2	97,736	112.3

TOTAL REVENUE—MILLIONS OF DOLLARS																								
1950.....	1,027	42	356	15.0	8	-----	9	-----	44	2.0	NA	-----	284	12.0	23	1.0	287	12.0	381	16.0	13	-----	2,431	100.0
1955.....	1,465	46	283	9.0	16	-----	7	-----	75	2.0	NA	-----	335	10.0	40	1.0	401	13.0	551	17.0	30	1.0	3,203	131.8
1960.....	2,123	55	154	4.0	33	1.0	6	0.2	116	3.0	5	0.1	309	8.0	50	1.0	437	11.0	561	15.0	43	1.0	3,837	157.8
1965.....	3,100	59	53	1.0	61	1.0	14	0.3	322	6.0	93	2.0	350	6.7	80	1.5	459	8.8	621	12.0	75	1.4	5,229	215.1
1970.....	4,193	57	37	0.5	102	1.4	11	0.2	812	11.0	420	5.7	207	2.8	101	1.4	594	8.0	647	8.7	282	3.8	7,408	304.7
1972 (p).....	5,400	58	28	0.3	110	1.0	8	0.1	1,046	11.0	719	8.0	149	1.6	93	1.0	728	8.0	659	0.7	348	3.7	9,288	382.1

<sup>1</sup> Class I and II motor carriers.

<sup>2</sup> Increases estimated 1960—present.

<sup>3</sup> Class A and B carriers.

<sup>4</sup> Estimated.

<sup>5</sup> Tons received from shippers.

<sup>6</sup> Includes heavy pieces of first class mail, air.

<sup>7</sup> Total may not equal sum of individual columns due to rounding of figures. Percentages will not total 100 because of rounding.

(p) Preliminary

SOURCE: Transportation Association of America, (calculation from ICC Transport Economics, various issues), Facts & Trends—October 1974.

TABLE 20.—Income projections—LTL/PTL traffic New York to Chicago lane  
(Thousands of 1975 dollars)

Year	Daily loads	Revenue	O. R. <sup>1</sup>	Net income	Net income (considering empty trailer utilization)
1977.....	2	\$564	121.3	(\$120)	(\$46)
1978.....	5	1,414	108.0	(113)	74
1979.....	7.5	2,121	105.0	(106)	174
1980.....	10	2,827	102.5	(70)	228
1981.....	14	3,958	100.0	-----	298
1982.....	19	5,372	97.0	161	459
1983.....	25	7,069	95.0	353	651
1984.....	32	9,048	93.5	588	886
1985.....	39	11,027	90.2	1,080	1,378

<sup>1</sup> Operating ratio=fully allocated expense÷revenue.

SOURCE: A. T. Kearney Highway Subsidiary Study New York, N.Y., USRA Contract 50117.

Although Pennsylvania Truck Lines has the existing substituted service authority to enter the New York-Chicago local market, some expansion in authority would be necessary. Interline service to points outside the Region would be facilitated through coordination with other railroad motor carrier subsidiaries.

The Association recommends that ConRail study the potential for LTL and consider demonstrating this potential in a few key "traffic lanes," initially using

trailers now being moved empty to the West due to traffic imbalances. This program could be implemented using leased equipment and terminals to avoid major capital expenditures. Based on shipper acceptance and favorable financial results, the services gradually could be expanded to additional markets. It is important that this market be entered on a gradual, selective basis so the necessary operating structure and supporting organization can be developed.

### Development of an Intermodal Operating Plan

The analysis of traffic flows, operating costs and projected market growth provided the basis for the Association's recommended operating plan discussed below.

### Route Structure

The proposed ConRail intermodal operating plan envisions a substantial reduction in route miles. The route structure would be limited to major freight corridors with service on additional routes provided by connecting conventional train services (see Figure 7). This plan would concentrate traffic flows over a core network, minimizing the route mileage that must be upgraded and maintained for high-speed (60 m.p.h.) operations.

The restructured system would continue direct service to all major ConRail market areas. Increased coordination with connecting railroads would improve service

to points outside the Region and would lead to the development of an efficient interregional intermodal network.

The Association's plan includes a number of specific coordinations and intermodal market exchanges, including the following.

Market	Recommendations
Elkhart, Ind.....	N&W to serve from South Bend.
Ft. Wayne, Ind.....	N&W to serve.
Huntington, Ind.....	N&W to serve.
Lima, Ohio.....	N&W to serve.
Louisville, Ky.....	ConRail to interchange traffic to and from East with L&N at Cincinnati; L&N to handle all remaining traffic.
Kalamazoo, Mich.....	Chessie to service markets from Benton Harbor and Grand Rapids.
Cincinnati, Ohio.....	ConRail to negotiate coordinated terminal operations with the L&N and/or Southern.
Wilkes-Barre, Pa.....	D&H establishing a terminal in Yatesville to serve region.

New York-Washington---- Amtrak to provide all Railway Post Office and "head end" mail service.

### Terminals

ConRail would continue to operate 26 terminals and would serve 21 principal market areas (see Figure 7). A total of 21 terminal facilities will be closed or consolidated under the proposed operating plan, as shown below.

### Intermodal Terminals

Present operator	Present	Proposed	Proposed operator
Penn Central.....	35	23	ConRail.
Lehigh Valley.....	4	1	ConRail.
Erie Lackawanna.....	19	13	Chessie. <sup>1</sup>
CNJ.....	2	2	ConRail.
Reading.....	8	8	Chessie.
Total.....	68	47	

<sup>1</sup> The Association's estimate of intermodal terminals which Chessie may wish to operate.

### REA

The Association commissioned studies to review the role of express service in the Region and to identify opportunities for increased coordination of rail and express services. REA Express, Inc., operates a nationwide express system but represents a relatively minor segment of the LTL business. Its revenue from total nationwide surface express (as differentiated from air express) was \$167 million in 1974, or 60 percent of REA's total revenues, and is projected to be \$110 million in 1975. REA operated a total of 301 terminals and service centers in 1973. Under its proposed restructuring program, 114 terminals will be consolidated or closed. Of the remaining 187 terminals, 44 will be located in the Region.

REA surface shipments have an average shipment weight of 167 pounds and an average length of haul of 925 miles, indicating the nature of REA's traffic; smaller shipments moving over relatively long distances. Approximately 20 percent of all REA line-haul movements are made by TOFC, but relatively few of these TOFC movements are made in the Region. However, 65 percent of all highway movements are made in the Region.

Based on 1972 statistics, REA surface express represented 0.6 percent of total small shipment traffic tonnage and 1.6 percent of revenues. Because of curtailments in service since that date by the company, its share today probably is lower.

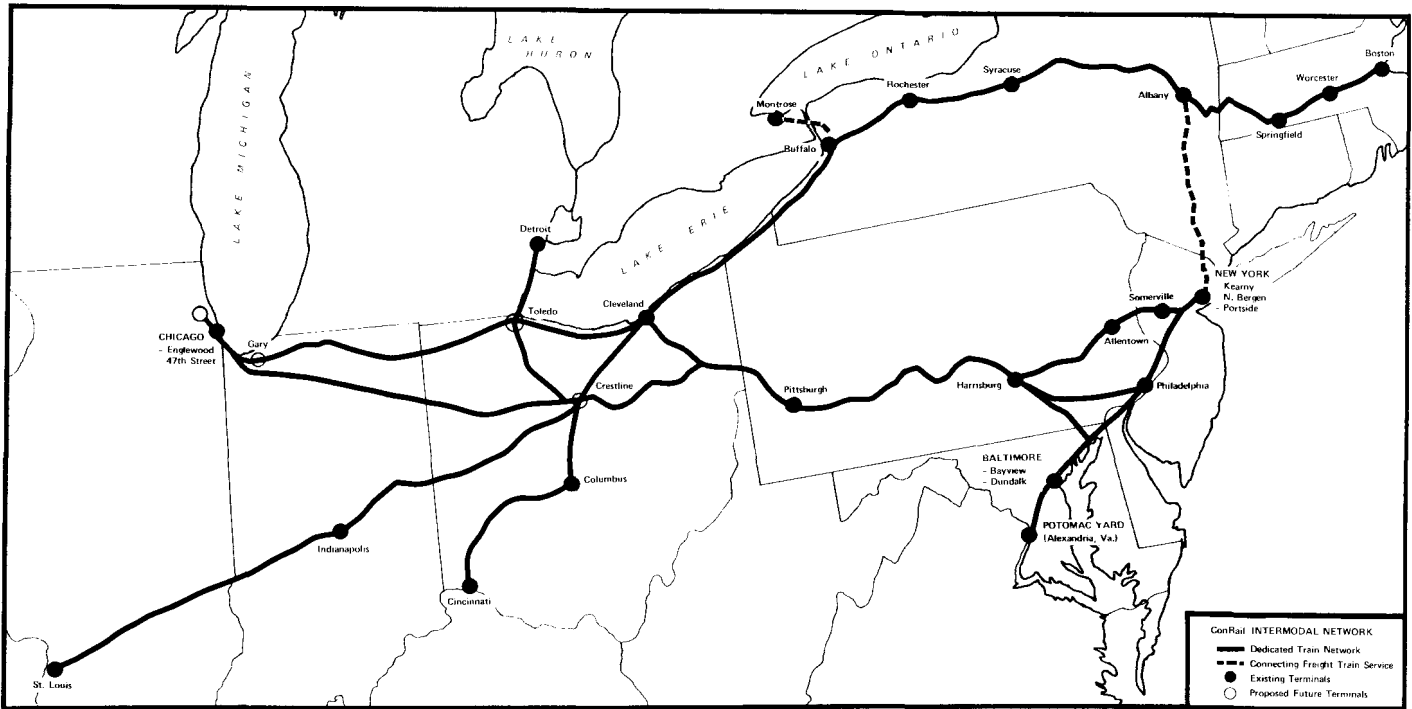
REA currently is undergoing reorganization pursuant to the Bankruptcy Act. If management is success-

ful in turning the company around, REA possibly could facilitate ConRail's expanded intermodal role. Were REA to curtail or discontinue its small shipment services, a few of its line-haul and pickup and delivery and local peddle operating rights, as well as terminal facilities, might be attractive acquisitions for ConRail if it sought to expand its service into LTL. The Association, nevertheless, recognizes a number of factors that might limit the potential contribution of portions of REA's business to ConRail's operations.

- The REA terminals basically are equipped to handle small shipments with sortation conveyors. The terminals are not readily adaptable to handle the wider range of piece weights and shapes which would be encountered in more normal LTL freight.
- REA's pickup and delivery zones are permitted to extend beyond commercial zones because of the express nature of the business. There is no assurance that such rights would be authorized to an LTL or truckload carrier.
- The REA highway rights also might be subject to cancellation if the nature of the freight was LTL instead of the original rail-oriented express activities.

The Association recommends that ConRail and REA explore the opportunities for increased coordination between the two companies, with particular emphasis on the use of wholesale line haul rates for REA traffic.

FIGURE 7.—ConRail Intermodal Network



Terminal capacity in 1976 would be approximately 4,200 lifts (loaded and empty trailers) per day; terminal lift volumes are projected at 3,800 per day. While capacity is sufficient on a systemwide basis, specific terminals require immediate modification or expansion to handle peak traffic periods efficiently.

Major terminal expansions are required to handle the projected increase in intermodal traffic by 1985. Improvements in terminal efficiency and increases in direct-rail interchange movements will moderate these requirements. Table 21 lists present and projected volumes and proposed improvements for the ConRail intermodal terminals serving eight major market areas. (These terminals accounted for 85 percent of the total 1973 lift volumes of the railroads in reorganization.) In addition to the improvements programmed for the major terminals, improvements and modifications will be required at the following nine secondary terminals: Harrisburg, Pa., Indianapolis, Ind., Columbus, Ohio, Cleveland, Ohio, Pittsburgh, Pa., Buffalo, N.Y., Rochester, N.Y., Syracuse, N.Y. and Springfield, Mass.

Traffic forecasts indicate a need for construction of new terminals at Toledo and in the Chicago area (Table 21) to serve growth markets. Additional terminals may be constructed in conjunction with several state transportation planning programs. New York City, for example, is evaluating the feasibility of providing direct intermodal service to New York City and Long Island, and Pennsylvania is assessing the feasibility of a corridor-type intermodal service between Pittsburgh and Philadelphia.

TABLE 21.—Principal ConRail intermodal terminals

Location	1973 Volume (annual lifts)	Projected 1985 volume	Remarks
Boston.....	57,600	75,400	Construct new regional terminal.
Chicago: 47th St.....	118,500	1 430,000	Expand and combine with EL 51st St. terminal. Construct future terminals in Gary and Northwest suburbs.
Englewood.....	148,500		Combine with expanded 47th St. terminal.
Lumber St.....	21,000		Close terminal and handle mail at expanded 47th St. terminal.
Cincinnati.....	41,900	1 54,900	Possible coordinated terminal with L&N and/or Southern.
Detroit.....	55,800	60,000	Minor expansion and modification.
E. St. Louis: Lower Yard.....	44,600		Close terminal and handle traffic at Rose Lake.
Rose Lake.....	36,800	1 124,000	Construct new regional terminal.
Baltimore: Bayview.....	22,600	29,300	Minor expansion and modification.
Dundalk.....	30,000	39,000	Maryland Port Authority Facilities.
New York: Kearney.....	122,000	200,000	Expand capacity.
North Bergen.....	63,500	121,000	Expand capacity or construct new terminal in New Jersey.
Port Newark.....	16,500		Combine with Portside.
Portside.....	30,000	58,000	Minor expansion and improvement.
Philadelphia.....	58,900	77,100	New terminal required.

<sup>1</sup> Volumes include interline traffic; much of which will be interchanged by rail.  
SOURCE: USRA staff analysis.

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There also may be opportunities for wholesale services between special shipper facilities, such as motor-carrier terminals, Postal Service Bulk Mail Centers and marine facilities operated independently of the basic intermodal networks. These potential expansions require thorough evaluation of their impact on the primary terminal network, to insure that they do not divert the baseload traffic.

Terminal costs per loaded trailer are projected to decrease 20 percent by 1979, reflecting the continued elimination of marginal terminals,<sup>32</sup> improved utilization of existing terminals, increased interline rail deliveries and improved efficiencies resulting from facility modernization.

A major new block-switching terminal is proposed at Crestline, Ohio, where the Chicago-Pittsburgh and Cleveland-St. Louis main lines cross. Construction of this terminal will:

- Concentrate all intermodal switching at one location, and hence, reduce switching activities at Harrisburg, Columbus, Cleveland, Elkhart, Syracuse, and Albany,
- Reduce intermodal train-miles by transferring blocks from trains operating between New England and Chicago/East St. Louis to trains operating between New York and Philadelphia, and Chicago/East St. Louis,
- Facilitate the operation of direct interline connecting trains or blocks, thus eliminating present terminal and highway transfer expenses associated with interline traffic and
- Enable ConRail economically to serve markets where volumes do not justify point-to-point train service or blocking.

#### Intermodal Equipment Requirements

For the immediate future, ConRail will depend exclusively upon Trailer Train for intermodal flat cars. The trailer fleet will consist of 11,500 units presently owned or leased by Penn Central or Pennsylvania Truck Lines. This base fleet will be supplemented by leased trailers to accommodate peak and seasonal demands.

Moderate improvements in flat car utilization (measured in car-day per originated carload) are projected due to enhanced car distribution procedures, track rehabilitation and transportation control improvements. Projected increases in load factors (the number of loaded trailers per car) resulting from more balanced flows, however, will increase significantly flat car revenue generation potential.

Trailer utilization (trailer-days per trailer load) is projected to improve by 20 percent by 1979 (a reduction of 1.5 days per load) due to reduced delay time in

terminals, reduced intermediate switching delays, improved over-the-road transit time, consolidation of marginal terminals and reduction in empty mileage.

#### Trucking Operations

ConRail will acquire most of the existing operating authorities and assets of Pennsylvania Truck Lines to support its intermodal operations. These support services include terminal operations, leasing and maintenance of highway equipment and provision of piggyback drayage and highway substituted service. This will provide ConRail with a capability to offer single-source door-to-door responsibility.

ConRail's truck operations will provide the basis for increasing revenues from piggyback collection and delivery service and facilitate the entrance into the LTL-PTL markets discussed previously. It has been estimated<sup>33</sup> that the market for drayage of Penn Central TOFC traffic was \$54 million in 1974. A successful marketing and service campaign could improve PTL's share of the drayage market from approximately 8 percent to 22 percent. These additional revenues were not incorporated in the FSP financial projections.

An effective highway operation will provide a means for ConRail to provide service to markets that may not be accessible with conventional rail service, thus participating in growth traffic. A key constraint to achieving this increased market share, however, is the present restriction of operations outside the commercial zone. Approximately 36 percent of all TOFC traffic will require drayage to customers located outside metropolitan areas by 1985.

#### Organizational Structure and Personnel

To meet effectively the needs of this highly competitive market, one quite different from the rest of ConRail, the Association recommends that all intermodal activities be concentrated in an Intermodal Department, to coordinate sales and operating activities and improve communications between functional activities. Terminal operations should be organized on a regional basis within the Intermodal Department with responsibility for sales, rating and billing, customer service and operations (terminal, equipment maintenance, local drayage and rail interface) concentrated at the terminal level. This decentralized structure would enable ConRail to respond quickly to operating problems or new revenue opportunities.

Corporate planning personnel, in conjunction with regional intermodal managers and sales personnel, should review regularly TOFC and boxcar traffic in each lane to determine the economics of alternative pricing, sales and operating programs. This review

<sup>32</sup> Ten terminals were closed in 1974 and early 1975, and several unprofitable services discontinued.

<sup>33</sup> A. T. Kearney, *op. cit.*

would enable ConRail to establish priorities for seeking new traffic or shifting traffic between boxcar and TOFC/COFC to improve overall profits.

### Management Information Systems and Controls

Clearly stated management goals and the necessary information and controls to monitor and track performance against these goals are essential to a successful intermodal program. Accordingly, the Association recommends that ConRail:

- Develop reports indicating profit and loss by terminal, traffic lane, commodity and type of service (calculations should be on a full economic cost basis and provide comparisons with goals),
- Implement standards for terminal and line-haul expenses, equipment utilization and customer service levels to aid in identifying operating problem areas,
- Develop real-time reports to support the terminal management decision process. (These reports should provide inventories of equipment on hand, project near-term equipment requirements, identify traffic imbalance problems and detail customer service failures.) And
- Identify the traffic characteristics and flow volumes in all lanes for ConRail and monitor the costs and service levels of competitors to identify new commercial opportunities.

The traffic lane profit and loss model used to develop the intermodal operating plan illustrates the type of management information required. Figure 8 is a sample printout of a traffic lane profit-and-loss report. It portrays costs in each major functional area on both a variable and full economic cost basis.

### Other Intermodal Services

The railroads in reorganization provide a number of other intermodal services in the Region, including rail-truck bulk commodity distribution, and automobile loading and distribution services. These activities are discussed in this section. Rail-barge intermodal services are provided to a limited extent. These services, however, were not studied in detail by the Association.

#### Bulk Intermodal Services

The railroads in reorganization operate 15 rail-truck bulk commodity transfer terminals. In 1973, these terminals handled approximately 1 percent of total freight tonnage. Cement, petroleum products, chemicals and foodstuffs were the principal commodities handled.

Although total delivered product cost generally is lower using an integrated rail-highway service, the railroads generally have not been able to compete success-

FIGURE 8.—Sample computer printout of traffic profit-and-loss analysis

CONRAIL TRAFFIC LANE PROFIT • LOSS STATEMENT			
1974			
LANE	( 10 TO 22 )		
AVG LOADS / DAY	5		
AVG EMPTIES / DAY	0		
		VARIABLE	FULL ECONOMIC
TRAIN COST		90.	99.
CREW WAGES	16.		16.
OPERATIONS • MAINTENANCE	51.		51.
LOCOMOTIVE • CAR OWNERSHIP	17.		26.
WRECKS • OTHER	5.		5.
RIGHT OF WAY COST		11.	45.
OPERATIONS • MAINTENANCE	11.		14.
OVERHEAD ALLOCATION	0.		31.
TERMINAL COST		113.	129.
TRANSFER OPERATIONS	52.		52.
TRAILER OWNERSHIP	33.		33.
OVERHEAD ALLOCATION	28.		45.
EMPTY MOVEMENT ADJUSTMENT		9.	11.
BALANCED	0.		0.
USED AT ORIGIN	6.		8.
CREATED AT DESTINATION	3.		4.
DELIVERY COST		14.	14.
BILLING • CLAIMS	9.		9.
DRAYAGE	5.		5.
TOTAL COST PER LOAD		237.	298.
AVERAGE REVENUE PER LOAD		252.	252.
PROFIT / LOSS PER LOAD		15.	-46.
OPERATING RATIO		94.23	118.42
LANE PROFIT / LOSS			
PER DAY		73.	-232.
PER ANNUM		19107.	-61029.

fully with the motor carriers who have an advantage in terms of service. The development of a single-source capability is essential to improve market share. Only when the railroads can provide complete distribution services will customers consider such programs as reasonable alternatives to motor carrier service.

This intermodal concept can be expanded to additional commodities and new market areas. (The Association estimates 30 transfer terminals could serve all major ConRail markets.) Although volume growth will accelerate if ConRail provides a coordinated single-source service, existing facilities generally have sufficient capacity to handle additional traffic and significant capital expenditures would not be required.

To expand the operating effectiveness with which the bulk intermodal services are provided, the organization and facilities engaged in this business should be consolidated with the other intermodal services described previously.

#### Automobile Loading and Distribution Services

Thirty-four automobile loading or distribution terminals are operated by the railroads in reorganization, including Penn Central (28), Erie Lackawanna (5) and Ann Arbor (1).

Most of these facilities serve a single automobile manufacturer. Consolidating distribution facilities into terminals jointly serving more than one manufacturer will improve both terminal efficiency and multilevel automobile car utilization.

ConRail management should encourage the consolidation of bulk commodity and automotive terminals, where feasible, to create a network of multipurpose rail and truck transportation centers. In many market areas these facilities could be consolidated with existing or proposed TOFC/COFC facilities and the supporting operating organizations integrated.

Modern, well designed and strategically located rail-truck transloading facilities, combined with efficient truck distribution services, will provide a basis for continuing service to shippers located on lines to be discontinued. They also will provide ConRail with the capability to serve customers located in suburban industrial and commercial developments not served directly by rail.

This concept will contribute not only to increased operating efficiency and control but will foster the development of comprehensive intermodal service "packages" combining the efficiency of rail line-haul service with the flexibility of highway gathering distribution services.

### Conclusions and Recommendations

Profitability of intermodal services under the recommended plan is projected to increase substantially. Factors contributing to increased profits include:

- Withdrawal from unprofitable markets where other carriers have an inherent competitive edge,
- Terminal consolidation and expanded use of motor carrier subsidiaries for TOFC/COFC collection and distribution,
- Expansion and modernization of terminal facilities,
- Consolidation of line-haul services and concentration of traffic flows over a core network,
- Improved equipment utilization and a reduction in empty mileage,
- Improved terminal operating efficiency, due to more effective scheduling and programming and increased productivity,
- Publication of single-trailer "retail" rates and a revision in the "wholesale" rate structure to provide low-cost terminal-to-terminal service with incentives for balanced movements and
- Coordination of services with connecting railroads to facilitate direct rail interchange at key gateway cities.

An efficient, restructured intermodal network will form the base for future growth. Major capital invest-

ments in expanded and modernized intermodal terminals, however, are essential to handle projected growth over the long term. Existing facilities are not properly designed and constructed to handle increased volumes efficiently and many existing facilities are not properly located to attract future growth traffic. Mechanization of terminals is essential to expedite transfer operations and to provide an expanded COFC capability.

While containerization offers an opportunity to reduce linehaul operating costs, the primary obstacles to significantly increased use of containers for domestic traffic are the existence of a large highway trailer fleet which, for the near future, will be the "common denominator" for intermodal services and the increased complexity of controlling and positioning containers and chassis. ConRail management should explore the long-term opportunities for increased use of containers.

Roadway and track improvements will improve service reliability and ultimately attract new business from the highways. ConRail management should explore jointly with other railroads, car builders, trade associations and government agencies the opportunity to further improve intermodal operations with lightweight, low-profile cars suitable to carry containers as well as highway trailers. Cars of this type will reduce fuel consumption and operating costs. These "third generation" cars should be capable of carrying all configurations of equipment, including 27-foot and 45-foot trailers.

To facilitate the gathering of intermodal traffic by highway to regional intermodal terminals, integrated rail-highway service using subsidiary motor carrier highway authority is essential. While ConRail will continue to offer terminal-to-terminal wholesale service, an expanded full-service program with single carrier, dock-to-dock responsibility will depend on increased use of existing subsidiary motor carrier authority, expanded in key metropolitan areas, to enable ConRail to participate in growth traffic generated by industry in suburban locations.

To plan, manage and control operations and to generate profitable growth traffic, an improved intermodal management information and control system should be implemented by ConRail management. Timely, responsive operating reports are required to control terminal operations, improve equipment utilization and facilitate revenue billing and collection. Profit and loss reports by terminal and market segment will provide management with the basic data to monitor and direct day-to-day operations and assist in formulating longer-term strategies and plans.

The projected financial results of the Association's recommended intermodal plan are summarized below.

*Projected ConRail intermodal revenues and expenses*

(In millions of 1974 dollars)

	1976	1980	1985
Gross revenue.....	\$205.8	\$247.5	\$321.5
Full economic cost.....	209.0	225.1	228.2
Contribution.....	(3.2)	22.4	33.3

On a full economic cost basis, net income will be approximately \$33.3 million in 1985. Contribution above variable costs will be approximately \$91 million. Revenue projections do not include additional revenue that may be generated by selective rate increases, a revised pricing system or increased "retailing" activity of the highway subsidiary. The projections, while conservative, indicate that ConRail can provide essential and

economically self-sufficient service to customers in the Region. Properly priced and effectively managed, this service will generate the cash flows necessary to sustain and expand operations to meet the demands of future growth.

The continuation and growth of TOFC/COFC will be an important element in the full-service marketing strategy of ConRail. Whether it concentrates on trailer-load operations, enters the small-shipment market or expands its capability to transfer bulk commodities to facilitate branch line abandonments, ConRail should be committed to an important involvement in intermodal transportation. Essential to success in this area is formation of a profit-oriented organization. ConRail has an opportunity to capitalize on its route structure and wide-area market coverage to fulfill an expanded role in the Region's transportation network.

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## EQUIPMENT

This section discusses USRA's estimate of ConRail's equipment requirements in the categories of:

- Freight cars, which details the improvement in freight car utilization and projected levels of freight car purchase, repairs and retirements,
- Locomotives, which details locomotive requirements and projected levels of ConRail locomotive purchases, repairs and retirements,
- Equipment and mechanical facility requirements for freight services and
- Mechanical facility requirements for commuter passenger services.

### Freight Cars

Because of the development of specialized cars, the substantial increase in replacement costs and little or no improvement in freight car utilization, the railroad industry is putting an increasing share of its total investment into freight cars. It is vital, therefore, that ConRail improve the efficiency of freight car use.

An important objective of any railroad in managing its freight car fleet profitably is to meet shippers' needs with the fewest number of cars. Traditionally, the railroad industry has been concerned with the availability of cars (car supply) and has placed little emphasis on forecasting demand effectively.

To improve freight car use to the fullest extent possible, development of projections for car demand should be as exacting as those developed for determining the expected supply of suitable cars.

Recently, the railroad industry's consideration of both supply and demand has become more balanced.

### Freight Car Demand

In a study prepared for USRA, Temple, Barker and Sloane forecast demand in terms of originated tonnage by basic commodity groups. This was converted into specific car type loadings for ConRail through 1985 (see Table 22). In this forecast, total car loadings are not expected to reach the 1973 level until after 1985. Total 1985 tonnage, however, is expected to increase by 15.5 percent over 1973 levels. This apparent discrepancy is due primarily to anticipated increases in average net tons per car, caused by a shift in the movement of specific commodities from one car type to another (e.g., grain from boxcars to covered hoppers) and the increasing size of cars within specific car types, reflecting the higher capacity of cars being added to the fleet relative to the older, smaller cars retired.

### Current Freight Car Supply

The number of freight cars owned and leased by each of the railroads in reorganization to be included in ConRail and reported to the ICC as of December 31, 1974, is summarized below and shown in detail in Table 23.

Railroad	Number of Freight Cars	Percent of Total
Penn Central.....	151,169	95.9
Lehigh Valley.....	3,873	2.5
Ann Arbor.....	378	.2
Central of New Jersey.....	2,128	1.4
Lehigh & Hudson River.....	6	.....
<b>Total.....</b>	<b>157,554</b>	<b>100.0</b>

TABLE 22.—ConRail projected freight car demand total car loadings (thousands)

Car type	1973 actual	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Plain box.....	442.3	405.8	404.6	381.6	377.0	393.4	393.4	394.2	401.9	404.2	405.3
Special box.....	568.1	512.7	529.3	494.5	491.4	529.7	536.2	534.4	552.5	567.8	565.7
Covered hopper.....	189.5	158.5	155.4	151.5	143.7	148.1	147.4	147.4	149.1	148.9	148.8
Gondola.....	372.4	343.8	355.0	336.7	339.8	364.6	384.3	385.9	393.0	396.0	400.5
Open-top hopper.....	1,072.0	939.6	947.4	913.7	924.5	980.5	999.3	1,020.1	1,038.4	1,058.5	1,089.9
Flat.....	66.2	61.3	63.7	60.6	61.3	66.0	70.1	70.3	72.1	73.0	73.5
TOFC.....	331.6	312.7	302.1	271.4	253.6	266.7	269.8	272.6	285.1	290.0	294.5
Multilevel.....	128.2	116.0	127.1	119.3	121.6	138.9	142.7	142.8	151.4	161.0	160.9
All other.....	96.8	85.6	83.9	78.2	74.4	76.7	76.0	75.9	75.3	74.5	74.3
<b>Total.....</b>	<b>3,267.1</b>	<b>2,936.0</b>	<b>2,968.5</b>	<b>2,807.5</b>	<b>2,787.3</b>	<b>2,964.6</b>	<b>3,019.2</b>	<b>3,043.6</b>	<b>3,118.8</b>	<b>3,173.9</b>	<b>3,213.4</b>
Index: 1973=100.....	100.0	89.9	90.9	85.9	85.3	90.7	92.4	93.2	95.5	97.1	98.4

SOURCE: Strong, Wishart & Associates *Freight Car Planning Final System Plan, USRA, June 1975.*

TABLE 23.—Summary of freight cars owned and leased—by railroad (as of Dec. 31, 1974)

Class of equipment	Penn Central			Lehigh Valley			Ann Arbor			Central of New Jersey			Lehigh & Hudson		
	Owned	Leased	Total	Owned	Leased	Total	Owned	Leased	Total	Owned	Leased	Total	Owned	Leased	Total
Box—general service (unequipped).....	10,555	15,755	26,310	763	808	1,571	97	10	97	439	.....	439	.....	.....	.....
Box—general service (equipped).....	13,219	7,369	20,588	.....	.....	.....	66	10	76	.....	.....	.....	.....	.....	.....
Box—special service.....	4,957	1,476	6,433	158	26	184	.....	.....	.....	2	.....	2	.....	.....	.....
Gondola—general service.....	16,579	10,750	27,329	956	284	1,240	.....	.....	.....	69	53	122	.....	.....	.....
Gondola—special service.....	3,480	1,218	4,698	.....	3	3	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hopper (open top)—general service.....	26,452	17,356	43,808	24	.....	24	.....	.....	.....	31	396	427	.....	.....	.....
Hopper (covered).....	6,825	3,566	10,391	521	176	697	201	.....	201	553	495	1,048	2	4	6
Tank, 12,000 to 18,999 gal.....	47	.....	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tank 25,000 gal. and up.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Refrigerator (other than meat) non-mechanical.....	.....	.....	.....	91	5	96	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stock.....	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Autorack.....	.....	4,822	4,822	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flat—general service.....	2,737	405	3,142	49	.....	49	.....	.....	.....	16	74	90	.....	.....	.....
Flat—special service.....	1,503	945	2,448	3	2	5	.....	4	4	.....	.....	.....	.....	.....	.....
Flat—TOFC.....	260	745	1,005	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....
All other.....	57	87	144	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total freight cars.....	86,675	64,494	151,169	2,569	1,304	3,873	364	14	378	1,110	1,018	2,128	2	4	6
Caboose.....	1,922	193	2,115	92	.....	92	14	.....	14	45	.....	45	6	.....	6
Grand total.....	88,597	64,687	153,284	2,661	1,304	3,965	378	14	392	1,155	1,018	2,173	8	4	121

## Summary of equipment by type:

Type of equipment	Number of cars	Percent of total
Plain box car.....	28,417	18.0
Equipped box car.....	27,283	17.4
Covered hopper.....	12,343	7.8
Gondola.....	33,392	21.2
Open-top hopper.....	44,259	28.1
Flat.....	5,738	3.6
TOFC.....	1,008	.6
Multi-level (autorack).....	4,822	3.1
Other.....	292	.2
Total.....	157,554	100.0

SOURCE: Railroad's Annual Report to Interstate Commerce Commission; Form R-1, Schedule 417, Dec. 31, 1974.

The number of freight cars owned and leased by the railroads in reorganization declined from 176,431 in 1970 to 157,554 in 1974. Of this 1974 total, more than 19,000 cars or about 12 percent were in bad order condition; that is, they were unserviceable, as shown in Table 24 and summarized as follows.

Car type	Total fleet	Unserviceable cars	Bad order ratio percent
Plain box.....	28,417	7,863	27.7
Equipped box.....	27,283	3,037	11.1
Covered hopper.....	12,343	847	6.9
Gondola.....	33,392	2,277	6.8
Open top hopper.....	44,259	4,164	9.4
Flat.....	5,738	610	10.6
TOFC.....	1,008	278	27.6
Multilevel (autorack).....	4,822	204	4.2
Other.....	292	51	17.5
Total fleet.....	157,554	19,331	12.3

The 12.3 percent bad order ratio<sup>34</sup> is unusually high when compared with the average 6.4 percent ratio for all Class I railroads. The latest information as of June 1, 1975, indicated an increase in the bad order ratio for all Class I roads to 7.5 percent and to 13 percent for the railroads in reorganization. USRA recommends that ConRail achieve a bad order ratio of about 5 percent by 1985.<sup>35</sup>

## Projected Freight Car Supply

The proposed ConRail car program for 1976-1985 calls for the acquisition of 24,155 new freight cars,

<sup>34</sup> "Bad order ratio" is a measure used by the railroads to determine the level of unserviceable equipment at any time. This ratio is calculated by dividing the number of unserviceable units (damaged, awaiting repairs) by the total fleet inventory and expressing the result as a percentage.

<sup>35</sup> A 5 percent bad order ratio provides an acceptable backlog of unserviceable freight cars for the efficient production line scheduling of different types of freight car repairs and is an accepted standard in the industry.

TABLE 24.—ConRail revenue freight cars in unserviceable condition

(As of Jan. 1, 1975)

Car type	Ann Arbor			Central of New Jersey			Lehigh Valley			Penn Central			Total system		
	Fleet (A)	B/O (B)	Percent	Fleet (A)	B/O (B)	Percent	Fleet (A)	B/O (B)	Percent	Fleet (A)	B/O (B)	Percent	Fleet (A)	B/O (B)	Percent
Plain box.....	97	66	68.0	439	138	31.4	1,571	621	39.5	26,310	17,038	26.7	28,417	7,863	27.7
Equipped box.....	76	5	6.6	2			184	21	11.4	27,021	3,011	11.1	27,283	3,037	11.1
Covered hopper.....	201	8	4.0	1,048	125	11.9	697	95	13.6	10,391	619	6.0	12,343	847	6.9
Gondola.....				122	4	3.3	1,243	312	25.1	32,027	1,961	6.1	33,392	2,277	6.8
Open-top hopper.....				427	38	8.9	24	10	41.7	43,808	4,116	9.4	44,259	4,164	9.4
Flat.....	4			90	4	4.4	54	11	20.4	5,590	595	10.6	5,738	610	10.6
TOFC.....							3			1,005	278	27.7	1,008	278	27.6
Multi-level.....										4,822	204	4.2	4,822	204	4.2
Other.....							97			195	51	26.2	292	51	17.5
<b>Total fleet.....</b>	<b>378</b>	<b>79</b>	<b>20.9</b>	<b>2,128</b>	<b>309</b>	<b>14.5</b>	<b>3,873</b>	<b>1,070</b>	<b>27.6</b>	<b>151,169</b>	<b>17,873</b>	<b>11.8</b>	<b>157,554</b>	<b>19,331</b>	<b>12.3</b>

(1) Penn Central CS60A modified to exclude PLE Bad Order counts from special study.

(2) Includes 6 Lehigh Hudson River cars.

(A) SOURCE: Railroads' annual report to Interstate Commerce Commission; Form R-1, dated Dec. 31, 1974.

(B) SOURCE: Association of American Railroads—CS60A report as of Jan. 1, 1975.

heavy repairs to 93,996 cars and the retirement of 75,027 cars (Table 25). These estimates are based on:

- A 28 percent improvement in freight car utilization as measured by total car-days per load originated on line,
- Projection of future freight car demands (shown in Table 22),
- Projected fleet attrition due to age, condition and nonanticipated losses such as cars damaged in derailments, fires, etc. and
- Projected heavy repairs to the existing fleet. The extent to which these repairs are made will depend on the demand for specific types of cars and the return on investment to be gained, considering the remaining life of cars to be repaired and the alternatives of buying new cars or foregoing the traffic.

Car utilization relates to how effectively a railroad uses the freight cars it operates (both its own and those of other railroads). To measure utilization effectively, several characteristics of freight car operation must be incorporated into the measurement. The use of "car days per load originated on line" as a measure was chosen because of the historical data currently available. Additionally, this measure can be subdivided into "loaded" and/or "empty" car days per load originated. Emphasis is placed on the originated load since a railroad's car supply usually is dictated by the needs of the originating shipper. Carloads received from connections also generate car days, but with effective car supply management cars can and should be moved off line as quickly as possible after release. It is the originated loads that require standby equipment.

USRA's projection of ConRail fleet requirements, as summarized in the prior table, assumes a significant improvement in freight car management and control. It

also depends on rehabilitation of main line tracks and equipment repair facilities and improved train blocking. Should current utilization levels persist without any significant improvement, the Association projects that an additional 26,011 new freight cars would be required over the forecast period (Table 26)—more than double the additions required under USRA's presently proposed utilization improvements. Purchasing these additional new cars would cost over \$500 million in 1973 dollars.

#### Freight Car Utilization

Improvement of existing freight car management systems is vital to achieve the higher use levels projected for ConRail. Strong, Wishart & Associates, Inc. (SWA) evaluated the potential for improving car utilization on the ConRail roads. The consultant identified four functional areas in the car distribution process and determined the current effectiveness of the railroads in reorganization comprising ConRail in these areas. SWA recommended a course of action to improve utilization, estimated the magnitude and timing of improvements and calculated achievable levels of car utilization by ConRail. The four functional areas of the car management process are defined by SWA as:

- Fleet sizing, the process whereby overall empty car supply by car type is maintained at a level consistent with loading demands,
- Fleet allocation, the process whereby empty equipment by specific car type is allocated to each freight station,
- Secondary distribution, a technique within this allocation process used in selected circumstances to allow cars to begin movement and apply final destinations before cars arrive at the final dispersal yard and

TABLE 25.—*ConRail estimated freight car acquisitions, heavy repairs and retirements with improved utilization*

Type car	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total
<b>Acquisitions:</b>											
Plain box.....											
Special box.....											
Covered hopper.....											
Gondola.....						805	1,427	1,708	1,500	1,578	7,018
Open-top hopper.....		851	388			618	3,477	3,649	3,704	4,048	16,735
Flat.....		74							77	251	402
TOFC.....											
Multi-level.....											
All other.....											
<b>Total acquisitions.....</b>		<b>925</b>	<b>388</b>			<b>1,423</b>	<b>4,904</b>	<b>5,357</b>	<b>5,281</b>	<b>5,877</b>	<b>24,155</b>
<b>Heavy repairs:</b>											
Plain box.....	3,005	2,952	2,879	2,635	1,385	2,109	2,109	2,009	2,009	2,009	23,101
Special box.....	1,427	1,491	1,590	1,351	1,090	1,258	1,258	1,258	1,258	1,258	13,239
Covered hopper.....	933	818	520	241	695	641	616	641	616	641	6,362
Gondola.....	2,380	1,920	2,587	2,165	2,184	2,483	2,458	2,483	2,458	2,483	23,601
Open-top hopper.....	3,055	3,060	2,350	2,401	2,150	2,775	2,275	2,275	2,275	2,275	24,891
Flat.....	335	269	355	257	230	252	252	252	252	252	2,706
TOFC.....											
Multi-level.....											
All other.....	24	24	24	24							96
<b>Total heavy repairs.....</b>	<b>11,159</b>	<b>10,534</b>	<b>10,305</b>	<b>9,074</b>	<b>7,734</b>	<b>9,518</b>	<b>8,968</b>	<b>8,918</b>	<b>8,868</b>	<b>8,918</b>	<b>93,996</b>
<b>Retirements:</b>											
Plain box.....	1,660	1,712	1,403	1,741	2,000	1,410	1,412	1,410	1,411	1,415	15,574
Special box.....	386	296	316	441	1,260	1,005	1,000	1,000	1,005	1,000	7,709
Covered hopper.....	418	368	368	218	630	325	325	325	325	325	3,627
Gondola.....	2,186	2,086	1,076	1,429	1,440	1,415	1,415	1,415	1,415	1,415	15,292
Open-top hopper.....	3,050	2,550	2,200	1,675	1,669	3,200	3,200	3,200	3,200	3,200	27,144
Flat.....	205	162	84	145	150	240	240	240	240	240	1,946
TOFC.....											
Multi-level.....	346	447	467	497	299	297	297	296	297	297	3,540
All other.....	30	30	30	75	30						195
<b>Total retirements.....</b>	<b>8,281</b>	<b>7,651</b>	<b>5,944</b>	<b>6,221</b>	<b>7,478</b>	<b>7,892</b>	<b>7,889</b>	<b>7,886</b>	<b>7,893</b>	<b>7,892</b>	<b>75,027</b>

SOURCE: Strong, Wishart & Associates *Freight Car Planning Final System Plan, USRA, June 1976.*

- Order match, the process of assigning a specific car in response to a specific shipper request.

The anticipated improvement in car utilization is based on the following organizational and systems design assumptions.

Achieving the full improvement potential requires the organization of car management activities in a two-tier structure, consisting of a centralized car distribution group responsible for fleet sizing, allocation and secondary distribution, with field personnel responsible for the order match function. In addition, a computer system to provide the information necessary to support the field operations and field operating discipline necessary to maintain the computer data base and to execute central car distribution decisions are required.

The essential requirements for an effective car management system are:

- An integrated car and yard control system using information from a single source to assure that operating management's decisions are carried out

at the yard level with regard to train classification, yard switching, industry and interchange movements,

- An accurate, on-line information base which tells where equipment is at any given time, how it is being used and where it is going,
- A reliable data base to provide information essential for fleet sizing and fleet allocation,
- Computer stored car distribution instructions supporting the "pipeline concept"<sup>36</sup> for general service equipment and providing appropriate system designations on assigned equipment,
- Automatic application of destinations by the computer when cars are released empty by industry or are received empty from a connecting carrier and
- Continuous monitoring for change of destination or movement, an essential control to protect the integrity of the pipeline.

<sup>36</sup> The flow of freight cars moving from origin to destination via a fixed route suggests a situation which relates time, distance and quantity similar to the flow of materials in a pipeline.

TABLE 26.—ConRail estimated freight car acquisitions without improved utilization

Car type	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total	Increase <sup>1</sup>	
												Number	Percent of cars
Plain box.....									749	1,366	2,115	2,115	
Special box.....							851	1,824	1,705	965	5,345	5,345	
Covered hopper.....										53	53	53	
Gondola.....		180		917	2,966	2,669	1,452	1,816	1,546	1,649	13,195	6,177	88
Open-top hopper.....	237	2,011	338	2,247	3,891	2,871	3,680	3,827	3,900	4,354	27,356	10,621	63
Flat.....		127			346	473	243	358	293	262	2,102	1,700	423
TOFC.....													
Multi-level.....													
All other.....													
Total.....	237	2,318	338	3,164	7,203	6,013	6,226	7,825	8,193	8,649	50,166	26,011	108

<sup>1</sup> Compared with acquisitions with improved utilization (Table 25).

SOURCE: Strong, Wishart & Associates *Freight Car Planning—Final System Plan, USRA, June 1975*.

SWA quantified utilization improvements, as measured in car days per load originated on-line, in the following areas.

*Fleet Sizing.*—Penn Central's best performance during 1973 was used as the basic fleet requirement. Total car days that accrued above this standard were considered to be potentially excess and subject to management control. These excess cars were accumulated for the other months of 1973 and divided by loadings for that car type to estimate car day savings possible through fleet sizing (e.g., reducing cars on hand to equal expected car requirements and sending excess cars home to their owning railroads).

*Car Distribution.*—Certain allowances for various car types were based on the following:

- Number of days for allocation (including secondary distribution) considered the average empty miles per originated load on Penn Central during 1973. This unit of measure reflected both mileage accrued in supplying equipment for an originating load and mileage added due to empty return of foreign equipment.
- Allowances for order-matching time and shipper loading days vary by car type because of differences in shipper loading time and short range demand changes. To quantify the improvement potential attributable to improved fleet sizing and better car distribution, the corresponding values were subtracted from the 1973 PC performance as measured by empty car days per load.

*Line Rehabilitation.*—Improvements in this area were based on the expected increase in road train speed due to rehabilitation.

*Operating Control System.*—An effective operating control system is a prerequisite for the fleet sizing and allocation savings. Such a system also would provide secondary benefits that would affect car utilization, including:

- Capability to plan yard operations and train make-up,
- Industrial switching being completed in a timely manner as cars are released or empty order match is issued and
- Reduction of hold cars due to missing waybills and waiting for distribution instructions.

The projected utilization improvement by car type resulting from all of these improvement factors is shown in Table 27.

In *Evaluation of the U.S. Railway Association's Preliminary System Plan*, the Rail Services Planning Office (RSPO) questioned the ability of ConRail to achieve the 31 percent increase in freight car utilization as projected in the Preliminary System Plan.<sup>37</sup> RSPO's analysis examined the separate aspects of car utilization

<sup>37</sup> The Association's projected 31 percent utilization improvement as stated in the Preliminary System Plan was subsequently revised to 28.4 percent for the Final System Plan.

TABLE 27.—ConRail car utilization savings

Car type	(Car days/load originated on-line)		
	1973 utilization level	1985 improved utilization	Percent improvement
Plain box.....	33.4	23.0	31.0
Equipped box.....	24.9	16.6	34.0
Covered hopper.....	27.8	18.6	33.0
Gondola.....	27.4	18.7	32.0
Open-top hopper.....	16.6	12.1	27.0
Flat.....	38.1	24.0	37.0
TOFC.....	4.7	4.5	4.0
Multi-level.....	11.0	10.8	2.0
All other cars.....	40.0	37.4	6.0
Weighted average.....	21.8	15.6	28.4

SOURCE: Strong, Wishart & Associates' *Freight Car Planning, Final System Plan, USRA, June, 1975*.

and concluded that 90 percent of this increase in utilization must come from improved yard throughput and car distribution improvements.

To place these projected improvements in perspective, it is helpful to examine historical utilization statistics. In 1973, freight car mileage per day on the Penn Central averaged 39 miles. The projected 28.4 percent utilization improvement means, therefore, that the average freight car mileage per day would climb from 39 miles to 50 miles during the next 10 years. This anticipated improvement compares favorably with the Penn Central's 18 percent increase over the last 5 years, a period during which the railroad did not have the type of centralized car distribution system recommended for ConRail.

The potential improvement is reinforced by an independent Penn Central study which estimated a 24 percent potential improvement in utilization by 1985 through expansion of the PC's Transportation and Billing System (TABS). The somewhat higher expectations by SWA are based on the installation and use of TOPS, a Total Operations Processing System now in use on the Southern Pacific and several other railroads. The improvements for ConRail depend on important changes in operations, maintenance, car management

and control systems and a greatly improved information system.

In addition to the savings projected from improved distribution techniques, ConRail's equipment utilization also should be improved due to implementation of an improved blocking plan that is projected to reduce car handling in intermediate yards by 25 percent and the implementation of terminal operating plans which should expedite car movements to and from shippers and interchange locations.

Certain industry-wide efforts to improve national car fleet utilization also could increase USRA's projections. These efforts include improving reliability of railroad freight service, the freight car clearing-house concept, incentives to reduce the time shippers keep cars for loading and unloading, reducing the present daily increment of 24 hours to a shorter time period for *per diem* charges, single ownership of general purpose fleets such as Railbox and additional interrailroad run-through trains bypassing interchange terminals.

The utilization improvement that ConRail should be able to attain by itself, combined with the benefits that might be derived from industry efforts, make the projected 28.4 percent improvement achievable.

### OPEN-TOP HOPPER SITUATION

The largest single portion (28 percent) of ConRail's freight car fleet will be open-top hopper cars. One-third of the projected car loadings over the next 10 years will be in this car type. To satisfy this demand, the estimated acquisitions of hoppers will account for 69 percent of all cars acquired. One-third of the retirements will be from this car group. Open-top hoppers are projected to constitute over one-quarter of the heavy repair program.

ConRail will have to consider whether to rebuild existing 70-ton cars or purchase 100-ton cars, as a program to rebuild these cars would compete with other types of cars for shop space and material availability. Preliminary computer analyses of the investment in new or rebuilt hoppers indicate that given present equipment costs, freight rates and car utilization, such expenditures might not be cost effective. In the future, should ConRail be able to obtain more satisfactory utilization and more compensatory freight rates, buy-

ing or rebuilding cars for this traffic could then be justified economically.

This type of computer analysis indicates the critical importance to all parties of improving equipment utilization and the yield on rates in many commodities. In addition, it indicates that the present rate of inflation in equipment prices may adversely affect that business substantially because the value of the equipment in some car types for many current traffic movements is now less than its cost.

Recognizing this problem, ConRail should discuss with utility companies and coal and ore customers alternative methods of supplying and paying for cars, including private ownership of open-top hoppers with resulting lower rates. Care should be exercised, however, not to transfer the problem back to the railroad in the form of rate reductions below the railroad's residual costs.

To achieve the projected levels of utilization, the management of ConRail should establish an effective operating control system to support freight car distribution. The benefits of such a system would be felt on several levels. ConRail would save capital by having fewer cars. The resultant smaller fleet would save main-

tenance and repair expenses. These cascading benefits would increase ConRail's ability to provide timely, efficient transportation service and enhance its competitive position in the marketplace. At the same time, ConRail would be able to meet shippers' needs with this smaller fleet.

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## Locomotives

As with freight cars, the railroad's investment in locomotives as a percent of total investment is increasing. The Association has studied the locomotive maintenance and utilization practices on the railroads in reorganization and developed recommendations for improvement. Based on the projected supply of locomo-

tives, the Association estimated the fleet additions required to handle ConRail's projected tonnage.

## Existing Locomotive Fleet

USRA has updated its inventory of freight locomotives of the ConRail revised roads since publication of the Preliminary System Plan. These inventories are summarized below and detailed in Table 28.

TABLE 28.—United States Railway Association; summary of locomotives by railroad; leased, trust agreements, conditional sales agreements and owned locomotives

Type locomotive	Builder	Builder model	Wheel arrangement	Number of units			Leased	Trust	C.S.A.	Owned
				A	B	Total				
Penn Central:										
Diesel road freight.....	EMD	F3; F7	B-B	100	11	111				111
	"	FP7	"	19	2	21				21
	"	GP9	"		40	40	30		10	
	"	GP20	"	13		13		13		
	"	GP30	"	62		62			52	10
	"	GP35	"	146		146	63	23	58	2
	"	SD35	C-C	40		40	40			
	"	GP40	B-B	272		272	252	5	15	
	"	SD40	C-C	110		110	45	57	8	
	"	SD45	"	135		135	70		65	
Subtotal.....				897	53	950	500	98	208	144
	ALCO	RS32	B-B	24		24		14		10
	"	RS27	"	15		15			15	
	"	C424	"	1		1				1
	"	C425	"	41		41	15	10	16	
	"	C628	C-C	15		15	10	5		
	"	C430	B-B	10		10	10			
	"	C630	C-C	15		15			15	
	"	C636	"	15		15	15			
Subtotal.....				136		136	50	29	46	11
	G.E.	U23B	B-B	77		77	77			
	"	U25B	"	152		152	40	45	56	11
	"	U25C	C-C	20		20	10	10		
	"	U28B	B-B	2		2		2		
	"	U28C	C-C	15		15			15	
	"	U30B	B-B	60		60	40	20		
	"	U30C	C-C	5		5			5	
	"	U33B	B-B	81		81	81			
	"	U33C	C-C	24		24	24			
Subtotal.....				436		436	272	77	76	11
Total diesel road freight.....				1,469	53	1,522	822	204	330	166
Diesel road switcher (over 1,500 hp):										
	EMD	GP7	B-B			237	75		35	127
	"	SD7	C-C			2				2
	"	GP9	B-B			453	84		40	329
	"	SD9	C-C			25	25			
	"	GP38	B-B			491	479		12	
	"	SD38	C-C			35	35			
Subtotal.....						1,243	698		87	458
	ALCO	RS3	B-B			97				97
	"	RSD4	C-C			4				4
	"	RS11	B-B			53	13			40
	"	RSD12	C-C			25	25			
	"	RS11 (Mod.)	B-B			6	6			
	"	RSD15	C-C			5				5
Subtotal.....						190	44			146
	G.E.	U23C	C-C			19	19			
Total diesel road switchers.....						1,452	761		87	604

TABLE 28.—United States Railway Association; summary of locomotives by railroad; leased, trust agreements, conditional sales agreements and owned locomotives—Continued

Type locomotive	Builder	Builder model	Wheel arrangement	Number of units			Leased	Trust	C.S.A.	Owned
				A	B	Total				
Diesel road passenger.....	EMD	E7a	Ala-Ala			4				4
	"	E8a	"			35				35
	"	FL9	B-Ala			30				30
	"	FL9	"			30		30		
Total diesel road passenger.....						99		30		69
Diesel yard switcher (under 1,500 hp).	EMD	SW1	B-B			142				142
	"	SW8	B-B			28				28
	"	SW900	B-B			16				16
	"	NW2	B-B			58				58
	"	SW7; SW9; SW1200	B-B			296	55		25	216
	"	SW1500	B-B			89	89			
Subtotal.....						629	144		25	460
	ALCO	S6	B-B			3				3
	"	S10	B-B			11				11
	"	RS10	B-B			4				4
	"	S12	B-B			17				17
	"	RS12	B-B							
	"	LE-RS12 (EMD)	B-B			1				1
Subtotal.....						36				36
	BALDWIN	S1; S3	B-B			15				15
	"	S2; S4	B-B			76				76
	"	T6	B-B			6	6			
	"	RS1	B-B			13				13
	"	RS3(EMD)	B-B			25				25
	"	AEH12 (EMD)	CC+CC			1				1
Subtotal.....						136	6			130
	G.E.	44 ton	B-B			1				1
Total diesel yard switchers.....						802	150		25	627
SUMMARY OF DIESEL ELECTRIC LOCOMOTIVES										
Road passenger.....						99		30		69
Road freight.....						1,522	822	204	330	166
Road switcher type—1,500 hp and over.						1,452	761		87	604
Yard switcher type—1,500 hp and under.						802	150		25	627
Grand total.....						3,875	1,733	234	442	1,466
Penn Central: electric locomotive:										
Road passenger	PRR/GE/ WE	GG1	2-C+C-2			41				41
	ALCO/GE	P2b	2-C+C-2							
	ALCO/GE	T3b	B-B+B-B			1				1
	G.E.	E40	C-C			6				6
Subtotal.....						48				48
Road freight.....	G.E.	E44	C-C			44	44			
	G.E.	E44a	C-C			22	22			
	PRR/GE/ WE	GG1	2-C+C-2			37				37
	G.E.	E33	C-C			10				10
Subtotal.....						113	66			47

TABLE 28.—United States Railway Association; summary of locomotives by railroad; leased, trust agreements, conditional sales agreements and owned locomotives—Continued

Type locomotive	Builder	Builder model	Wheel arrangement	Number of units			Leased	Trust	C.S.A.	Owned
				A	B	Total				
Switching.....	PRR	B1	C							
	ALCO	S2	2-D-2			6				6
Subtotal.....						6				6
Total electric locomotive.....						167	66			101
Lehigh Valley Railroad:										
Diesel road switcher (over 1,500 hp).	EMD	GP-18	B-B	6		6				6
	EMD	GP-38	B-B	4		4				4
	EMD	GP-38-2	B-B	12		12	12			
Subtotal.....				22		22	12			10
	ALCO	RS-2	B-B	4		4				4
	ALCO	RS-3	B-B	6		6				6
	ALCO	RS-11	B-B	6		6	6			
	ALCO	C-420	C-C	12		12	12			
	ALCO	C-628	C-C	17		17				17
	ALCO	DL-701	B-B	4		4				4
	G.E.	U23B	B-B	12		12	12			
Subtotal.....				61		61	30			31
Total road switchers.....				83		83	42			
Diesel yard switcher.....	EMD	SW1	B-B	2		2				2
	EMD	SW6, 7, 8, 9	B-B	52		52				52
	EMD	NW2	B-B	6		6				6
Subtotal.....				60		60				60
Total yard switchers.....				60		60				60
SUMMARY OF DIESEL ELECTRIC LOCOMOTIVES										
Diesel road switchers.....						83	42			41
Diesel yard switchers.....						60				60
Grand total.....						143	42			101
Central of New Jersey:										
Diesel road switcher-freight.....	EMD	GP7	B-B	4		4				4
	"	SD35	C-C	12		12		12		
	"	SD40	C-C	9		9		9		
Subtotal.....				25		25		21		4
	ALCO	RS3	B-B	33		33				33
Total road freight.....				58		58		21		37
Diesel road switch-passenger.....	EMD	GP7	B-B	9		9				9
	"	GP40	B-B	13		13	13			
Subtotal.....				22		22	13			9
Diesel yard switcher.....	EMD	SW600	B-B	4		4				4
	"	SW900	B-B	15		15				15
	"	SW1000	B-B	2		2				2
Subtotal.....				21		21				21
SUMMARY OF DIESEL ELECTRIC LOCOMOTIVES										
Road switcher-freight.....						58		21		37
Road switcher-passenger.....						22	13			9
Yard switcher.....						21				21
Grand total.....						101	13	21		76

TABLE 28.—United States Railway Association; summary of locomotives by railroad; leased, trust agreements, conditional sales agreements and owned locomotives—Continued

Type locomotive	Builder	Builder model	Wheel arrangement	Number of units			Leased	Trust	C.S.A.	Owned
				A	B	Total				
Ann Arbor Railroad:										
Diesel road switcher (over 1,500 hp).	EMD	GP-35	B-B	10		10				10
Diesel yard switcher	ALCO	S1, S3	B-B	2		2				2
		S2	B-B	1		1				1
		RS1	B-B	2		2				2
Subtotal/yard switcher				5		5				5
Lehigh & Hudson River:										
Diesel road switcher (over 1,500 hp).	ALCO	C-420	C-C	6		6				6
Pennsylvania—Reading Seashore Line:										
Diesel road switcher (over 1,500 hp).	EMD	GP38	B-B	10	0	10	10			
Subtotal				10		10	10			
Yard switcher	Baldwin	S-8	B-B	1	0	1				1
	"	S-16	B-B	3	0	3				3
	"	S-12	B-B	10	0	10				10
Subtotal				14		14				14
Total diesel switcher				24		24	10			14

NOTE: Above figures for Penn Central as of Apr. 1, 1974.

SOURCE: Railroad Operating Records, October 1974 supplemented by USRA staff analysis.

Freight locomotives

	PC	LV	CNJ	AA	LHR	PRSL	Total
Diesel:							
Road freight	1,522						1,522
Road switcher	1,452	83	58	10	6	10	1,619
Yard switcher	802	60	21	5		14	902
Total diesel	3,776	143	79	15	6	24	4,043
Electric:							
Road freight	113						113
Yard switcher	6						6
Total electric	119						119
Grand total	3,895	143	79	15	6	24	4,162

Only 12 new freight locomotives have been added to this fleet since 1973. The combined fleet is, however, basically sound. Overall, reasonable heavy repair programs have continued on the Penn Central and Lehigh Valley fleets, although the CNJ fleet is deteriorating both in general condition and availability for service. With current depressed business conditions, the railroads in reorganization have stored some of their least efficient units.

Projected Locomotive Fleet Requirements

Based on historical relationships, additional locomotive requirements during the 1976-85 period have been

related to projections of future ConRail tonnage in the area of:

- Road freight fleet, a direct function of percentage changes in tonnage volume,
- Road switcher fleet, a 50-percent incremental relationship to tonnage changes and
- Yard-switcher fleet, a 25-percent incremental relationship to volume changes.

In addition to tonnage, four other factors are determinants in projecting locomotive requirements.

*Track Rehabilitation.*—Reductions in over-the-road train running times resulting from plant rehabilitation will affect road fleet utilization. The Association estimates a 15.8-percent reduction in train running times which will enable ConRail to operate with fewer locomotives with most of the reduction realized in road freight units.

*Yard Rehabilitation.*—This program is not expected to affect yard engine performance significantly until 1979, at which time minor utilization improvements should be realized.

*Consolidations and Abandonments.*—Locomotive savings are anticipated from interchange consolidations, branch line abandonments and transfer of certain facilities to solvent carriers. The magnitude of the savings was based on previous merger and abandonment studies. Savings from these sources are projected to begin in 1977 for the road-switcher fleet and will con-

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tinue increasing for 6 years. Savings estimated for the yard-switcher fleet begin in 1978 and continue through 1985. No savings in the road-freight fleet are projected from these sources.

*Utilization Improvements.*—Locomotive utilization gains also will accrue from higher levels of use and increased levels of mechanical effectiveness, subjects discussed later in this section.

*Special Requirements for Road Freight and Road Switcher Units.*—As ConRail through freight operations are moved from the electrified Penn Central Northeast Corridor main line to the nonelectrified main lines of the Baltimore & Ohio, Reading and Lehigh Valley from Washington to New York, projections for the road-freight fleet include the anticipated replacement of the 113 existing Penn Central electric-freight units with 142 diesel units, a 5 to 4 replacement ratio. This ratio results in a reduction in total horsepower, but it will eliminate those points, or interfaces, where electrification ends and diesel locomotives are then utilized. The elimination of the electric-diesel interfaces will reduce locomotive idle time typically introduced at points where power is changed and thereby reduce the total diesel acquisitions that would have otherwise been required. Although the ConRail operating plan assumes that the existing electrified freight operations will be converted to diesel, a systemwide study of electrification also is under way which may alter this assumption. It is described later in this section.

In addition, the estimated need for more work trains for track rehabilitation will demand additional road switching units. Since many work-train operations are likely to fall in off-peak traffic seasons, it is estimated that 25 percent of this locomotive demand can be met by units required for peak-revenue traffic, available in off-peak periods as is customary in the industry.

The total fleet requirement, based on changes in tonnage levels and the adjustments noted above, must be modified to reflect retirements, temporary allocations and conversions to define ConRail's expected fleet requirements. These adjustments are discussed below.

*Retirements.*—To determine the extent of necessary locomotive retirements through 1985, USRA conducted its own analysis, studying retirement projections of the railroads in reorganization and considering the recommendations of the Association's locomotive utilization consultant, Emerson Consultants, Inc.

USRA based its projections on present conditions. ConRail may have to revise these projections in the light of future developments, such as major technological advances in locomotive design, substantial changes in the cost of overhauling locomotives as opposed to replacing them or a decision to electrify key line segments. The following three factors should be noted concerning USRA's recommended locomotive retirement policy.

- Retirements from the road-switcher fleet should be curtailed in 1976 and 1977 to reduce purchases during ConRail's early low-volume traffic years. Retirements should be increased to normal levels in 1978 to begin to eliminate obsolete units in the fleet.
- Normally, locomotive production capacity limits the number of new units ConRail may acquire in a single year to 250. The retirement policy was affected by this constraint during some years.
- The Association projects an accelerated major repair schedule for ConRail locomotives. During the 1976-85 period, major repairs to road locomotives would average 610 units per year, an increase of over 20 percent from current repair levels on the railroads in reorganization. Major repairs to switcher locomotives would average 99 units per year.

*Temporary Allocations.*—The need for temporary allocations was projected between the road-freight and road-switcher fleets in 1976. Some road-freight units, because of a fleet surplus, temporarily would be assigned to the road-switcher fleet which is projected to have shortages in 1976. In 1977, the road-freight units would be returned to their normal use and replaced in the road-switcher fleet by new units.

*Conversions.*—Conversion of selected units from road to yard switchers was projected to be made during the 10-year period. These conversions not only would allow upgrading the yard fleet with suitable older units but also would enable upgrading the road-switcher fleet with new power.

*Locomotive Horsepower Growth.*—The net available units resulting from these three adjustments represented the available fleet to meet calculated locomotive requirements. The unfilled demand represented the necessary acquisition level in 1973 unit equivalents. Since locomotives now being made and those to be made in the future will have greater horsepower than the average of units now in service, not as many will be required. The resulting adjustment factors for converting 1973-equivalent unit requirements into actual acquisitions were the following.

Unit type	Adjustment factor
Road freight.....	0.88
Road switcher.....	0.95
Yard switcher.....	0.92

The results of this analysis are summarized below (see Table 29 for yearly details).

#### Locomotive Utilization

Utilization is a major determinant of the size of locomotive fleet ConRail will require. For locomotives, utilization is composed of time utilization and detention.

TABLE 29.—ConRail locomotive demand worksheet—in units

Fleet—Year	Beginning fleet	Traffic Volume change		Track rehabilitation changes		Consolidation and abandonment		Utilization improvement		Other units	Fleet required
		Percent	Units	Percent	Units	Percent	Units	Percent	Units		
<b>Road freight:</b>											
1975	1,553	(13.20)	(205)								1,348
1976	1,348	4.63	72					(.5)	(7)		1,418
1977	1,418	2.64	41	(.5)	(7)			(.5)	(7)	71	1,511
1978	1,511	(2.06)	(32)	(1.0)	(15)			(.5)	(8)	71	1,527
1979	1,527	2.03	32	(1.0)	(15)			(1.0)	(15)		1,529
1980	1,529	7.44	116	(1.5)	(23)			(1.0)	(15)		1,607
1981	1,607	3.41	53	(1.5)	(24)			(1.5)	(24)		1,612
1982	1,612	3.41	53	(1.5)	(24)			(1.0)	(18)		1,625
1983	1,625	3.41	53	(1.0)	(18)			(.5)	(8)		1,654
1984	1,654	3.41	53	(1.0)	(17)						1,690
1985	1,690	3.41	53	(1.0)	(17)						1,726
<b>Total</b>	<b>1,552</b>	<b>18.53</b>	<b>289</b>	<b>(10.0)</b>	<b>(158)</b>			<b>(6.5)</b>	<b>(100)</b>	<b>142</b>	
<b>Road switcher:</b>											
1975	1,559	(6.60)	(103)								1,456
1976	1,456	2.32	36							5	1,497
1977	1,497	1.32	21			(.25)	(4)	(.5)	(7)	5	1,512
1978	1,512	(1.03)	(16)	(.5)	(8)	(.5)	(8)	(.5)	(8)	5	1,477
1979	1,477	1.02	16	(.5)	(7)	(.5)	(7)	(1.0)	(15)	4	1,468
1980	1,468	3.72	58	(.5)	(7)	(1.5)	(22)	(1.0)	(15)	12	1,494
1981	1,494	1.70	27	(.5)	(7)	(1.5)	(22)	(1.0)	(15)	1	1,478
1982	1,478	1.71	27	(1.0)	(15)	(1.0)	(15)	(.5)	(7)		1,468
1983	1,468	1.70	27	(1.0)	(15)						1,480
1984	1,480	1.71	27	(1.0)	(15)						1,492
1985	1,492	1.70	27	(.5)	(7)					(3)	1,509
<b>Total</b>	<b>1,489</b>	<b>9.27</b>	<b>147</b>	<b>(5.5)</b>	<b>(81)</b>	<b>(5.25)</b>	<b>(78)</b>	<b>(4.5)</b>	<b>(67)</b>	<b>29</b>	
<b>Yard switcher:</b>											
1975	968	(3.30)	(32)								936
1976	936	1.16	11					(.5)	(5)		942
1977	942	.66	6					(1.0)	(9)		939
1978	939	(.52)	(5)			(1.0)	(9)	(1.0)	(9)		916
1979	916	.51	5	(.25)	(2)	(1.0)	(9)	(1.0)	(9)		901
1980	901	1.86	18	(.25)	(2)	(1.0)	(9)	(.5)	(4)		904
1981	904	.85	8	(.25)	(2)	(1.0)	(9)	(.5)	(4)		897
1982	897	.85	8	(.5)	(4)	(1.0)	(9)	(.5)	(4)		888
1983	888	.85	8	(.5)	(4)	(1.0)	(9)	(.5)	(4)		879
1984	879	.85	8	(.5)	(4)	(1.0)	(9)	(.5)	(4)		870
1985	870	.85	8	(.5)	(4)	(1.0)	(9)	(.5)	(4)		861
<b>Total</b>	<b>913</b>	<b>4.62</b>	<b>43</b>	<b>(2.75)</b>	<b>(22)</b>	<b>(8.0)</b>	<b>(72)</b>	<b>(6.5)</b>	<b>(56)</b>	<b>0</b>	
<b>Grand total</b>	<b>3,954</b>		<b>479</b>		<b>(261)</b>		<b>(150)</b>		<b>(223)</b>	<b>171</b>	
<b>Percent average fleet</b>	<b>100.0</b>		<b>12.1</b>		<b>(6.6)</b>		<b>(3.8)</b>		<b>(5.6)</b>	<b>4.3</b>	

SOURCE: Emerson Consultants, Inc. June 1975.

A major determinant of locomotive detention is mechanical effectiveness.

*Time Utilization.*—Figure 9 displays the elements in the locomotive time cycle. “Utilized time” is the time during which a locomotive actually is moving a train. “Unavailable detention time” is the time consumed in yards moving to and from road trains and in mechanical servicing. “Available but not used detention time” is the time that units are available for service but are not used in train operation. As Figure 9 shows, Penn Central units presently are utilized 12.38 hours per day. By increasing the number of hours each locomotive actually is moving trains, the number of new locomo-

tives required will be reduced. It is projected that ConRail would be able to increase productive utilization time per day to 13.4 hours by:

- Improved mechanical facilities, operating plans and procedures to reduce detention time,
- Improved information systems, such as has been proposed for use in distributing cars, to allow a closer matching of locomotive supply and demand, thus reducing idle time,
- Greater standardization of the locomotive fleet and
- Explicit recognition of peak traffic demands accompanied by appropriate planning to maximize locomotive utilization during these periods.

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ConRail locomotive fleet<sup>1</sup> 1976-85

	Road freight	Road switcher	Yard switcher	Total fleet
Beginning inventory—				
1975.....	1,576	1,565	902	4,043
Retirements:				
Number.....	(291)	(393)	(521)	(1,205)
Percent 1975 fleet.....	18.5	25.1	57.8	29.8
Conversions:				
Number.....		(426)	426	
Percent 1975 fleet.....		27.2	47.2	
Net acquisitions:				
Number.....	388	721	45	1,154
Percent 1975 fleet.....	24.6	46.0	5.0	28.5
Projected fleets:				
1976.....	1,413	1,497	942	3,852
1980.....	1,531	1,472	904	3,907
1985.....	1,673	1,471	856	4,000

<sup>1</sup> The road freight figure of 1,576 includes 25 CNJ and 29 LVRR units which were classified as road switchers in Table 28. Similarly, the figure of 1,565 for road switchers is 54 units less than that shown in Table 8. This adjustment was necessary to more realistically reflect the type of service performed by these 54 units which are presently used for road-freight service despite their inventory classification. This table excludes the 119 existing electric locomotives in freight service but includes the diesel locomotives necessary to replace these existing electric locomotives.

**Mechanical Effectiveness.**—Mechanical effectiveness is the reliability with which locomotives operate while being utilized in train service.

Increased reliability will:

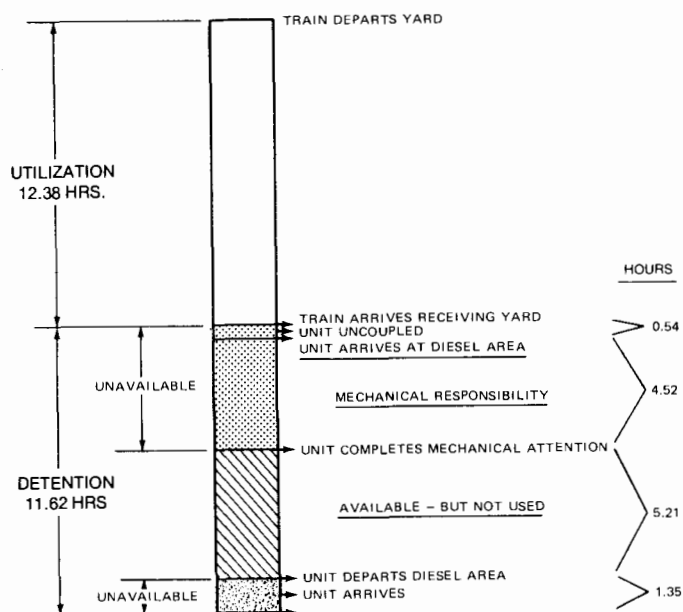
- Reduce train overpowering<sup>38</sup> to protect against locomotive failures while in train service and
- Reduce the number of instances in which locomotives must receive unscheduled emergency service, upsetting planned shop workloads and material requirements and increasing locomotive out-of-service time.

A greater emphasis on quality control, both in routine maintenance and in rebuilding programs, is essential to increase mechanical effectiveness. To accomplish this, the following are necessary.

- An effective locomotive quality control system should be developed to pinpoint individual units which have high failure rates and identify general problem areas with a particular model of locomotive.
- Mechanical work forces should be increased to a level which would produce an optimum level of reliability.

<sup>38</sup> "Overpowering" is the practice of using more locomotives on a train than is required for movement of the tonnage. This is done to increase train speed and/or to protect against failure of one of the locomotive units.

Figure 9.—Locomotive unit time cycle—hours



Source: Emerson Consultants, Inc.  
June 1975

- Locomotive rebuilding programs should consider not only initial costs but also the anticipated reliability of the rebuilt units.
- Greater attention must be paid to preventive maintenance.

### Electrification

The recommended change in the road-freight fleet includes replacement of existing Penn Central electric-freight units with diesel locomotives to facilitate moving the Corridor freight operations to the nonelectrified B&O line, assuming a final agreement is reached with the Chessie for purchase or lease of that alternate route (see FSP Chapter 2). The Association, however, is also evaluating the potential for electrifying an estimated 2,900 miles of ConRail main line.

Until recently, there was little interest in railroad electrification in the United States, primarily because this country builds diesel locomotives that are relatively inexpensive, powerful, reliable and economical to operate, especially when fuel oil was far less expensive. Unlike Europe and Japan, diesel and electric locomotives in this country are competitive in price per horsepower.

Recently, changes have occurred which could make railroad electrification more desirable than a diesel-oriented operation. Fuel prices have risen sharply and the possibility of fuel shortages continues to cloud the future. Development of the solid-state rectifier and

thyristor controls, which permit electric locomotives to operate directly from commercial frequency high-voltage power sources, has improved the economic outlook for electrification. These developments also have made possible the use of a far less costly catenary system not only as the power transfer device but also as the distribution medium, eliminating expensive frequency conversion equipment. It is reasonable to anticipate that with a major electrification program, the scale economies also would reduce the investment required for electrification significantly, which in the past was sufficiently expensive to make it uneconomic to electrify any but the highest density routes.

*Analytic Approach.*—To develop a thorough understanding of these factors and to carry out a preliminary economic analysis, USRA has engaged Arthur D. Little, Inc. to determine which segments of ConRail might have immediate economic justification for electrification and which other segments show future potential for electrified operations. Initially, the contractor is evaluating the following 2,900 miles of ConRail line segments. They are:

- St. Louis to Cleveland (via Indianapolis, Union City and Crestline, Ohio.),
- Chicago to Springfield, Mass. (via Cleveland, Buffalo and Selkirk),
- Toledo, Ohio to Newark, N.J. (via Crestline, Alliance, Pittsburgh, Harrisburg and Allentown),
- Harrisburg to Philadelphia (via Columbia, Pa.),<sup>39</sup>
- Harrisburg to Perryville, Md.<sup>40</sup>
- Detroit to Cincinnati (via Toledo, Columbus, and Dayton),
- Cleveland to Alliance, Ohio and
- Washington to Manville, N.J. (via B&O from Washington to Philadelphia and the former Reading from Philadelphia to Manville, N.J.).

A number of factors are being explored to determine whether it would be desirable for ConRail to expand electrified operations. For example, the consultants are studying whether the cost of building an overhead catenary system with the appropriate power distribution facilities and signalling systems would be offset by higher electric locomotive performance and lower equipment maintenance costs. Specific factors and tasks under study relative to the economic feasibility of electrifying segments of ConRail include:

- Catenaries. Determine the installation cost of an entire catenary system, including the associated switching equipment. Evaluate the relative cost of owning substations versus buying commercial power at catenary voltage levels.
- Signal and communications. Determine the costs of modifying signal and communications systems, including the placing of all cables underground.

<sup>39</sup> Line segment already electrified.

<sup>40</sup> *Ibid.*

- Locomotives. Define the basic unit costs and the size of fleet required to replace the diesel units. Allowance will be made for reduced turnaround times and the higher horsepower per trailing-gross-ton usually possible with electric locomotives. Additional allowances will be made for the higher horsepower per unit and the higher ratio of intermittent horsepower to rated horsepower (perhaps reducing or eliminating helper service). An offsetting increase in unit requirements resulting from utilization loss at points of interface between electric and diesel locomotives also will be considered.
- Motive Power Maintenance. Estimate possible savings from lower maintenance requirements generally needed by electric locomotives.
- Signal and Communication. Define specific costs per road mile for signal and communication maintenance, which is generally more expensive in an electrified system.
- Energy. Project the relative cost and expected availability of diesel fuel and electric power on a regional basis.
- Environment. Determine the environmental consequences of shifting from diesel to electric.
- Civil Construction. Estimate the amount of potential major expenditures for such projects as improving clearances, daylighting tunnels, raising bridges and widening cuts to provide for catenary requirements.

This preliminary analysis of electrification should be completed by the end of September 1975. If the study concludes that ConRail would be justified to consider electrification of significant portions of their system, the Association may recommend that ConRail begin detailed feasibility studies.

### Mechanical Facilities—Freight Services

ConRail will require mechanical facilities to handle:

- A freight-car fleet of approximately 140,000 cars,
- A freight-locomotive fleet of approximately 4,000 units,
- Heavy and medium repairs to an average 10,000 freight cars per year and
- Major repairs to an average 700 locomotives per year.

The Altoona shops of the Penn Central, which include the Samuel Rea Car Shop and the Juniata Locomotive Shop, will be the major mechanical facilities on ConRail. These shops should handle nearly all heavy and medium car repairs and a large portion of the major locomotive repair program. In addition, the Altoona shops will be the primary suppliers of reconditioned locomotive and freight car components to ConRail.

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The operating plan assumes that equipment repair programs will be expanded sufficiently by 1985 to reduce ConRail's freight car bad order ratio from 13 percent to 5 percent. It also assumes an expanded locomotive heavy repair program. To carry out such expanded car and locomotive repair programs, it is necessary to improve the operating effectiveness of the facilities at Altoona. This requires improved tooling, better manpower training and expanded maintenance forces in those areas where coverage currently does not meet minimum levels for effective repairs and equipment maintenance.

USRA estimates that \$14.5 million in capital improvements are required at Altoona if it is to fulfill the needs of ConRail efficiently. This investment represents over one-half of the total anticipated ConRail expenditures to upgrade all major shop facilities.

The proposed capital improvements at the other major facilities are displayed in Table 30.

In addition to upgrading shop facilities, the Association believes that some of the present locomotive servicing facilities require extensive improvements. These improvements will minimize delays in preparing loco-

TABLE 30.—Capital improvements, major shop facilities—ConRail freight operations

Shop and location	Current activity	Proposed capital improvement—dollars	Future activity role
Altoona, Pa., Juniata locomotive shop.....	Locomotive heavy repair and locomotive component rebuild.	\$6,819,000	Increased production of locomotives and rehabilitated components with strong emphasis on improved quality.
Hollidaysburg, Pa., Samuel Rea car shop.....	Heavy repair of freight cars.....	7,665,000	Increase over current production levels. Capabilities for heavy rebuilding and for new car production. Rebuild costs and new car costs, however, must be within competitive guide lines.
Cleveland, Ohio, Collinwood locomotive shop....	Limited locomotive heavy repairs and locomotive component rebuilding.	(1)	Production of Alco and G.E. rehabilitated components. Locomotive truck production and heavy repairs to locomotives.
Albany, N. Y., Selkirk locomotive shop.....	Running maintenance to a large fleet of road locomotives. Heavy maintenance programs in progress.	125,000	No extensive changes in activities anticipated. Requires locomotive service area upgrading.
Albany, N. Y., Selkirk car shop.....	Running maintenance to freight cars..	125,000	Upgrade RIP track.
Syracuse, N. Y., DeWitt locomotive shop.....	Running maintenance shop for local and switching locomotives modification.	125,000	No changes anticipated in early years. Upgrade servicing facilities.
Syracuse N. Y., DeWitt car shop.....	Running maintenance to freight cars..	125,000	Improvements to RIP track. Enclose shop.
Buffalo, N. Y., Frontier locomotive shop.....	Running maintenance to local and switcher locomotives.	118,000	To extend present shop to obtain additional shop space.
Buffalo, N. Y., Frontier car shop.....	Running maintenance to freight cars..	125,000	Upgrade building housing RIP tracks to obtain increased production of repaired cars and to increase FRA inspections.
Elizabethport, N. J., locomotive shop.....	Running maintenance to locomotives.	1,025,000	New sanding and fueling facilities. Inspection pit and track changes.
Allentown, Pa., diesel shop.....	Running maintenance to locomotives.	850,000	New sanding and fueling facilities. Inspection pit changes.
Allentown, Pa., car shop.....	Running maintenance to freight cars..	125,000	Improvements to RIP track.
Baltimore, Md., Bay View car shop.....	Running repairs to freight cars.....	200,000	Upgrade a modern car repair facility for increased production.
Morrisville, Pa., Morrisville locomotive shop.....	Running maintenance to road, local, and yard locomotives.	700,000	Significant changes in work load may result after conveyance of Delmarva routes to solvent railroad. Requires upgrading to servicing facilities.
Harrisburg, Pa., Enola diesel shop.....	Running maintenance to a large fleet of road locomotives, diesel and electric.	250,000	Continues to be a high production unit for locomotive maintenance. Alterations to shop tracks and servicing facilities required to reduce detentions to locomotives in shop area.
Harrisburg Pa., diesel shop.....	Running maintenance to passenger locomotives and road freight locomotives, limited heavy repair work.	(2)	An important shop to ConRail for freight locomotive maintenance and an important installation due to its location and capabilities of a well designed facility.
Pittsburgh, Pa., area, Conway diesel shop.....	Running maintenance to road, local and switcher locomotives.	3,500,000	New shop needed to replace an obsolete, inefficient facility at an important yard installation.
Ashtabula, Ohio, car shop.....	Car repairs to large number of cars involved in coal and ore pier operation.	200,000	Upgrade RIP tracks and buildings for increased production.

TABLE 30.—Capital improvements, major shop facilities—ConRail freight operations—Continued

Shop and location	Current activity	Proposed capital improvement—dollars	Future activity role
Toledo, Ohio, Stanley diesel shop.....	Maintain and service locomotives used in Toledo and Detroit areas.	400,000	Upgrade servicing facilities and improve shop tools to increase production at an important area shop.
Chicago, Ill., 59th Street diesel shop.....	Terminal servicing and local locomotive maintenance work.	300,000	Upgrade obsolete and inadequate servicing facilities for increased production.
Newark, N.J., Oak Island locomotive shop.....	Running maintenance to locomotives	850,000	New sanding and fueling facilities. Inspection pit and track changes.
Newark, N.J., Oak Island car shop.....	Running maintenance to freight cars..	1,750,000	New RIP track.
Detroit, Mich., West Detroit diesel shop.....	Maintaining yard locomotives in cooperation with Toledo shop servicing terminal for road locomotives.	300,000	Upgrade servicing facilities for increased production.
Indianapolis, Ind., Avon locomotive shop.....	Maintains road, local and yard locomotives.	2,150,000	An important facility in this area. Requires additional storage areas, a wheel-truing machine and servicing area improvement.
Indianapolis, Ind., Avon car shop.....	Running repairs to freight cars.....	125,000	Upgrade repairs to RIP tracks and buildings.
Cincinnati, Ohio, Sharonville locomotive shop....	Running repairs and servicing road and yard locomotive.	1,600,000	Requires new shop to accommodate increased activity in this area. Improved service facility is important to increased productivity.

<sup>1</sup> Under further study.<sup>2</sup> Under study.

Source: USRA staff analysis.

motives for service. The following locations need immediate attention.

Elizabethport—Newark, N.J.	Morrisville—Trenton, N.J.
Oak Island—Newark, N.J.	Selkirk—Albany, N.Y.
Allentown—Allentown, Pa.	Frontier—Buffalo, N.Y.
Conway—Pittsburgh, Pa.	Stanley—Toledo, Ohio
59th Street—Chicago, Ill.	Beacon Park—Boston, Mass.
Junction—Detroit, Mich.	

In addition to capital improvements to mechanical facilities, the impact of an effective management cannot be overemphasized. To carry out the projected maintenance and repair requirements, the mechanical department management should design and use an effective computer-based system to control centrally all mechanical activities and inventories. It also should weigh trade-offs on a continuing basis between labor expense and locomotive reliability or car delay. It should formulate analytical techniques to determine when to repair or acquire equipment and to assist field personnel in making decisions that will improve ConRail's return on its equipment investment. It also must be responsive to changes in business levels, fleet size or composition and safety regulations.

### Mechanical Facilities—Passenger Equipment

USRA anticipates that ConRail will assume on a fully reimbursed basis the passenger operating and equipment maintenance responsibilities of the Penn Central, Reading, Erie Lackawanna and Central of New Jersey. Passenger equipment for each of these roads includes the following.

Car type	PC	RDG	EL	CNJ	Total
Diesel locomotive.....	167	3	33	22	225
Electric locomotive.....	71				71
Commuter cars.....	972	167	230		1,369
Coaches.....	1,333	6	153	149	1,641
RDC rail diesel cars.....	38	16		10	64
Total passenger equipment.....	2,581	192	416	181	3,370

A total of 4,427 employees are engaged in passenger equipment maintenance. The major maintenance shops where most of these employees currently work are listed in Table 31.

At present, the Reading passenger shop at Wayne Junction, Pa., maintains all Reading equipment in the Philadelphia area. The Penn Central commuter equipment in the Philadelphia area is maintained at Paoli, Pa., 30 miles from downtown Philadelphia. With completion of the midcity tunnel now under construction in Philadelphia, it will be possible to maintain both Penn Central and Reading equipment at a single facility. The railroads, as well as the Southeast Pennsylvania Transportation Authority, have studied this problem extensively and have concluded that a new commuter equipment maintenance shop should be constructed at 30th Street in Philadelphia. With a passenger maintenance facility located in downtown Philadelphia, it will be possible to improve utilization of passenger equipment significantly because maintenance can be performed while cars lay over between rush hours rather than either during the morning rush hour (first trick maintenance) or the evening rush hour (second trick maintenance) which is necessary at present, given

TABLE 31.—*Capital improvements, major shop facilities—ConRail passenger operations*

Shop and location	Current activity	Proposed capital improvement—dollars	Future activity role
Wilmington, Del.	Maintain "G" locomotives, Metroliners plus heavy repairs to commuter cars.	Under study	Will continue in present capacity plus picking up heavy maintenance in Reading SEPTA fleet. Also major supplier of commuter car components.
Philadelphia, Pa., Paoli	Maintains Penn Central commuter cars	Under study	No change.
Harmon, NY	Maintains MTA. AC-DC commuter cars, RDC cars, suburban coaches, plus FL-9s.	Under study	No change.
Philadelphia, Pa., Wayne Junction	Maintain Reading SEPTA fleet.	Under study	Needs wheel-truing machine. Will continue to maintain Reading SEPTA fleet with heavy repairs being sent to Wilmington.
Bethlehem, Pa., Bethlehem engine terminal.	None	None	Will cycle Reading RDC to Bethlehem Engine Terminal for periodic inspections and repairs.
Hoboken, N.J.	Maintains EL commuter and push-pull units.	Under study	Needs new shop. EL push-pull locomotives to be assigned to Elizabethport for maintenance.
Baritan, N.J.	Maintain locomotive and suburban cars		New facility—No change.
Boston, Mass.	MBTA maintains RDC cars, suburban coaches, and Diesel locomotives.	Under study	Proposed new shop to handle present equipment and new Amtrak turbo trains.
Sunnyside and Penn Station, N.Y.	Running repairs to "G" locomotives, Metroliner coaches and commuter cars.		No change.
Providence, R.I.	Maintenance of RDC cars, locomotives and suburban coaches.		No change.

SOURCE: USRA staff analysis.

the out-of-town location of the existing passenger maintenance facilities.

It might also be possible to maintain all Amtrak equipment utilized in the Northeast Corridor, including the Metroliners and electric locomotives, at the new 30th Street maintenance facility. If this is possible, the

existing maintenance facility at Wilmington, Del. could be closed.

It is recommended that ConRail, in conjunction with Amtrak and the commuter authorities, review and evaluate the proposal to construct a new maintenance facility at 30th Street in Philadelphia.

## MAINTENANCE AND REHABILITATION OF PHYSICAL FACILITIES

An adequately maintained physical plant is essential to the efficient and dependable operation of a railroad. This includes not only the need for track which will support the number of trains, axle loadings and tonnage to be operated on any given line, but also encompasses yards, signals, bridges and tunnels, servicing plants, shops, buildings, electric traction and communication facilities. The deteriorating condition of the plant of the railroads in reorganization is a major factor adversely affecting the operation of trains. Examples are abundant.

- Because of slow orders, through freight trains between some major yards and terminals now require up to twice the travel time previously necessary when track was maintained adequately. This often makes it necessary to reduce the length of some crew districts and to recrew more trains enroute.
- Slow orders also prevent the efficient operation of high priority piggyback trains. These trains must be dependable and fast to compete in the time sensitive markets.
- Except for the New York-Washington corridor, today's passenger train schedules are often slower than those in existence 30 years ago.
- Portions of some key yards are out of service because the track cannot meet minimum Federal Railroad Administration (FRA) standards. This results in yard congestion and traffic delays.
- Inadequate maintenance of facilities other than track also results in delays to traffic caused by signal interruptions, inability to move controlled switches, communications system failures, etc.
- Freight loss and damage payments from derailments and from operations on poorly maintained track continue to increase.
- Frequency of yard and main-line derailments makes "crisis" operations the norm, reducing planning or control of operations.

One of the major problems faced by the Association in its planning activities has been the magnitude of past deferred maintenance. The Association recognized that without adequate programs for rehabilitation and normal maintenance of key facilities and lines, it would be impossible to implement a reorganization plan which could fulfill the requirements of the Act. After consideration of the present condition of the railroads' facilities and an assessment of work levels necessary to restore the plant and to prevent further deferrals, programs were constructed to provide Con-Rail with the physical plant it will require to support its projected traffic and to compete for new traffic.

### Facilities Evaluation and Planning

Development of realistic programs and cost estimates first required an inventory of all existing facilities as well as an assessment of their present condition. This information gathering initially was conducted by several engineering consulting firms working in conjunction with the Association's staff; one of the consultants acted as the project's technical direction coordinator to assure uniform sampling and reporting procedures.<sup>41</sup> This analysis was necessary as no recent study provided such comprehensive information for the railroads under study. Further, it was essential that the Association base its planning decisions on independent and detailed data depicting the existing condition of the railroads' facilities.

The Association's planning activities also included:

- Determination of deferred work necessary for rehabilitation,
- Determination of normal maintenance levels required to prevent further deferrals,

<sup>41</sup> The Inventory and Assessment project conducted for the Association is described in the Preliminary System Plan, pp. 71-73. A detailed description is contained in *Inventory and Assessment Project for Rail Service in Midwest and Northeast Region*, Bechtel Inc., San Francisco. See PSP, pp. 322-323.

- Assessment of the effect of possible constraints (such as lack of manpower and material) on performing normal maintenance and rehabilitation work,
- Evaluation of the extent to which such constraints could be overcome,
- Consideration of inputs from USRA staff groups including definition of the consolidated system and proposed traffic densities,
- Time phasing of the necessary work functions required to maintain and rehabilitate the system and
- Development of an annual maintenance program.

### Rehabilitation and Maintenance Programs

The work functions required to accomplish the Association's proposed programs were phased over time to represent realistically the resources which would be available in each year of the program. These programs were then translated to cost estimates for use in the Association's *pro forma* financial projections, with the projected expenditures divided between rehabilitation,

normal maintenance and capital. These expenditures were assigned to appropriate major ICC accounts and then, where applicable, were capitalized and depreciated. (A summary of such projected expenditures is shown in Table 32.)

*Rehabilitation.*—This program includes work required to restore a line to a desired level of operations where normal maintenance cycles have not been followed in the past. The primary basis for development of the Association's rehabilitation program was the deferred maintenance identified for all lines as of Fall 1974 by the various consultants under the inventory and assessment contract. The deferred work units then were identified for those lines selected for rehabilitation. Annual normal requirements were added to this base, and a 10-year program was developed to accomplish the desired rehabilitation and to provide an adequate level of normal maintenance to prevent further deferrals.

*Normal Maintenance.*—Normal maintenance involves that level of activity necessary to prevent further de-

TABLE 32.—*ConRail maintenance of way expenditures*

[Millions of 1973 Dollars]

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total
MAJOR ACCOUNTS											
Structures.....	21	21	21	21	21	21	21	21	21	21	210
Ties.....	41	46	45	46	46	47	47	47	48	48	461
Rails.....	16	17	17	25	33	34	35	35	36	37	285
Other track material.....	22	25	25	29	34	35	35	36	36	37	314
Ballast.....	13	13	14	14	14	14	15	15	15	15	142
Track laying and surfacing.....	86	88	78	82	86	88	89	90	91	91	869
Communications and signals.....	30	29	30	31	32	32	32	32	32	32	312
Maintaining joint facilities—net debit.....	11	11	10	10	11	11	12	12	12	12	112
Other M of W accounts.....	102	105	102	106	105	111	109	109	109	110	1,068
Additions and improvements.....	56	82	72	75	89	44	44	44	44	44	594
Total M of W expenditures.....	398	437	414	439	471	437	439	441	444	447	4,367
UNINFLATED											
M of W expenditures capitalized.....	163	201	209	229	258	219	222	224	226	228	2,179
Cost of salvage removal to accumulate depreciation.....	12	13	15	16	18	19	19	19	19	19	169
M of W expenditures charged to operating expenses.....	223	223	190	194	195	199	198	198	199	200	2,019
Total M of W expenditures.....	398	437	414	439	471	437	439	441	444	447	4,367
INFLATED DOLLARS											
M of W expenditures capitalized.....	217	293	332	394	478	433	468	504	542	587	4,248
Cost of salvage removal to accumulate depreciation.....	16	19	24	29	34	37	40	42	46	49	336
M of W expenditures charged to operating expenses.....	298	324	301	332	362	394	418	446	479	515	3,869
Total M of W expenditures.....	531	636	657	755	874	864	926	992	1,067	1,151	8,453

ferrals. The Association's proposed normal maintenance is based on:

- Size of system,
- Estimates of how long the track material (rail, ties, etc.) will last,
- Development of a cycle, based on system size and the materials' life expectancy, leading to
- Geographically specific programs for necessary rail and tie replacement, track surfacing, track inspections, weed and brush control and other activities to assure adequate maintenance.

The preparation of normal maintenance estimates differs from rehabilitation calculations in that normal maintenance requirements are based on projections of what work is expected to accumulate annually. Rehabilitation estimates, on the other hand, are based on the known present condition of the plant compared to its desired condition. The Association's normal maintenance costs for track were developed in the following ways.

- Data collected by USRA's operations planning group provided the basis for dividing track miles into several categories based on the proposed gross tonnage to be operated over them. This allowed for the application of different cycle projections for those track components, such as rail and ties, which vary depending on the amount of traffic over any given line. Life cycles for such tonnage-sensitive materials were developed from analysis of historical data supplemented by field sampling and staff experience.
- Annual maintenance requirements for fixed cost items, such as drainage and weed and brush control, were identified in essentially the same manner.
- Unit costs (per mile of track maintained) were developed for approximately 40 different maintenance functions to provide labor, material and equipment factors which then were applied to the track mileage identified in different tonnage categories.
- Total programs then were developed and phased over time from the summation of normal maintenance and rehabilitation requirements in three categories, including production gangs, production support and basic day-to-day activities.

### Facilities Planning Since the Preliminary System Plan

The rehabilitation estimates described in the Preliminary System Plan were based on rehabilitating all lines to be included in the consolidated system to their highest utility since 1969. Various other rehabilitation strategies which might be appropriate for ConRail also were discussed. Since the Preliminary System Plan, the Association has refined its maintenance programs to define a more line specific and selective program, placing emphasis on those primary routes and major yards where rehabilitation expenditures will return the greatest savings to ConRail in reduced operating expenses.

The rehabilitation and maintenance programs described in this chapter and reflected in the *pro forma* financial statements include the rehabilitation and maintenance deemed necessary by the Association to support ConRail's proposed operations. These programs also reflect a reassessment of constraints based on revised determinations on the availability of manpower, material and equipment.

The revised program proposed in the FSP produces a significant reduction in overall funding requirements and provides a more balanced capital structure for ConRail than would the estimates contained in the PSP. Based on present traffic projections, the FSP program is a realistic and rational assessment of ConRail's requirements.

In addition to these rehabilitation planning efforts, the Association's recent engineering activities also have included:

- Refinements in unit costs used in preparation of maintenance calculations,
- Determination of requirements for clearance routes,<sup>42</sup>
- Assistance in the implementation of the Section 215 program for maintenance on the railroads in reorganization prior to conveyance and
- Consideration of capital projects such as new track connections required to implement the Final System Plan.

### FSP Rehabilitation Recommendations

The Association's rehabilitation program described in the PSP included all lines selected for inclusion in ConRail regardless of projected traffic. As it was estimated that such a program would require at least 14 years, priorities were recommended so initial emphasis

<sup>42</sup> These are particular routes for the handling of oversize shipments.



would be placed on ConRail's primary freight routes. Rehabilitation of the lighter tonnage lines was scheduled for the program's later years as resources became available.

Recognizing that ConRail's proposed operations depend on a rehabilitation program for its principal freight lines, the Association's revised strategy continues to provide for their complete rehabilitation. These were the Association's first and second priority lines in the Preliminary System Plan and remain so in the Final

System Plan (see Table 33). Removal of existing slow orders and other deteriorating conditions on these routes, including major yards, is critical to provide ConRail with the plant it will require to support both heavy tonnage freight trains and higher speed piggyback trains. Accelerated maintenance expenditures for rehabilitation of such lines and key yards is cost effective and directs engineering resources to those areas where ConRail will be able to achieve the greatest operational economies in the shortest possible time.

TABLE 33.—*Summary of rehabilitation strategy*

	<i>Track miles</i>
<b>Normal Maintenance and First Priority Rehabilitation Program</b>	
This is a 10-year program providing for normal maintenance and complete rehabilitation of those lines shown in a solid line in Figure 10. These are the lines which are proposed to carry 20 million or more gross tons per track annually plus those lines on which an operating speed of 60 m.p.h. is desired for piggyback trains. These lines are proposed to carry approximately 66 percent of ConRail's projected tonnage.	5, 339
This program also includes rehabilitation of major classification yards which support these routes.	1, 700
<b>Normal Maintenance and Second Priority Rehabilitation Program</b>	
This program includes those lines which are proposed to carry 5 to 20 million gross tons per track annually shown in a broken line on the map in Figure 10. This is a longer range rehabilitation program which will be carried out concurrently with the first priority program as resources become available. These lines are proposed to carry approximately 27 percent of ConRail's projected tonnage.	6, 255
<b>Normal Maintenance—RDG and EL Commuter Lines</b>	
This includes normal maintenance on the lines of the RDG and EL on which passenger service will be operated. (This does not include the EL line from Cleveland to Youngstown on which passenger service will be operated by the Chessie.)	1, 060
<b>Normal Maintenance—No Rehabilitation</b>	
The lines included in this category are proposed to carry 1 to 5 million gross tons per year. Normal maintenance levels will be applied on such lines, but such lines are not included in the rehabilitation program. These lines are proposed to carry approximately 6 percent of ConRail's projected tonnage.	5, 638
<b>Essential Yard Tracks Which Support Lines Carrying 1 to 20 Million Gross Tons</b>	
These yard tracks will be included in the Association's normal maintenance program; however, rehabilitation activities on this trackage will be performed only to the extent such rehabilitation is required to support train operations. (NOTE: The traffic on these tracks is included in the estimate shown for the second priority and 1 to 5 million gross tons categories.)	1, 500
<b>Holding Maintenance—No Rehabilitation</b>	
The lines in this category include those lines which are proposed to handle under 1 million gross tons annually plus essential supporting yard and switching tracks. This category will receive the level of maintenance necessary to support operations at 10 m.p.h. These lines are proposed to carry approximately less than 1 percent of ConRail's projected tonnage.	
Running Track	2, 365
Yard and Switching Tracks	3, 996
<b>No Maintenance—No Rehabilitation</b>	
This includes yards and switching tracks not presently deemed necessary to support ConRail's operations.	
Total	29, 853
The following trackage will receive holding maintenance on an interim basis:	
Light density lines available for subsidy	18, 892
Northeast Corridor (to hold trackage until arrangements are complete for rerouting on the Chessie System)	445
Second main tracks to be maintained on an interim basis until signalling projects allowing for their retirement are complete	762
Out-of-Service lines and supporting trackage	1, 784

<sup>1</sup> It should be noted that the figure 8,892 includes all *track* miles associated with the light density lines and not the *route* miles as reported elsewhere in this chapter.

A first priority 10-year program has been constructed for those lines which will carry 20 million or more gross tons per track mile annually plus those lines on which a freight train speed of 60 m.p.h. is desired for piggyback trains. The early years of this program will be devoted to those lines in this category where removal of existing slow orders is the most critical to improve operations in terms of reduced recrewng expenses, elimination of capacity bottlenecks, improvement in transit times, etc. As resources become available, a concurrent, longer-range second priority program also will be implemented for those lines which will carry at least 5 million gross tons per track mile annually. Those programs also include essential supporting tracks in yards and terminals. These first and second priority lines are shown in the map in Figure 10. In total, more than 90 percent of ConRail's projected tonnage moves over these lines.

The Association reconsidered its proposed maintenance programs for those remaining lines which will carry less than 10 percent of ConRail's total projected gross tons but which account for almost one-third of its total system miles. Such lines were included in the original rehabilitation program but were given low priority. With the reduced traffic growth now projected by the Association, these lighter tonnage lines simply do not justify economically the level of maintenance expenditures originally proposed in the Preliminary System Plan. Some degree of maintenance, however, will be required, and these lines were considered in two categories: those lines handling 1 to 5 million gross tons annually and those handling less than 1 million gross tons annually.

The Final System Plan maintenance program envisions applying the Association's normal maintenance levels on those lines handling 1 to 5 million gross tons annually, although these lines have not been included in the proposed rehabilitation program. This strategy will sustain present operations and prevent further deferred maintenance. Further, since the Association's proposed normal maintenance levels do provide an increase over past inadequate levels, this program gradually will upgrade these lines as track materials are replaced consistent with normal life cycles.

For example, the average life for hardwood ties on such lines is approximately 35 years. With approximately 3,000 ties per mile, theoretically 86 ties would wear out each year ( $3,000 \div 35 = 86$ ). Assuming that ties were replaced in 7-year cycles,<sup>43</sup> 602 new ties would be installed in each mile of track in each 7-year cycle ( $7 \text{ years} \times 86 \text{ ties falling out each year} = 602$ ). There-

fore, after the third 7-year cycle, or 21 years, 1,806 ties would have been replaced in each mile of track ( $602 \text{ ties per cycle} \times 3 \text{ cycles} = 1,806 \text{ ties}$ ). At this point, 60 percent of the ties in each mile of track would have been renewed. After the fifth 7-year replacement cycle (35 years), all the ties would have been replaced and the track would be on a normal maintenance cycle.

Those lines where projected traffic levels are less than 1 million gross tons annually present a particular problem. The revenues derived from the light density traffic on these lines do not support the magnitude of expenditures necessary for complete rehabilitation at today's costs; indeed, as some critics of the Preliminary System Plan correctly have suggested, operations at minimum levels of 10 m.p.h. on some of these lines might provide the most cost effective alternative for preserving rail service. The other consideration, of course, is the effect of such minimum maintenance on day-to-day train operating expenses. It was necessary for the Association to structure a rehabilitation strategy for these lines reflecting a cost effective balance between these two considerations.

Through cost/benefit analyses by the Association's operations planning group of the relationship of rehabilitation and transportation expenses, it was determined that such lines would be kept on a holding maintenance basis providing the level of work required to sustain operations at minimum FRA levels. The Final System Plan *pro forma* financial projections do not reflect any provisions for normal maintenance or rehabilitation on these lines. With this rehabilitation strategy, sufficient "maintenance on demand" is provided so that service can be sustained initially on these lines while allowing ConRail to proceed with the important task of rehabilitating its essential main lines, yards and other facilities.

These holding maintenance estimates were developed by an analysis of minimum structural integrity requirements necessary to meet minimum FRA standards for the class of track. These estimates considered such factors as the history of rail failures, present tie conditions and minimum surfacing required. Work functions necessary to perform these minimum activities were included in the Association's total programs.

At some point, however, it may be necessary to upgrade the physical condition of certain lighter tonnage lines when holding actions no longer can preserve service. At this point, ConRail's management would have to reevaluate service on these lines and make appropriate recommendations for increased maintenance, subsidy or suspension of service.

A summary of track miles included in each of the above categories is shown in Table 33. If future traffic levels, the Nation's energy situation, the economy and other factors subsequently indicate a change in the cost/

<sup>43</sup> The 7-year cycle used in this theoretical example is based on replacing 600 to 800 ties per mile which is the optimum range for today's mechanized tie replacement gangs in accordance with normal maintenance cycles.

benefit balance between transportation and rehabilitation expenses, ConRail then should make appropriate adjustments to the programs proposed in this plan.

### Availability and Programming of Resources

The Association's proposed programs envision a significant increase in maintenance work over the present levels of the railroads in reorganization. Such acceleration in turn will create new demands on material and equipment suppliers and increase the need for trained labor. The work functions required for rehabilitation and normal maintenance of ConRail's plant, therefore, were phased over time to structure a program which would reflect a realistic estimate of the availability of necessary manpower, material and equipment. Various possible constraints to carrying out such a program include:

- Availability of material (rail, ties, ballast, etc.),
- Availability of qualified manpower,
- Availability of new roadway work equipment and the condition of the railroads' existing equipment,
- Availability of rail welding facilities and related equipment,
- Interference of maintenance-of-way work with day-to-day train operations and
- Financial constraints.

The effect of these constraints has been mitigated somewhat by the more line specific and selective rehabilitation strategy in the Final System Plan. Table 34 shows major deferred work units used in calculating the FSP rehabilitation program.

TABLE 34.—Summary of major deferred work units

#### Final System Plan rehabilitation programs

(1976-85)

Rail (miles):	
New	2, 170
Relay	2, 345
Total	4, 515
Ties	12, 260, 000
Switch ties	325, 000
Turnouts	5, 950
Road crossing track feet	276, 000

SOURCE: Data collected and summarized by engineering consultants to USRA.

After interviews with suppliers, the railroads' purchasing officers and others, the Association prepared assumptions on the extent to which the required equipment, material and trained manpower would be available to complete its restructured normal maintenance and rehabilitation programs. A summary of the Association's revised material, manpower and equipment programs is shown in Table 35.

TABLE 35.—Summary of USRA proposed programs plans for additional material and equipment

Year	USRA Programs Provide for: <sup>1</sup>
1975 <sup>2</sup> -----	Initiation of training program 12 new tie gangs 1 new rail gang 12 new surfacing gangs 224 special ballast cars 84 tie cars 480 miles of rail laid (projected) 2.50 million ties installed (projected)
1976-----	Additional welding line 3 new rail gangs 2 new welded rail trains 250 special ballast cars 35 tie cars 515 miles of rail laid 3.58 million ties installed
1977-----	Additional welding line 5 new tie gangs 1 new rail gang 250 special ballast cars 35 tie cars 531 miles of rail laid 3.89 million ties installed
1978-----	New reclamation plant <sup>3</sup> 1 new rail gang 4 new welded rail trains 250 special ballast cars 25 tie cars 657 miles of rail laid 3.71 million ties installed
1979-----	Major new rail welding facility 2 new rail gangs 4 new welded rail trains 250 special ballast cars 25 tie cars 864 miles of rail laid 3.70 million ties installed
1980-----	4 new welded rail trains 25 tie cars 1,109 miles of rail laid 3.70 million ties installed
1981-----	2 new welded rail trains 1,158 miles of rail laid 3.71 million ties installed
1982-----	1,173 miles of rail laid 3.72 million ties installed
1983-----	1,187 miles of rail laid 3.74 million ties installed
1984-----	1,202 miles of rail laid 3.76 million ties installed
1985-----	1,216 miles of rail laid 3.78 million ties installed

<sup>1</sup> This table lists equipment acquisitions over and above existing roadway work equipment. The capital program also provides for some replacement of existing equipment as it wears out. It should also be noted that these figures differ slightly from those shown in Figure 7, p. 87, Final System Plan. Certain passenger train data were excluded from Figure 7, and other data refinements have been made since publication of the FSP. These refinements do not affect ConRail's cash requirements.

<sup>2</sup> Activities in 1975 are included in the Association's Section 215 program.

<sup>3</sup> A reclamation facility reclaims and rebuilds rail material, such as frogs, switch points, joint bars, spikes, bolts, etc., made available from renewals and track retirements for use elsewhere.

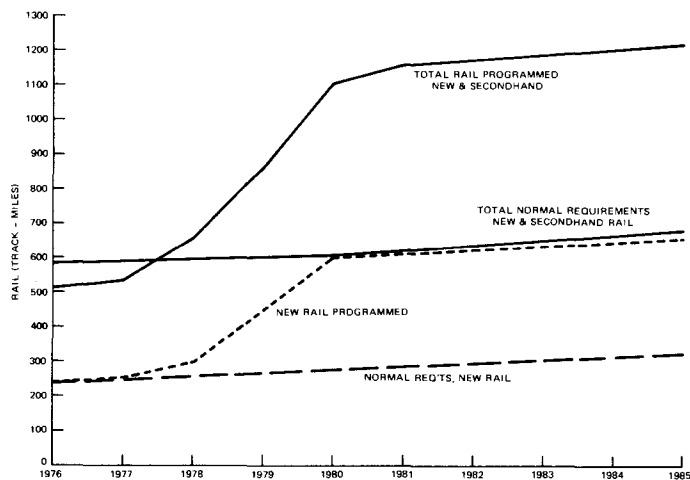
## Rail Renewal

The chart below summarizes the proposed miles of rail (both new and second-hand) which will be needed in representative years of the Association's proposed normal maintenance and rehabilitation programs. This rail program is summarized in more detail in Figure 11.

### Rail Requirements

Year	Miles of rail		
	New	Second hand	Total
1976.....	242	273	515
1980.....	600	509	1,109
1985.....	657	559	1,216

FIGURE 11.—Projected rail renewal program requirements 1976-1985



Rail laying activities initially will be constrained by lack of:

- Availability of new rail,
- Facilities to weld rail,
- Rail trains to distribute continuous welded rail and
- Equipment and qualified manpower to install new rail.<sup>44</sup>

The Association's present projections of what equipment will be acquired to alleviate these constraints is summarized in Table 35.

Continuing discussions with steel industry representatives have indicated that the supply of rail will not be as great a constraint as discussed in the Preliminary System Plan, particularly in view of current economic conditions and the Association's revised program. There

<sup>44</sup> A more detailed description of the constraints affecting rail renewals is contained in the Preliminary System Plan, pp. 73-75.

will be, however, some supply problems in ConRail's initial years. The proposed programs reflect a gradual buildup in rail laying activities to coincide with the concurrent buildup in the steel industry's capacity to produce new rail. This gradual buildup generally will be accomplished by reallocation of ingot steel and improvements to existing facilities. Future long-term commitments will be necessary to assure the continuing availability of new rail, particularly if overall rail industry requirements should increase to the point where a new facility may be required. Possible changes in the economy and the possibility of revisions in ConRail's future maintenance programs require a continuing liaison with the steel industry.

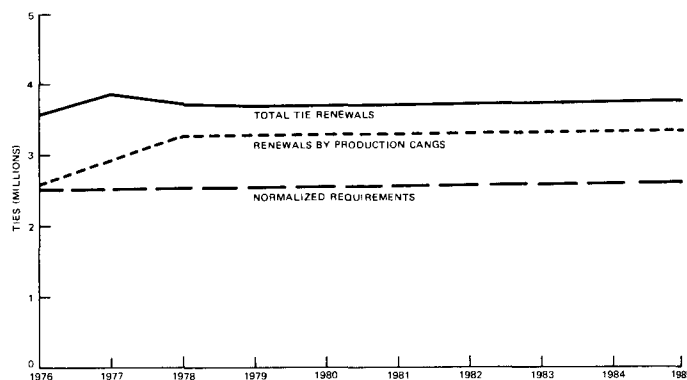
## Crosstie Replacement

The following chart depicts crosstie replacements in representative years of the Association's proposed programs. A more detailed summary of proposed crosstie replacements is shown in Figure 12.

### Tie requirements

Year	Number of ties (millions)
1976.....	3.58
1980.....	3.70
1985.....	3.78

FIGURE 12.—Projected renewal of ties 1976-85



Unlike rail, where supply will be limited during the next several years, the crosstie industry presently is faced with a surplus of ties, primarily resulting from the inability of some railroads to sustain their current maintenance programs because of reduced traffic and revenues. The timber industry has indicated that it can supply the ties and timber products necessary to support ConRail's proposed programs providing that appropriate commitments are made and honored. Should there again be competition for the available supply of timber from pallets and housing increase, however, the required quantity of ties again might become difficult to obtain.

### Ballast and Track Surfacing

Track surfacing involves the distribution and compacting of ballast material under the ties to correct the track's profile and the cross level relationship of one rail to the other. Surfacing is related closely to rail and tie renewals.

The chart below summarizes the miles of track to be surfaced in representative years of the Association's proposed normal maintenance and rehabilitation programs.

#### Surfacing Requirements

Year	Miles of track
1976	6,100
1980	6,300
1985	6,060

The constraints on the availability of resources for track surfacing are essentially the same as discussed in the Preliminary System Plan. The need for additional special equipment to haul and distribute the ballast material is the primary problem in this area and the Association's proposed programs provide for the acquisition of 1,224 special ballast cars to be delivered over a 5-year period beginning this fall.

### Communications and Signals (C&S)

Revisions have been made to the Association's original programs to reflect the refined definition of the ConRail system and the FSP's proposed industry structure, particularly with regard to offers made to the Chessie System.

The FSP program maintains the railroads' C&S facilities in compliance with FRA Rules, Standards and Instructions. This includes provisions for the repair and renewal of C&S apparatus which has deteriorated. The programs also have been modified to reflect additional centralized traffic control installations<sup>45</sup> and other newly proposed signal changes. A partial list of such revisions is shown in Table 36.

### Bridges and Buildings (B&B)

Normal maintenance on bridges and buildings remains basically the same as originally proposed, with appropriate revisions to reflect refined definition of the ConRail system and the FSP's proposed industry structure, particularly with regard to offers made to the Chessie System. Changes in the rehabilitation program are consistent with the revised rehabilitation strategy. Some structures will require complete rebuilding. The cost of such projects is included in the proposed Con-Rail capital budget.

### Manpower Requirements

The number of employees required for maintenance depends on the plant's size, traffic carried, location and condition of the property. The present manpower levels

<sup>45</sup> Centralized traffic control installations provide for remote controlling of many interlockings under the control of one man and provide a signal system so that trains can run in either direction on a track with such movement governed by signal indication. These installations usually increase track capacity on single track lines or, where substantial excess capacity exists, may allow for retirement of one track in multiple track territory.

TABLE 36.—Signal programs and proposed track retirements for freight operations

Line	Present operation	Proposed operation
Bucyrus, Ohio to Whiting, Ind. via Fort Wayne.	Two main tracks; signal system provides for eastbound trains on one track and westbound trains on the other track under an automatic signal system.	Retire one main track; provide reverse signaling and controlled sidings to operate traffic under centralized traffic control rules.
Suspension Bridge, N. Y. to Windsor, Ont.	Same as above	Same as above.
Detroit (Wayne Jct.), Mich. to Kalamazoo, Mich.	Same as above	Same as above. <sup>1</sup>
Logansport (Van), Ind. to Hartsdale, Ind.	Two main tracks; signal system provides for eastbound trains on one track and westbound trains on the other track under an automatic signal system.	Retire one main track and signal system; remaining track to be operated under timetable and train order rules.
Pittsburgh, Pa. to Johnstown, Pa. via Greensburg.	Generally three main tracks; signals and operating rules provide for operation in either direction on one track and for directional running on the other two tracks.	Retire one main track; provide controlled sidings and reverse signalling on the remaining two main tracks with train movements under centralized traffic control rules. This project is presently in progress.

<sup>1</sup> Revisions may be necessary if Amtrak's desired level of service in the Detroit-Chicago corridor requires it to provide additional facilities.

SOURCE: USRA staff analysis.

of the railroads in reorganization are inadequate for proper maintenance. Further, the railroads present training programs are also inadequate, and the railroads in reorganization do not have the necessary resources to undertake the training activities which will be required.

In structuring its proposed maintenance programs, the Association considered the total manpower needed to accomplish the work functions outlined for each year of the program. In determining appropriate manpower levels, it also was necessary to consider what improvements in productivity reasonably could be expected in future years as well as providing for the necessary training programs.<sup>46</sup> Total manpower requirements for the proposed FSP maintenance-of-way activities are summarized in Table 37. The manpower projections cover the general areas of supervision, track, signals and communications, bridges and buildings and electric traction.

### Section 215

The Final System Plan maintenance projections are based on the railroads' 1974 maintenance accomplishments and their projections for 1975. During 1975, the preservation and in some areas the increase in maintenance levels have been accomplished by the application of section 215 funds.<sup>47</sup> As indicated in Table 35, section 215 funds have been used to purchase roadway work equipment prior to conveyance as part of the Association's total plan to provide ConRail with the tools it will need to undertake the proposed maintenance and rehabilitation programs. Other miscellaneous materials and equipment have been purchased to support these programs, including approximately 2.5 million ties and 250 miles of new rail.<sup>48</sup> This interim funding provides some assurance that the level of preconveyance maintenance work during 1975 will enable ConRail to attain the Association's proposed levels for 1976.

### Capital Program

The Association's capital program is discussed in the Freight Operations Section of this chapter. The

<sup>46</sup> The Association's determinations with regard to productivity involving tie and rail gangs are discussed in more detail in the Preliminary System Plan, pp. 74-76.

<sup>47</sup> These are funds provided under section 215 of the Act. Such funds enable rehabilitation activities to be performed on the estates of the railroads in reorganization prior to conveyance to alleviate further deterioration which might occur otherwise.

<sup>48</sup> This 250 miles of new rail is included in the overall projection of 480 miles of both new and second-hand rail shown in Table 35 for 1975.

Association's facilities evaluation and planning staff has devoted particular emphasis to those capital projects which will be necessary to implement the Final System Plan, including the construction of new track connections, new crossovers and new sidings. A partial listing of major projects is shown below.

Location	Project
Flemington, N.J.-----	Construct connection from LVRR to CNJ.
Brewster, N.Y.-----	Construct new connection from former New Haven Maybrook Line to former New York Central Harlem Line north of Brewster in the vicinity of Dykemans.
Bucyrus, Ohio.-----	Construct connection in northeast quadrant off N&W/PC connecting track to maintain service to Spore, Ohio.
Lebanon, Pa.-----	Construct two new connections between Penn Central Lebanon Running Track and Reading Cornwall Branch in the vicinity of Lebanon.
Lafayette, Ind. <sup>49</sup> -----	Construct new connection between PC and L&N in the southeast quadrant.
Shamokin, Pa.-----	Construct new connection between Reading and PC.
Vincennes, Ind. <sup>50</sup> -----	Construct connection between B&O and L&N in northwest quadrant, and upgrade connection in the northeast quadrant.
Washington, Ind. <sup>50</sup> ----	Construct connection west of Washington between B&O and PC's Petersburg Branch in the southwest quadrant.
Ann Arbor, Mich.-----	Construct new crossover between tracks on the PC's Detroit-Jackson line.
Three Rivers, Mich.---	Construct 8,000 feet passing siding.
Elizabethport, N.J.---	Construct connection at engine house.
Poughkeepsie, N.Y.---	Restore bridge across Hudson River to service.
Mt. Carmel, Pa.-----	Construct new connection between RDG and PC in vicinity of Mt. Carmel.
Newark, N.J.-----	Construct new connection between LVRR main line and PC's Passaic and Harrison Branch.

<sup>49</sup> Contingent upon completion of negotiations with L&N for trackage rights.

<sup>50</sup> Contingent upon completion of trackage rights negotiations with the B&O and L&N.

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TABLE 37.—Maintenance-of-Way Manpower Projections

Year	Track					Other							Total
	Basic	Production	Support	Holding		Total	Supervision and Clerical	C&S	Electric Traction	B&B	Miscellaneous		
				CRC	NEC								
1976.....	4,499	3,467	944	2,594	149	11,653	1,132	3,003	260	1,533	698	18,279	
1977.....	4,503	3,827	1,114	2,558	149	12,151	1,122	3,003	260	1,533	716	18,785	
1978.....	4,539	3,907	1,134	79	92	9,751	1,121	3,005	260	1,533	755	16,425	
1979.....	4,570	4,007	1,164		92	9,833	1,120	3,009	163	1,533	702	16,360	
1980.....	4,585	4,067	1,194		92	9,938	1,167	3,012	94	1,533	618	16,362	
1981.....	4,585	4,067	1,194		46	9,892	1,158	3,013	79	1,533	618	16,293	
1982.....	4,585	4,067	1,194			9,846	1,152	3,013	66	1,533	618	16,228	
1983.....	4,585	4,067	1,194			9,846	1,152	3,013	66	1,533	618	16,228	
1984.....	4,585	4,067	1,194			9,846	1,152	3,013	66	1,533	618	16,228	
1985.....	4,585	4,067	1,194			9,846	1,152	3,013	66	1,533	618	16,228	

NOTE: These figures differ slightly from those shown in Table I, p. 160 and Table 7, p. 164 of the Final System Plan. Refinement since that time revealed that while the total dollar projection in the Final System Plan *Pro Forma* Statements properly estimated M of W Manpower Requirements, there was an error in reporting total jobs associated with the Association's projected holding maintenance activities. Appropriate refinements have been made to properly reflect the proposed total jobs.

SOURCE: USRA staff analysis.

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## Community and Employment Impact

*The community and employment impact of implementing the Final System Plan is expected to be minimal as upward adjustments in economic activity should outweigh the anticipated adverse effects on the localities in the Region. Approximately 913,000 man years of employment will be generated as a result of the proposed rehabilitation and maintenance of the restructured system. Not only will there be newly created railroad jobs but there will be an even larger percentage of new jobs created in other industries.*

*Branch line abandonment is expected to have some effect on a few communities, but net increases in employment and incomes from increased maintenance expenditures and rehabilitation should offset any negative impact. Less than 0.12 percent of the approximately 9.5 million industrial jobs in the areas surveyed will be affected. Although the goal of providing an adequate and more efficient railway system will cause certain lines to be deleted from the restructured system, rail service continuation subsidies provide one means of alleviating negative effects.*

Implementation of the Final System Plan is expected to have significant effects on the entire economy. Most important, the proposed reorganization is expected to produce a rail system capable of providing adequate and more efficient service.

Along the way to achieving this goal, upgrading Con-Rail's physical plant will generate much new employment; expenditures for rehabilitating and maintaining the restructured system between 1976 and 1985 are estimated to generate 913,000 man years of employment throughout the economy. The large percentage of new jobs created in other industries broadens the labor market, creating jobs for other than rail employees.

Many shippers, community leaders and spokesmen for environmental groups have testified that large scale trackage abandonments in the Region would have widespread detrimental effects. Net increases in employment and incomes from increased maintenance expenditures and rehabilitation, however, should offset any negative impact which might occur as a consequence of line abandonment. Subsidies provided by the Act also can ease negative effects of the abandonment of light density lines. Rail service continuation subsidies can be used to cover the "cost of operating adequate and efficient rail service, including necessary improvement and maintenance of track and related facilities" (Section 402(j) Regional Rail Reorganization Act of 1973).

The results of an analysis performed for USRA by the Public Interest Economics Center (PIE-C) indicate that the potential overall impact from the termination of rail service on all of the abandoned lines represents a very small proportion of the existing economic bases of the 279 counties studied. In only 15 counties is the predicted decrease in industrial employment in excess of 1 percent. The potential reduction in county income is less than 1 percent in 90 percent of the counties and the increase in transportation costs as a percent of income is less than 1 percent in all but two counties. Industry impacts generally are very small.

In sum, the impact of abandonment is expected to be minimal and even this minimal impact will be offset through internal industry adjustments, service continuation on some lines and employment generated by expanded rail activity in the Region. The expected benefits to the users of the remaining restructured system and the effects of the positive stimulus to economic activity should far outweigh the anticipated adverse effects from discontinuance of service.

PIE-C assessed this entire process as follows:

"There was no real knowledge in advance of the magnitude of the consequences of the potential abandonments. There had been no systematic analysis of the magnitude or even of the detailed nature of the economic and environmental consequences. Therefore, some quantification of the problem was essential. It turned out that the fears were not groundless but exaggerated; the prospects of significant economic,

environmental or energy impacts are trivial relative to the size of the economies affected, and they should be amply offset if USRA is successful in designing a system that is even marginally more efficient than the present one."<sup>1</sup>

Until the past year, the removal of rail service to communities has not been subjected to much analysis. The DOT report<sup>2</sup> in February 1974, the PSP in February 1975 and the RSPO hearings held on these reports have spawned numerous studies. While in the past there have been many economic and social impact studies, they have been concerned with the addition of a public facility to the physical infrastructure. The removal of a facility and the effects of removal have been subjected to little analysis. All impact analyses have at their core the identification of consequences to an area from the removal or addition of a facility. The consequences typically are expressed in terms of effects on business activity, employment and income. Recently, public law has subjected many federal actions to assessments of social and environmental effects as well.

The Congress expected that any plan for the railroads in reorganization in the Region would be sensitive to these issues. One of the eight goals of the FSP is:

"the minimization of job losses and associated increases in unemployment and community benefit costs in areas in the Region presently served by rail service." (Section 206(a)(8).)

The problem of identifying community impact is predominantly an economic one. The discontinuance of rail service deprives a community of an economic asset, an asset that is complementary to the existing stock of labor, land, capital facilities and equipment. Tracing and measuring the consequence of this change comprise the essential problem.

The impact described in this chapter presents an estimate of the maximum potential effect on communities and employment within the Region. It is expected that these effects will be diminished significantly through the use of rail service continuation subsidies and the provision of service to much of the affected traffic by profitable railroads, as identified in Chapter 8 of the Final System Plan.

The rail system in the Region is more comprehensive than in other parts of the Nation. Early settlement concentrated population and industrial activity in this area. Subsequent changes in industry, technology and settlement patterns, however, produced changes in rail use, particularly in service to local areas. The expansion of highways, waterways, pipelines and use of liquid fuels all contributed to the shift in the pattern of rail use. As a result, many rail lines have proved to be uneconomic.

<sup>1</sup> Public Interest Economics Center, *Final Report*, June 1975. Introduction.

<sup>2</sup> U.S. Department of Transportation, *Rail Service in the Midwest and Northeast Region*, Vol. I and II, 1974.

Decentralization of population complementary to highway development has made much transportation more suitable for trucking than rail service. The relocation of industry and commerce often reduced distances for the movement of commodities and enhanced the ability of motor carriers to serve decentralized communities.

Industry in the United States has not been completely mobile for a number of reasons. Newer industries not based on fixed natural resources are less dependent on any one type of transport than are heavy industries.<sup>3</sup> Large scale capital investments for manufacturing such as steel and textile mills, oil refineries, pipelines and communication networks require heavy financial commitments as well as a long period before production can be undertaken. It is usually more efficient to ship commodities than to relocate production facilities. The process of locational change in industry is usually the slow buildup of production in one area by incremental capital investment and its reduction in other areas through deterioration of capital investment.

Economic activity in the Region is expected to grow more slowly than in other parts of the Nation, since the Region is at an advanced level of industrial maturity. These expectations condition the tremendous interest in retaining railroad facilities for service to heavy industry, mining, and agriculture and the need to move goods to and from populated areas. The Region, of course, would retain any competitive advantage it possesses if alternative transport facilities are available at similar costs.

### Analyses of Community Impact<sup>4</sup>

The recent interest in railroad financial problems and the suggested reorganizations have led to a number of railroad abandonment impact reviews. Information concerning the potential impact is available from a series of federal, state and local studies, as well as individual and group testimony at the RSPO hearings on both the DOT report of February 1974 and the PSP of February 1975.

In general, these studies estimate the economic consequences to the users of the railroad facility being considered for abandonment. The consequences are expressed in terms of the impact on employees, costs of operation and transportation and market position in terms of local or regional purchases and sales.

These data provide approximations of the extent to which business would be shifted from the community

and indicate the loss to the community in terms of employment, payrolls and taxes. Part of these impacts are offset by compensatory income to a community in the immediate period through employment insurance and transfer payments from the community itself and from the State.

A growing community should be able to absorb employment reductions. A depressed community could find itself with more problems, although existing economic development and contingency plans in the area may be available to compensate for any negative effects. Positive results should arise from attracting particular types of economic development and freeing up land, as well as by the good market position of firms in the area.

### Impacts on Shippers

Valuable insights have been obtained from shipper surveys, retrospective studies by Simat, Helleisen and Eichner (SH&E) and Boston University and case studies by Consad Research Corp., Jack Faucett Associates<sup>5</sup> and the Department of Agriculture (USDA). Some conclusions can be drawn from these studies regarding the types of impact that can be expected among different types of shippers and the impact on the surrounding community.

USDA indicated that "shippers and communities depending on railroads that are about to be abandoned fear losses. Industry relocation might sometimes appear possible, but where there is substantial investment in fixed plant and facilities, managers would then have to resort to alternative modes of transportation, such as motor carriers. Although shippers might be willing to pay higher charges for alternative means of transport, problems could still arise if rural highways and bridges cannot handle increased traffic and heavier loads.

"Community leaders fear declining property values, the loss of jobs, and lessened prospects for economic development that can follow rail abandonment. In fact, leaders in some rural communities fear that the communities will cease to function as trade centers and thus face economic extinction."<sup>6</sup>

*Farming.*—In farming areas, increased transportation costs for bulk commodities (grain and fertilizer) would be borne largely by local farms, though some could be absorbed by the shippers. The portion of the costs to be absorbed locally would depend on the percentage of farm land in the area belonging to outside corporations. Total costs for feed grains generally should rise in proportion to the distance from the nearest active rail facility.

<sup>3</sup> Jack Faucett Associates, Inc., *Projections of Rail Freight Demand in the ConRail Region*, prepared for the U.S. Railway Association, January 1975.

<sup>4</sup> Consad Research Corp., *Analysis of Community Impacts Resulting From Loss of Rail Service*, Vol. I.—Documentation, Chapter 3, prepared for U.S. Railway Association, Oct. 18, 1974. Especially references to Simat, Helleisen and Eichner, *Retrospective Rail Line Abandonment Study* (revised) for United States Department of Transportation, 1973 and Boston University Bureau of Business Studies on *Economic Impact of Rail Abandonment*, June 1965.

<sup>5</sup> Jack Faucett Associates, Inc., *Potential Impact of Termination of Rail Service to 12 Selected Communities*, prepared for U.S. Department of Transportation, December 1973.

<sup>6</sup> U.S. Department of Agriculture: *Changing Rail Service in the Midwest and Northeast Region: Impacts on Agriculture and Rural Areas* prepared for the Committee on Agriculture and Forestry, U.S. Senate, 1975.

If some agricultural supply firms in an area retain the rail service, those that lose their service would lose some of the market and could be forced out of business.

Grain elevators are less likely to go out of business because of the relatively large existing capital investment and probable capacity limitations at other elevators in the area.

Grain mills could pass along some increased costs to their customers. Indeed, two of the three mills included in the SH&E study were able to pass along most or all of the increased costs. On the other hand, the third mill had been closed as a consequence of the loss of rail service.

In a summary of various studies on rural areas, USDA concluded that rural areas have not suffered to any great extent by railroad abandonments and that:

"The potentials for future rural development in the region at large also probably will not suffer significantly from rail reorganization. . . . Thus, there are a large number of rural locations, 'growth centers,' where rail service, which is expected to be improved, will be available, if heavy manufacturing industries needing rail services wish to locate new plants in rural areas. As for light manufacturing of the type more frequently locating plants in local rural areas, highways have become a strong determinant of location."<sup>7</sup>

*Mining Operations.*—These are dependent on potentially abandoned rail lines and usually are small producers of a low-value commodity not produced for a local market. The retrospective studies encountered only one active operation which suffered a permanent loss of rail service; this was a talc producer which was able to absorb trucking costs.

*Logging Operations and Saw Mills.*—These could encounter substantially increased transportation costs. They could, however, pass along some of the increased costs, at least in the short run. In other respects, the impact generally could be similar to those resulting from loss of rail service to mines. Large operations studied in the retrospective analyses generally were able to absorb the increased costs while several marginal logging operations and saw mills were forced out of business.

Pulpwood and paper operations are affected to a lesser degree than lumber operations, as in-forest chipping machines have reduced the advantage of rail for pulpwood hauling. Such firms will be more able to absorb the increased costs.

*Manufacturing.*—This area has the most varied sets of circumstances. For many industries, the advantages of improved service and better inventory control more than compensate for any increased costs of shipping by truck; for them, rail is no longer an important factor. For others, such as heavy manufacturing, transporta-

tion costs of materials presently shipped by rail represent such a small percentage of total costs that even a relatively large increase in the cost of shipping these materials can be absorbed easily. In still others, the degree of product differentiation gives the manufacturers some ability to pass on costs, at least in the short run.

Of 17 manufacturers considered in the two retrospective studies, none had closed, only one (an unspecified industry) had reduced local employment by transferring part of its operation to a plant in another area and one had abandoned plans for expansion. Of 11 food processors, none closed or reduced their employment, but one dairy did transfer some of its operations to a nearby plant where rail service had been unaffected. Thus, it appears that loss of rail service to a manufacturer only occasionally will result in an immediate loss of local employment if rail service continuation subsidies are not provided. Since several of the firms did absorb nonnegligible cost increases, however, it is possible that loss of rail service would set in motion a gradual process of disinvestment for some otherwise viable firms which ultimately could result in their reducing employment or closing. Alternatively, some of the financial impact on the firm could be passed on to the community in the form of lower-than-normal wage increases.

*Retail Firms.*—In this area, only two types of firms are likely to be hurt by the loss of rail service: coal dealers and lumber yards.

In the case of any surviving retail coal dealers, it is reasonable to assume that the cost increase would cause their customers to switch to other fuels and that they would close or move to other locations.

In the case of the retail lumber yard, the response of the yard would depend on its ability to absorb trucking cost increases and/or pass them along to its customers in the community. If competing lumber yards exist on surviving rail lines in the area, the affected firm likely would lose some of its market or be forced out of business. This impact can be alleviated through the provision of rail service continuation subsidies.

Any other retailers or wholesalers who receive shipment by rail could be affected to a much lesser extent. The Boston University study cites six wholesale grocers who together absorbed a total of \$50,000 per year in increased transportation costs.

### Impact on Communities

A 1945 ICC study of railroad abandonments during the 1920's and 1930's showed that while the populations of communities which had lost rail service grew more slowly (or declined faster) than that of similar communities which had not lost service, the relative decline was greatest during the decade preceding the aban-

<sup>7</sup> U.S. Department of Agriculture, *op. cit.*

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donment.<sup>8</sup> Communities for which abandonments were precipitated as a result of the depletion of natural resources were excluded from the study. The result, of course, is of questionable value in analyzing the potential community impact of abandonments currently under consideration, both because railroad dependence is much weaker than it was 50 years ago and because the economic factors influencing railroad abandonment have changed. Nonetheless, it is important to observe that economic decline appears to have been more significant as a factor causing abandonment than as an effect of abandonment.

Using the knowledge gained from these various retrospective studies as well as case studies, USRA developed a guidebook to assist states and communities in evaluating the community impact of loss of rail service on employment, income, retail sales, tax base and transport costs. Social and environmental features also are discussed. The manual describes how a survey of rail shippers could be conducted, how a community could be defined and how the data collected from the survey could be merged with readily available published data.

The major purpose of the guidebook is to facilitate the collection of information by states and communities for use in local planning, in presentation of testimony at hearings and in applying for rail service continuation subsidies under Title IV of the Act. It should be noted that both USRA and RSPO have developed manuals to provide states and communities with tools to measure the impact of loss of rail service.<sup>9</sup>

These manuals are complementary efforts. The USRA manual focuses entirely on the economic impact of freight service termination and contains substantial materials on the development of independent estimates of rail-user impact. The RSPO guide contains procedures for evaluating environmental impact and for checking the USRA light density line analysis in addition to measuring economic impact.

The states may wish to undertake or coordinate the analyses of potentially adverse local impact. To facilitate the most complete consideration of potential impact, one of the responsibilities of RSPO is to solicit, evaluate and make available the views of the public, as well as those of state and federal officials. While there could be significant adverse local, industry-wide or regional impact from reductions in the size of the rail system, four factors serve to diminish the potential for widespread impact.

First, the planning process is directed toward the revitalization of the system as well as its restructuring. Most users will benefit greatly from improvements in rail service.

Second, the restructured system will represent a sizeable portion of the Region's rail system—a system that will continue to be extremely comprehensive even if none of the excluded lines are continued in service through the use of rail service continuation subsidies. Virtually all areas of the Region will continue to have access to rail service.

Third, the ubiquity of highways and the ready availability of private, contract and common motor carriage serve further to diminish the potential impact of reductions in the size of the rail system in any given area. Depending on the costs to the shipper, motor carriers could provide the entire transportation service, or a portion of it, with the joint use in some cases of rail or water carriers.

Fourth, almost by definition the adverse economic effects of abandonments tend to be minimal except for quite specific local communities and shippers that are involved directly. Lines identified for either subsidy or abandonment have very low traffic volume.

#### **PSP Analyses of Potential Community Impacts**

In the PSP, USRA and its contractors undertook a regional overview of the community impact problem resulting from loss of rail service. The regional review pinpointed those counties where rail abandonment could present significant problems.

This overview, based on a county-by-county analysis of the recommendations contained in the February 1, 1974 DOT report, found that only 15 counties of 453 studied would show potential effects on industrial employment of 1 percent or more.<sup>10</sup>

The method used in this analysis by PIE-C generally overstated the results because of the use of the 15,575 miles declared potentially excess by DOT as opposed to the 6,200 active miles of roadway excluded by USRA in the PSP, the method of developing alternative transport costs and the use of a regional DOT zonal factor rather than a county industry factor to estimate branch line traffic. Furthermore, it did not consider the effect of rail service continuation subsidies or the possibility that profitable railroads would acquire many affected lines.

In the PSP, the community impact of the loss of rail service was found to be minimal. The impact was expressed in terms of the potential job losses, reductions of income and increased energy consumption. In some cases, resource conservation was improved with the abandonment of light density lines. It was found that service by the alternative mode, the truck, used less fuel on many light density hauls than rail despite the greater fuel economy of rail for long hauls.

<sup>8</sup> Consad Research Corp., *op. cit.*, Vol. IV.

<sup>9</sup> Interstate Commerce Commission, Office of Public Counsel, Rail Services Planning Office, *Guide for Evaluating the Community Impact of Rail Service Discontinuance*, Jan. 10, 1975 and Consad Research Corp., *op. cit.*, Vol. III—Manual.

<sup>10</sup> Public Interest Economics Center, *Community Impacts of Abandonment of Railroad Service*, prepared for U.S. Railway Association, Dec. 31, 1974.

The PSP recommended 6200 miles of active light density lines be abandoned or subjected to further study. USRA contracted to have another analysis performed to estimate the potential effects on communities of service discontinuance on those lines not recommended for inclusion in the restructured system, including those on the Erie Lackawanna (which were contained in a supplemental volume).<sup>11</sup> A number of refinements were introduced into the analytical approach which were designed to enhance the accuracy of the estimated impacts. The results of this analysis are contained in Chapter 9 of the FSP.

#### Objective of the PIE-C Study<sup>12</sup>

The scope of the problem of measuring community impact could be based on surveys of thousands of small communities along branch lines or a systematic approach using recent nationally available data which would make it possible to estimate quickly the magnitude of the potential impacts. A method based on county data was adopted because it enabled a systematic approach using the most disaggregated published data. This approach was the same as that described in Chapter 7 of the PSP. Use of this approach was dictated by the fact that systematic data on employment, production, wages and output are not available at a level of aggregation below the county level. The county approach also meets the objective of pinpointing those areas where individual communities may be affected to a significant degree.

The objective of the study was to show, county by county, the gross maximum potential economic consequences of abandonment, specifically, to measure the displacement of workers and output, the decline in local real income and income, payrolls and nonlabor income generated in the affected communities. It also estimates the decline in revenues of local suppliers of directly affected firms. Further, the study presents summaries, industry by industry, of the gross displacements of jobs and output and the gross reductions in income generated by the directly affected plants. The impact of the abandonments on the use of energy and on the environment also was evaluated as discussed in Chapter 3 of this Supplemental Report.

The study was not designed to produce precise results, only to develop general guides as to the nature of the local impact of discontinuance of rail service. The PIE-C study makes no recommendation as to whether any particular lines should be abandoned, nor does it attempt to strike a balance between the gains and losses derived from curtailing and consolidating the rail network in the Region. The study is confined to estimating

the local economic impact of discontinuance of rail service. It does not discuss the additional effects of abandonment of rights-of-way.

Furthermore, the econometric model and the data used by PIE-C have been structured and selected to produce high rather than low estimates of the maximum potential economic consequences of service discontinuance. Thus, the results are adequate to identify those counties where any serious consequences would follow from the abandonment of rail service and provide high side estimates of the impact of discontinuance of rail service.

#### General Approach

As described in the PSP, abandonment of rail service may have direct economic effects in a community, impinging on the level of output, employment, wages and their rate of increase; on the returns to both capital and land with consequent impact on capital values, and on the market for local supplies and materials. These effects will flow into the local economy through the plants that use, or potentially would use, the rail service.

The magnitude of the effects will depend upon how the increase in transportation cost affects the profit position of the using plants and how managements act to minimize those adverse effects. The magnitude and distribution of the burden will depend upon:

- The relative importance to the plant of transportation costs in total costs,
- The availability and cost of other usable modes of transportation,
- The possibility of passing cost increases forward to customers through price increases, which in turn depends largely on whether the plant's output is sold in a competitive national market or the somewhat monopolistic local market and whether competing plants are experiencing comparable increases in costs and
- The possibility of passing the cost increase backward to suppliers, which in turn depends on whether nonlabor inputs are purchased in competitive or other markets, whether labor has good employment alternatives and is strongly unionized and whether competitors are facing comparable cost increases.

All these factors will vary from community to community and some of them may vary among plants within the same community.

The transition from effects on firms to effects on the community raises the problem of defining a community. If one considers that the community is the people who live there, the economic problem of abandonment is the loss of real income to the present residents, which can be estimated as the loss to individuals who

<sup>11</sup> Public Interest Economics Center, *The Impacts on Communities of Abandonment of Railroad Service: Final Report*, and Executive Summary, prepared for U.S. Railway Association, June 1975.

<sup>12</sup> Public Interest Economics Center, June 1975, *op. cit.*

buy and sell their labor and other factor services in the community. Obviously, in most cases this set includes many residents of the community but is not congruent with the set of residents. The study refers to the set analyzed as "residents."

The loss in residents' real income has two components: first, the reduction in purchasing power brought about by higher prices the rail-using firms charge for their products in the local market and second, the loss in income as a result of having to accept employment of labor, capital or materials elsewhere, or of suffering reduced returns or involuntary unemployment. The loss in workers' income as a result of having to accept employment elsewhere should include the loss of income during any period of (transitional) unemployment, the (negative) economic value of any disadvantages of the new versus the previous job, the full cost of moving or a longer trip to work and any decrease in wages.

In no case is the loss of real income to residents greater than the total increase in the cost of production of all local firms directly affected by abandonment. The increase in the transportation cost of the preabandonment level of output is a high side estimate of the real economic impact of abandonment on the residents.

If the community is defined geographically, the results are logically and empirically different. With that definition one would be interested in estimating the loss of factor income produced in the community. This is the sum of the reductions in wages, rents and other factor income paid by all directly affected plants, increased by an appropriate multiplier. With the parameters used, the loss in factor income consistently exceeds the loss of real income to residents of the community.

#### RSPO Testimony <sup>13</sup>

The impact upon communities of railroad abandonment had engendered considerable interest. Community leaders, environmental groups and industrial leaders testified at the March 1975 RSPO hearings on the PSP, expressing their concern for their community if individual lines were abandoned. Environment, energy, coal use, land banking, safety, alternate modes and economic impacts were the primary areas of concern.

Some witnesses criticized the use of a county-based analysis as being too gross to indicate the localized community impact on industry, employment, income and the substitution of costly, inadequate or unavailable alternative modes.<sup>14</sup> Witnesses alluded to the al-

ready high unemployment rates and suggested that abandonment would make matters worse. The Appalachian Regional Commission (and others) criticized the impact analysis because it did not review the potential for economic development that would be aborted by loss of rail service. A number of witnesses were concerned with the potential impact of line closings on regional economies, especially in the Delmarva Peninsula, northern Michigan and the eastern Pennsylvania coal regions.

#### Refinements in Study Method

The PIE-C study method has at its core a key factor, the increase in transportation cost associated with substituting motor carrier service for rail service. The estimates of the increase in transportation cost for each industry in each county reported in this chapter are clearly superior to those used in the PSP report because new and more complete data were available.

In the earlier report estimates were made of the rail revenues associated with traffic originating and terminating in each county, i.e., the costs of rail service provided to the plants in each county, using estimates of annual sales by industry in each county and national input-output coefficients of rail use (both inbound and outbound). The volume of rail traffic by industry and by county that would be affected by abandonment was computed by reducing that estimate of total payments to railroads by applying a "zonal factor" from the DOT report. That factor indicated the fraction of rail traffic in the zone within which each county fell that would be discontinued if all the potentially excess lines in that zone were abandoned. This estimate of total costs of rail services then was multiplied by an estimate of the increased transportation costs per ton by industry associated with a shift to motor carriage. This final product was the estimate of increased transportation cost, by industry by county, predicted to result from abandonment.

The method used in calculating changes in transportation costs in the FSP uses the traffic and revenue data of the railroads in reorganization. These traffic and revenue data were developed by station on the involved lines. The originating and terminating revenues associated with each station were accumulated by county. From these data, the rail expenditures (railroad revenues) by industry and by county were estimated. The amount of rail service (dollar value of rail services purchased) that would be denied each industry was taken as each industry's proportionate share of the total county rail revenue. To this, a factor again was applied to reflect the increased cost per ton associated with shifting from rail to motor carriage.

This procedure provides precise identification of the counties affected by abandonment of service, an estimate of the increase in transportation cost by industry based on revenues generated by only the stations considered

<sup>13</sup> Rail Services Planning Office, Interstate Commerce Commission *Evaluation of the U.S. Railway Association's Preliminary System Plan*, Apr. 26, 1975.

<sup>14</sup> The reaction to the effects on industrial development was summarized by Governor Ella Grasso of Connecticut who stated: "This plan, as it is now—will have a crippling impact on Connecticut. Our effort to attract new industry will bear little fruit unless we can guarantee adequate rail service to carry out their operations." RSPO Hearings on PSP, Hartford, Conn., March 1975.

for abandonment rather than the cruder multicounty "zonal factor," based on carloads.

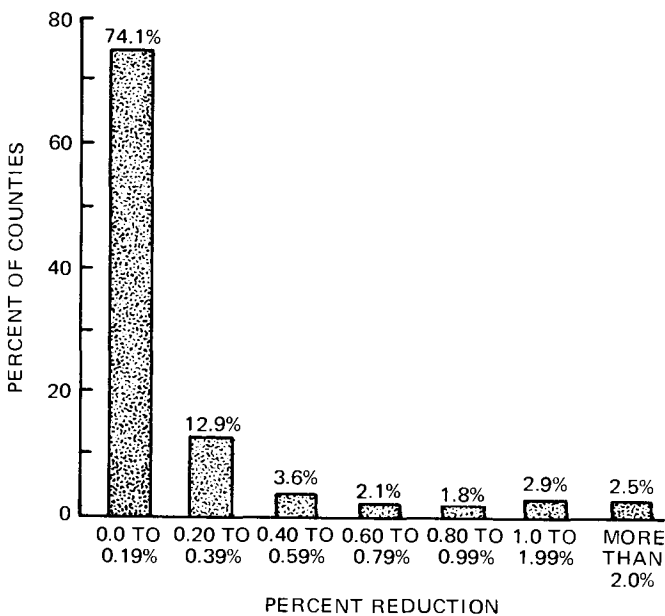
**Results of the Analysis**

The most significant fact about the results of the calculations is that, relative to the economies of the affected counties, the impact of the abandonment of rail service is extremely small. Some of the predicted changes are substantial in absolute terms, ranging occasionally into hundreds of workers who might be displaced and up to several million dollars of income potentially lost. Not only are these estimates biased upward for the reasons previously cited, but absolute numbers are not very good indicators of the significance of abandonments. The size of the impact is correlated with the size of the county economies. Consequently, when the estimates of changes are normalized to reflect the amount of economic activity in each county, for the most part the impact is found to be small.

The results of the analysis are summarized in Figures 1 through 3. Declines in real income attributable to loss of rail service are minimal. They indicate that the predicted overall impact from the termination of rail service on lines recommended in the PSP to be excluded from ConRail represent a very small proportion of the counties' existing economic bases.

- Figure 1 indicates that in only 15 communities (5 percent) of the 279 counties did the estimated decrease in industrial employment exceed 1 percent.

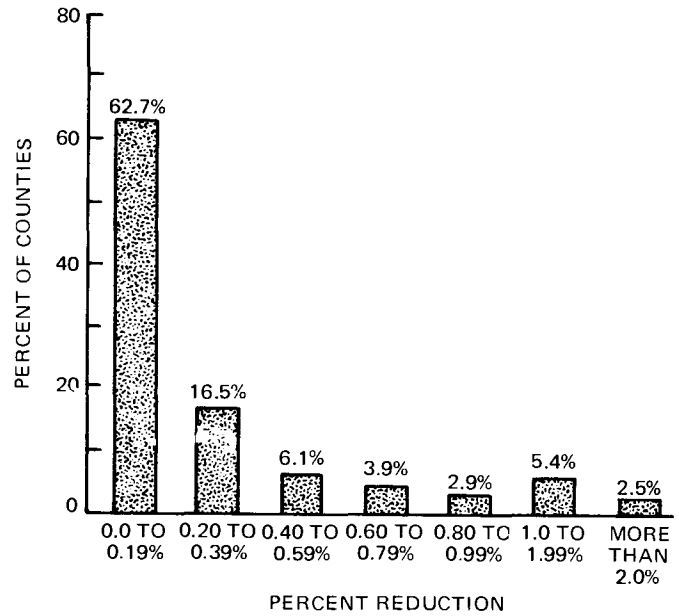
FIGURE 1.—Potential reduction in county employment after discontinuance of light density line rail freight service.



SOURCE: Public Interest Economics Center, *Community Impacts of Railroad Service*.

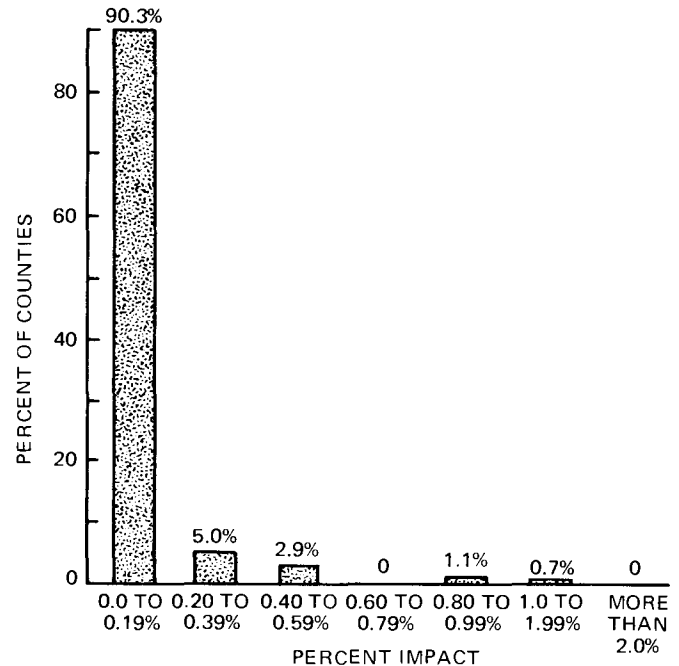
- Figure 2 shows that the potential reduction in county income is less than 1 percent in almost 90 percent of the counties.

FIGURE 2.—Potential reduction in county income after discontinuance of light density line rail freight service.



SOURCE: Public Interest Economics Center, *Community Impacts of Railroad Service*.

FIGURE 3.—Potential increase in transportation cost, as percent of county personal income, after discontinuance of light density line rail freight service.



SOURCE: Public Interest Economics Center, *Community Impacts of Railroad Service*.

TABLE

Connecticut  
Delaware  
Illinois  
Indiana  
Maryland  
Massachusetts  
Michigan  
New Jersey  
New York  
Ohio  
Pennsylvania  
Rhode Island  
West Virginia

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- Figure 3 indicates that the potential increase in transportation costs as a percent of income is less than 1 percent in 99 percent of the counties studied.

TABLE 1.—Change in Employment as a Percentage of County Employment

State	Number of counties	Percent change						
		0.0-.19	.20-.39	.40-.59	.60-.79	.80-.99	1.00-1.99	2.00+
Connecticut.....	5	4	1					
Delaware.....	3	2	1					
Illinois.....	17	16	1					
Indiana.....	44	40	1	1	2			
Maryland.....	9	4	1			1	1	2
Massachusetts.....	10	7	1	1	1			
Michigan.....	43	26	4	4		2	3	4
New Jersey.....	15	13	1				1	
New York.....	32	22	7	1			1	1
Ohio.....	53	40	7	1	4		1	
Pennsylvania.....	43	29	11	1		1	1	
Rhode Island.....	4	3		1				
West Virginia.....	1	1						
Total.....	279	207	36	10	6	5	8	7

SOURCE: Public Interest Economics Center (PIE-C), *The Impacts on Communities of Abandonment of Railroad Service: Final Report, Executive Summary*, prepared for U.S. Railway Association, June 1975.

NOTE: On June 30, 1975, USRA included all or some lines in 54 counties in ConRail that had been previously recommended for abandonment or restudy. Accordingly, the extent of impact in these frequency distributions would change mainly in the lower ranges. In the significant range of 1 percent and above, one county would be deleted in Ohio plus one county in Michigan since all lines are now included in ConRail.

#### SIC Code Description

SIC	Description
203	Canned and Preserved Fruits and Vegetables
240	Lumber and Wood Products, except Furniture
242	Sawmills and Planing Mills
262	Paper Mills, except Building Paper Mills
280	Chemicals and Allied Products
281	Industrial Inorganic Chemicals
289	Miscellaneous Chemical Products
300	Rubber and Miscellaneous Plastics Products
320	Stone, Clay, Glass and Concrete Products
330	Primary Metal Industries
333	Primary Smelting and Refining of Nonferrous Metals
344	Fabricated Structural Metal Products
360	Electrical and Electronic Machinery, Equipment and Supplies
370	Transportation Equipment

The quantitative predictions of impact are summarized in Tables 1 through 7. In only a very small proportion of the counties is any significant impact predicted. Tables 1 through 5 are frequency distributions of various measures of impact, showing the number of counties in each affected state that are predicted to experience various levels of relative change in real income, employment and money income generated.

The estimated impacts are less than 0.2 percent for the majority of the counties. The estimated changes in real income as a percentage of total personal income is less than 0.2 percent in almost 90 percent of the counties. In only two cases does the predicted change exceed 1 percent. The other measures of impact are biased upward and exceed the estimated maximum change in real income. In 74 percent of the counties, job displacement is less than 0.2 percent. In seven counties this figure

TABLE 2.—Change in County Income as a Percentage of County Personal Income

State	Number of counties	Percent change						
		0.0-.19	.20-.39	.40-.59	.60-.79	.80-.99	1.00-1.99	2.00+
Connecticut.....	5	3	2					
Delaware.....	3	2		1				
Illinois.....	17	12	1	1	1	1	1	
Indiana.....	44	28	7	4	1	3	1	
Maryland.....	9	4	1				2	2
Massachusetts.....	10	7	2	1				
Michigan.....	43	22	6	2	4		4	5
New Jersey.....	15	13	1			1		
New York.....	32	21	6	2		1	2	
Ohio.....	53	32	10	2	4	2	3	
Pennsylvania.....	43	27	9	4	1		2	
Rhode Island.....	4	3	1					
West Virginia.....	1	1						
Total.....	279	175	46	17	11	8	15	7

SOURCE: Public Interest Economics Center, *op. cit.*

NOTE: On June 30, 1975, USRA included all or some lines in 54 counties in ConRail that had been previously recommended for abandonment or restudy. Accordingly, the extent of impact in these frequency distributions would change mainly in the lower ranges. In the significant range of 1 percent or above only one county each in Michigan, Ohio and Illinois would be deleted since all the county lines are now included in ConRail.

TABLE 3.—Change in Real Income as a Percentage of County Personal Income

State	Number of counties	Percent change						
		0.0-.19	.20-.39	.40-.59	.60-.79	.80-.99	1.00-1.99	2.00+
Connecticut.....	5	5						
Delaware.....	3	2	1					
Illinois.....	17	16	1					
Indiana.....	44	43	1					
Maryland.....	9	5	1	1		2		
Massachusetts.....	10	10						
Michigan.....	43	35	3	2		1	2	
New Jersey.....	15	14	1					
New York.....	32	29	2	1				
Ohio.....	53	48	3	2				
Pennsylvania.....	43	40	1	2				
Rhode Island.....	4	4						
West Virginia.....	1	1						
Total.....	279	252	14	8	0	3	2	0

SOURCE: Public Interest Economics Center, *op. cit.*

NOTE: On June 30, 1975, USRA included all or some lines in 54 counties in ConRail that had been previously recommended for abandonment or restudy. Two counties in Ohio and one in Michigan would be deleted from the categories 0.38 through 0.47 since all the lines are now included in ConRail.

exceeds 2 percent. The maximum loss is 4.61 percent. The estimate of the absolute number of jobs displaced in any county is 364; however, that county does not place in the list of 15 counties subject to relative job impact greater than 1 percent. In one county, 25 jobs would be displaced, but this represents 1.5 percent of employment. In two counties, the percentage change in jobs is greater than 3 percent of total county employment. The relatively large percentage impact in these cases, however, is due to the small scale of economic activity in

TABLE 4.—*Absolute Change in Employment*

State	Number of counties	Percent change						
		0-19	20-39	40-59	60-79	80-99	100-199	200+
Connecticut.....	5	2	1			1	1	
Delaware.....	3	2						1
Illinois.....	17	16	1					
Indiana.....	44	39	3	1	1			
Maryland.....	9	5	1			1	1	1
Massachusetts.....	10	2	3			2	1	2
Michigan.....	43	25	5	4	4		4	1
New Jersey.....	15	9	2	2		1	1	
New York.....	32	18	4	2	3	1	1	3
Ohio.....	53	39	5	4			5	
Pennsylvania.....	43	25	6	1	1	1	4	5
Rhode Island.....	4	3		1				
West Virginia.....	1	1						
Total.....	279	186	31	15	9	7	18	13

SOURCE: Public Interest Economics Center, *op. cit.*

NOTE: On June 30, 1975 USRA included all or some lines in 54 counties in ConRail that had previously been recommended for abandonment or restudy. Accordingly, the extent of impact in these tables would change mainly in the lower ranges. But in the range of 150 jobs or over four counties would be omitted from the distribution in Delaware (1), Pennsylvania (2) and Michigan (1) since all the lines are now included in ConRail.

TABLE 5.—*Absolute Change in County Income Generated*

[In thousands of dollars]

State	Number of counties	Income ranges						
		0-1,000	1,001-2,000	2,001-3,000	3,001-4,000	4,001-6,000	6,001-8,000	8,001+
Connecticut.....	5	2	1		1	1		
Delaware.....	3	2						1
Illinois.....	17	12	4	1				
Indiana.....	44	34	7	2	1			
Maryland.....	9	4	2		1	1	1	
Massachusetts.....	10	4	1		2		2	1
Michigan.....	43	26	4	4	2	3	2	2
New Jersey.....	15	9	3	1	1			1
New York.....	32	17	5	2	2	2	1	3
Ohio.....	53	33	11	3	1	2	3	
Pennsylvania.....	43	25	7		1	2	3	5
Rhode Island.....	4	3	1			2		
West Virginia.....	1	1						
Total.....	279	172	46	13	12	11	12	13

SOURCE: Public Interest Economics Center, *op. cit.*

NOTE: On June 30, 1975 USRA included all or some lines in 54 counties in ConRail that had previously been recommended for abandonment or restudy. Accordingly, the extent of impact in these tables would change mainly in the lower ranges. But in the range of \$4 million or over, income generated in two counties would be omitted in Michigan (1) and Ohio (1) since all the lines are now included in ConRail.

these counties rather than a large abandonment of local rail traffic.

The percentage change in income is larger than the other ratios. Over 37 percent of the counties show more than a 0.2 percent decline in income generated as a fraction of total personal income. The estimated change in income generated is greater than 2 percent in seven counties and exceeds 1 percent in a total of 22 counties.

Tables 5 and 6 are frequency distributions by county of absolute changes predicted in employment and in-

TABLE 6.—*Industries With Greater Than 1 Percent Change in Employment by State*

SIC Code	[In percent]													
	MA	RI	CT	NY	NJ	PA	OH	IN	IL	MI	DE	MD	WV	
203.....	1.87			2.23		1.15								2.16
240.....	1.21		1.34							2.68	3.09			
242.....														
262.....	1.65		1.88											
280.....		2.09												
281.....											1.46			
289.....			1.08											
300.....											1.14			
320.....	1.08													
330.....											6.08			
333.....				2.65							1.29			
344.....											1.02			
360.....														
370.....	1.07													

NOTE: 24R is the "residual" calculation for the 24 SIC code after the components which could be calculated at the 3-digit level of detail have been calculated. This convention is used throughout the table. The SIC code descriptions refer to SIC 240 rather than 24R. The inclusion of lines in Delaware in ConRail as of June 30, 1975 reduced the industry impact considerably.

come. In 90 percent of the counties, fewer than 100 jobs would be displaced.

The estimated total of jobs displaced in all the 279 affected counties is less than 11,000. This number, however, is based on data collected from the Preliminary System Plan; the number of job displacements is expected to be smaller under the FSP, since many light density lines previously identified for abandonment have been returned to the ConRail System. The relative number of jobs displaced by potential abandonments is negligible—less than 0.12 percent of the approximately 9.5 million industrial jobs in the counties affected. The 14 states in which these counties are located account for 36 million nonagricultural jobs in all categories of work.

For the combined states, the personal income and employment changes are less than 0.1 percent of the totals in the states studied. But these declines are concentrated in five states, Ohio, Michigan, New York, Pennsylvania and Indiana, which make up 77 percent of the 279 counties with proposed rail service abandonments.

Relative to the number of counties affected at all by potential abandonments in a given state, Maryland, and to a lesser degree Michigan, bear a disproportionate share of the larger impact. All four of the Maryland counties showing large impact are on the Eastern Shore (Delmarva Peninsula). It is doubtful that all these lines will be abandoned; Southern Railway has evidenced strong interest in acquisition and operation of nearly all the Delmarva Peninsula lines and USRA has designated the rail operation to Southern. The actual impact on the State of Michigan also would seem to be reduced in light of the extensive program for maintaining rail service which the state is considering. The program would use joint federal-state funds under the provisions of the Act.

## INCLUDED LINES

USRA restudied the light density lines not recommended for inclusion in the PSP and has included in ConRail an additional 55 segments (754 miles) of branch lines in seven states—Delaware, Pennsylvania, Indiana, Michigan, New Jersey, New York and Ohio. This reduced the total mileage excluded from ConRail and lowers considerably the number of affected employees in the Region from the June 1975 report of 11,000.

While adjustments would need to be made to the frequency distributions shown in Tables 1 through 5, they

affect mainly the lower ranges in the seven states. They do not change the analysis to any extent other than to show the impact to be even less than originally predicted.

Some 54 counties of the 279 listed would require some changes from the predicted impacts, since all or some of the lines in those counties now are included in ConRail. Each table has been noted to indicate the extent of this change, although the text has been held to the PIE-C findings of its June 1975 report.

### Industry Impact

PIE-C estimated the employment change that would result from rail abandonments for each three-digit SIC<sup>15</sup> industry category within each state in the Region. These industry impacts generally are very small. In five states, New Jersey, Ohio, Indiana, Illinois and West Virginia, no three-digit industry category showed an estimated job employment displacement to be as great as 1 percent of the total employment for that industry category in the state. Indeed, if 1 percent of state employment in a given industry is set as the threshold of significant employment displacement, only 14 three-digit SIC industry categories are significant in 8 states. These industry categories and the percent of employment displaced in the industry category are shown by state in Table 6. The industries "hardest hit" in terms of the employment criterion are SIC 203, Canned Fruits and Vegetables, and SIC 240, Lumber and Wood Products. Each of these industry categories have more than a 1 percent decrease in employment in four states: Massachusetts, New York, Pennsylvania and Maryland in the case of SIC 203 and Massachusetts, Connecticut, Michigan and Delaware in the case of SIC 240. The remaining industry categories have a greater than 1 percent decline in employment in no more than two states.

A second measure of impact is the percentage change from initial employment by industry in the Region. This measure is shown in Table 7 for those SIC industry categories where the employment change is greater than 1 percent of the initial employment, along with the number of counties for which the industry change was registered (a crude measure of the number of counties in which abandonment might be expected to affect the industry). Seven SIC industry categories appear. The industry categories most widely affected are SIC 200, Food Processing, and SIC 240, Lumber and Wood Products, which are affected in 144 and 111 of the 279 counties reviewed in the study. This reflects the very widespread distribution of food processing ac-

tivities of various kinds throughout the Region. The appearance of SIC 333, Primary Nonferrous Metals, reflects the fact that it appeared in only one county. The impact in that county was substantial.

The estimates of impact by industry shown here are conservative. That is, it assumes an industry's loss of sales, income generated, employment, etc., resulting from the increased transportation costs stemming from rail abandonment probably will not be offset elsewhere in that industry category in the same state or in other states. This assumption overstates the "loss" of employment or income that states actually would experience, since some of the business loss in one county or a state can represent a gain in another county in the same state as buyers shift from one supplier to another.

TABLE 7.—Percentage Change From Initial Employment by Industry in Northeast Quadrant

SIC industry category	Number of counties	Percent change from initial employment
200.....	144	1.6
203.....	39	3.5
240.....	111	3.2
242.....	24	2.4
260.....	81	1.5
262.....	8	1.8
333.....	1	4.2

#### SIC Code Description

SIC	Description
200	Food and Kindred Products
260	Paper and Allied Products

SOURCE: Public Interest Economics Center, *op. cit.*

### Future Development

Future development potential in areas facing the possible abandonment of rail service was the second area of specific criticism of the PIE-C approach. One might try, for example, to consider the economic potential contemplated in existing official development plans, though surely an aggregation of all such plans would produce an overly optimistic result.

<sup>15</sup> Standard Industrial Classification System, at 3-digit industry level.

The potential for near-term traffic growth has been considered in developing the disposition of each individual line. The Association's policy and analytic procedures pertaining to traffic growth are discussed in Chapter 9 of the FSP. Briefly, where thorough documentation firmly indicates that rail traffic is likely to increase sufficiently in the near term to support viable rail service, the line has been retained in the restructured system.

It must be noted, however, that the affected interests can influence the traffic development potential of the involved lines. Regional development commissions, states and other public bodies have social objectives which can be attained through careful local and state planning.<sup>16</sup> It is unreasonable, however, to expect a railroad with a profit goal to sustain losses to assist a region to develop. States wishing to continue service on such railroad branch lines should use the service continuation subsidies or other funds to help attain development objectives. If during the subsidy period a line demonstrates sufficient traffic growth to be viable or is viewed as a potential industrial development site, it is anticipated that ConRail would purchase the line for inclusion in the system.

### Conclusions

The Association's analysis overstates the potential impact of termination of services on lines not proposed for inclusion in ConRail. This occurs partly because of the use of transportation and industry averages and has been verified in case studies. Another factor resulting in the overstatement is the fact that potential impact of rail service continuation subsidies and purchase of some lines by profitable railroads has not been considered. In computing the increased costs of alternative transportation, the difference between estimated rail and common motor carrier costs was used. The two most important alternatives excluded by this approach are private carriage and trailer-on-flat car or container-on-flat car service. Because increased transportation costs are the most significant impact identified by the analysis, inclusion of these two services probably would have reduced the impact further.

The PIE-C study did not take account of the reinclusion of certain line segments after publication of the PSP. These changes have reduced the impacts by a considerable extent. In addition, impacts shown for Maryland will not occur if the Southern Railway System acquires the Delmarva lines.

<sup>16</sup>In testimony before Rail Services Planning Office hearings on the PSP in Washington, D.C. on March 19, 1975, Donald Whitehead, Federal Co-Chairman, Appalachian Regional Commission (ARC) expressed his opposition to line abandonment in his 13-State area by stating: "Over the long run, potential abandonment would seriously impair the ability of the affected communities to bring to successful fruition their economic development programs." He criticized USRA for its short-range approach. The ARC has used development assumptions in some of its studies. See INTASA, *The Railroad Reorganization Act and Its Impacts on Economic Development*, prepared for ARC, October 1974.

For the few counties in which impacts on the economic base may be significant, the states and communities should make the decision as to whether the social benefits to be attained by continuing service would be worth the investment in service continuation subsidies under Title IV or some other arrangement.

### Employment Impact of the Final System Plan

Employment opportunities in the areas served by ConRail will be enhanced by the activities associated with restructuring and rebuilding the system. Approximately \$2.1 billion in new investment and maintenance funds will flow into the Region as system improvements are made. During the 1976-1985 decade about \$7.5 billion will be spent on ConRail facilities. The employment generated by these expenditures will offset some losses of employment income in the Region which might occur as a result of abandonment.

While direct economic stimulation resulting from the restructuring process was not a primary focus of USRA's planning efforts, it is an important ancillary benefit. USRA commissioned a study to analyze the employment and income generating aspects of the rehabilitation and investment program.<sup>17</sup>

Railroad rehabilitation is primarily an investment activity. That is, it does not add immediately to the supply of consumer goods. The incomes which rehabilitation generates, however, become immediately available for the purchase of the existing supply of consumer goods. Consumer goods purchases, in turn, lead to employment and incomes far in excess of those created by the initial investment, a phenomenon known as the multiplier principle.

USRA's study assessed the overall impact of the rehabilitation and investment program during the initial 10-year period of ConRail's existence and was evaluated with special emphasis on the temporary additional impacts related to the injection of new capital funds (i.e. \$2.1 billion). In addition, changes in the character of maintenance expenditures to more labor intensive forms were reviewed because these also tend to increase employment. The permanent benefits of a revitalized rail system to the Region were not addressed, although some jobs generated by the rehabilitation programs will not be temporary. The enlarged maintenance program, for example, will continue to support some increased employment after complete rehabilitation.

<sup>17</sup>Jack Faucett Associates, *Employment Effects of the Plan*, prepared for U.S. Railway Association, July 1975. Data and classifications used in this study vary somewhat from the information in the FSP on rehabilitation and investment expenditures. These calculations are based on slightly earlier information, are in 1973 dollars, assume 1973 level of expenditures for 10 years and define the difference from total 10-year expenditures as the contribution of additional FSP expenditures to employment and income.

## Approach

To derive "net" employment and income effects of the rehabilitation program, a "normal" expenditures concept was used. This represents the employment which would have been generated by a decade of expenditures at the 1973 level by railroads considered for the ConRail system. The analysis assumes that, in the absence of reorganization and rehabilitation, system maintenance employment would have continued at the 1973 level. The net impact, then, is the difference between predicted gross man years generated over the 1976-1985 decade less 10 times the 1973 estimates.<sup>18</sup> This approach has not considered the impact of rail service continuation subsidies provided in the Act or the probable acquisition of many lines by profitable railroads. Both of these factors would increase the employment gains resulting from the implementation of the Final System Plan.

The industrial distribution of impact was based upon an industrial classification and analysis of materials, parts, supplies and labor to be purchased by ConRail. Probable location of key suppliers was determined by contacting involved railroads and some supplier industries.

Direct, indirect and induced levels of employment and incomes were estimated. Direct employment and incomes are those generated on the rehabilitated railroads; indirect are those generated by firms who supply the railroads, directly or indirectly. It includes construction on such projects as buildings, bridges and terminals which is performed by outside contractors. Induced employment and incomes are generated in consumer industries when direct and indirect income recipients spend their earnings. An additional multiplier effect occurs when increases in industry output exhausts capacity and causes investment in new facilities; the USRA contract study also made estimates of this effect.

To estimate direct employment<sup>19</sup> on the railroads and that component of indirect employment which occurs when railroads purchase goods and services from other industries, ConRail expenditures were structured into 11 categories which conform to ICC expenditure accounts. The material component of these expenditures was determined, and labor input and production cost patterns of the industries involved were applied to their values.

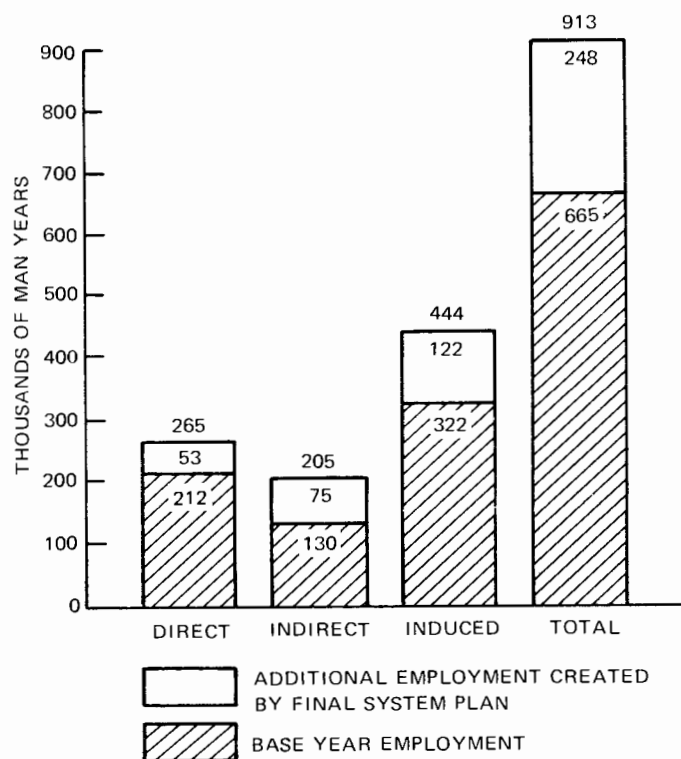
Other indirect and all induced employment and incomes were derived by utilizing the multiregional input-

output model of the United States economy.<sup>20</sup> Use of this 50 state, 80 industry model insures consistency within and between industrial and regional effects. All data in the published estimates are in 1973 prices.

## Results

The planned total expenditure of \$7.5 billion for rehabilitating and maintaining the ConRail system between 1976 and 1985 would generate an estimated 913 thousand man years of employment, more than \$9 billion in wages and salaries and over \$2.5 billion in other personal income.<sup>21</sup> (See Figure 4.)

FIGURE 4.—Aggregate U.S. employment impact of ConRail rehabilitation



The \$7.5 billion represents a 40 percent annual increase over the 1973 base year maintenance and investment expenditure. The net increment to total employment resulting from additional rehabilitation and increased maintenance expenditures would number 248 thousand man years for the decade or 24.8 thousand per year and added income of over \$3.1 billion for the decade.

<sup>18</sup> To the extent that lines included in the base period but not in ConRail are rehabilitated by their new owners as a condition for acquiring them, the estimates here tend to understate the actual impact of rehabilitation.

<sup>19</sup> This definition of direct employment is different from that used by the contractor. It has been changed to identify positively railroad employment and to conform to other distributions of direct and indirect employment in proposed rail programs now before the Congress. The contractor's totals have been retained.

<sup>20</sup> This model was developed at Harvard University and Massachusetts Institute of Technology by Dr. Karen Polenske with the support of various agencies.

<sup>21</sup> Includes direct, indirect and induced employment and income. Direct employment is on the railroads; indirect employment is in industries that supply railroads; induced employment are jobs created primarily in consumer goods industries. Direct, indirect and induced incomes have similar connotations. In addition to wages and salaries, proprietary incomes such as profits, interest and rents are included.

Twenty-nine percent of all jobs (approximately 265 thousand man years over 10 years) actually would be on the ConRail system, Another 22 percent (approximately 205 thousand man years) would be at the plants of the firms which sell to railroads directly or indirectly. The balances about 444 thousand man years represents the job creation effect of recipients spending the direct and indirect incomes received from the rehabilitation and investment program. Such jobs are distributed throughout the consumer goods industries.

Income distribution would follow a similar pattern. Net increases in employment and incomes from increased maintenance expenditures and rehabilitation should offset any negative impacts which might occur as a consequence of line abandonments. Moreover, only the temporary effects of rebuilding the system are included. The longer term benefits of a revitalized rail system, which might be of even greater magnitude, were not addressed.

Table 8 summarizes estimated gross and net employment and income effects estimated for the decade.

TABLE 8.—*Summary of Employment and Income Effects of Rehabilitation*<sup>1</sup>

Item	Employment (man years)	Incomes (thousands of 1973 dollars)	
		(Salaries and wages)	(Proprietary incomes) <sup>2</sup>
10-year total.....	913, 127	9, 140, 054	2, 559, 215
Annual.....	91, 313	914, 005	255, 922
Base year (1973).....	66, 470	672, 414	188, 276
Annual increment.....	24, 843	241, 591	67, 646
10-year increment.....	248, 430	2, 415, 910	676, 460

<sup>1</sup> Sum of Direct, Indirect and Induced Employment and Income.

<sup>2</sup> Derived from salaries and wages utilizing a factor of 28 percent of salaries and wages in 1973 from National Income Accounts.

SOURCE: Jack Faucett Associates, *Employment Effects of the System Plan*, July 1975, prepared for the U.S. Railway Association. To derive indirect and induced man years of employment and incomes, the multiregional input-output (MRIO) model of the U.S. was used. Use of MRIO insures consistency between industrial and regional effects.

Total incomes generated by the expanded ConRail maintenance and investment programs are estimated to reach almost \$12 billion and to consist of over \$9 billion in wages and salaries and more than \$2.5 billion in proprietary incomes such as profits, rents and interest. Table 9 shows the distribution of these incomes by type and by source. Only salaries and wages have been allocated by function and category.

Employment on ConRail will account for 35 percent of the total wages and 30 percent of total man years. Each ConRail maintenance job will be worth, on the average, \$12,205. The amount compares with \$11,835 in

TABLE 9.—*Income Generation by Type and Source for 1976-85*

	[Thousands of 1973 dollars]			
	Category			
	Direct <sup>1</sup>	Indirect	Induced	Total
<b>Function:</b>				
Road bed and structure.....	\$1, 795, 997	\$1, 266, 277	\$2, 166, 018	\$5, 228, 292
Rolling stock.....	\$1, 438, 457	\$891, 248	\$1, 582, 057	\$3, 911, 762
Total wages.....	\$3, 234, 454	\$2, 157, 525	\$3, 748, 075	\$9, 140, 054
Percent of total.....	35.4	23.6	41.0	100.0
Average wage per worker.....	\$12, 205	\$10, 545	\$8, 449	\$10, 009
Add—proprietary incomes <sup>2</sup> .....				\$2, 559, 215
Total income.....				\$11, 699, 269

<sup>1</sup> Income to Con Rail workers.

<sup>2</sup> Proprietary incomes were estimated at 28 percent of salaries and wages based on the 1973 relationship between wages and other incomes as reflected in the personal income tabulations of the U.S. National Income Accounts.

actual average wages paid to railway maintenance workers during 1973. The increase reflects changes in the mix of employees from the base period.

The industrial and geographical distribution of wages and incomes will be about the same as the distribution pattern of employment simply because 78 percent of income is wages.

#### Annual Employment Impact

Once rehabilitation has begun, the program should provide a stable source of employment and income to the Region. The number of man years should increase gradually over the period, reaching its highest level in 1985. During this period, there is expected to be some shortages of skilled labor and critical material parts and components, such as rail and crossties, as well as a shortage of industrial capacity to produce some of the necessary components.

The apparent stability reflects the fact that activities within different functions tend to peak at different times. Table 10 shows expected ConRail employment and other employment by year and how they are affected by the planned rehabilitation program. Expenditures for roadway and structures peak in 1980, decline slightly, then remain constant. Within this account, however, expenditures for track work, reflecting shortages of competent crews and track material, do not peak until 1982, after which they also remain constant. Peak rolling stock expenditure does not occur until 1985 when new freight car purchases are at the maximum, although a secondary peak occurs in 1977 when new locomotive purchases get under way.

To facilitate the analysis, it was assumed that employment related to an expenditure would occur during the same accounting period as the expenditure. Such

TABLE 10.—Annual Employment Generated  
[Thousands of man-years]

	Employment	ConRail <sup>1</sup>	Other
1976.....	80.2	26.4	53.8
1977.....	92.8	26.9	65.9
1978.....	85.2	26.3	58.9
1979.....	86.0	26.5	59.5
1980.....	91.5	26.8	64.7
1981.....	89.3	26.7	62.6
1982.....	95.5	26.4	69.1
1983.....	97.0	26.3	70.7
1984.....	96.9	26.3	70.6
1985.....	98.5	26.3	72.2
Total.....	913.0	265.0	648.0

<sup>1</sup> Employment estimates and staging of ConRail rehabilitation employment in the Faucett report are somewhat less than those shown in Chapter 6 of the FSP. Virtually all of this difference is accounted for by the omission in the Faucett study of maintenance employees in 1976 and 1977 of lines that may be subsidized and EL and Reading passenger employees. Other minor variations result from the use of data in the Faucett study at an earlier stage, some differences in classification, the dependence upon expenditure data in the I-O model from which employment conversions were developed, the use of 1973 productivity and similar methodology differences.

coincidence might never happen for any given expenditure because of lead times necessary for procuring equipment and stockpiling parts and supplies. Procurement lead time can be as much as 15 months. Moreover, induced employment may lag the direct and indirect employment to which it is related by as much as 18 months. The inherent assumption in the approach used is that over the decade, the accounts would tend to balance out.

#### Industry and Geographic Distribution of Employment

In this area, the railway industry will benefit more than any other. Of the total 10-year job estimate for the \$7.5 billion program of 913 thousand man years, 265 thousand represent direct man years of employment projected for the ConRail system. Included within this total program are 53 thousand in direct man years of new employment on the railroads. In addition, there are increases of 75 thousand indirect and 121 thousand induced man years distributed over all other industries.

The increment to railroad employment reflects a number of planned changes in the distribution of expenditures between the roadway and structures and rolling stock accounts as well as in the distribution of funds within the accounts, especially for the rolling stock.

In the comparison year of 1973, for example, rolling stock maintenance and investment accounted for 54 percent of the total, while roadway and structures accounted for 46 percent. Planned outlays would allocate only 39 percent to rolling stock but 61 percent to roadway and structures.

The combined effect of these changes is to shift much of the new employment to other industrial sectors of the economy and reduce the ratio of direct man years from 32 percent of the total to 29 percent.

The following tabulation sets forth the five industries in which the 10-year direct and indirect impact of the program results in the sales of \$1 billion or more. Generally a large sales figure means large employment, but the rank order of sales does not necessarily indicate the rank order of employment.

Industry Name	Sales (Millions of 1973 Dollars)
Primary Iron and Steel.....	\$2,591
Wholesale and Retail Trade.....	2,079
Real Estate and Rental.....	1,464
Transportation Equipment (except auto and aircraft) ..	1,292
Food and Kindred Products.....	1,097

Because of the intense industrial nature of the Region, only a few of the new jobs will be in other states. Inside the Region, 775 thousand total man years of work would be generated, primarily in Pennsylvania, Ohio, Indiana, New York and Illinois. Pennsylvania would represent 145 thousand total man years of employment, more than double that of the next highest state, Ohio, which would receive 70 thousand total man years. The large number of jobs in Pennsylvania, of course, reflects the fact that more miles of ConRail track lie within Pennsylvania's borders than any other state and that several large railroad shops, one steel mill and most relevant crosstie production is within that state.

As shown in Table 11, 90 percent of all new direct and indirect man years in the Region would be generated in seven states; 5 percent in New England and the balance in other smaller states.

TABLE 11.—Location of Direct and Indirect New Employment in the ConRail Region (1976-85)

Location	New Employment (Man Years)	Percent of Total
New England.....	5,920	5.1
Pennsylvania.....	32,860	28.3
Ohio.....	20,430	17.6
New York.....	13,040	11.2
Indiana.....	15,260	13.1
Illinois.....	13,080	11.2
New Jersey.....	3,810	3.2
Michigan.....	5,530	4.8
All Other States.....	6,380	5.5
Total Direct and Indirect.....	116,310	100.0
Induced Employment.....	97,010	
Total Employment.....	213,320	

#### Conclusion

The number of man years of new or additional employment, related wages and other incomes that

would be generated by the ConRail rehabilitation and investment program should be greater than the number of jobs and incomes that might be lost as a result of branch line abandonments. Over the decade, 128 thousand new direct and indirect jobs, an average of 12.8 thousand jobs per year, would be created. In addition 120 thousand jobs, or 12 thousand per year, result from the multiplier and induced effects<sup>22</sup> of expenditures by these employees.

The total program of investment and rehabilitation expenditures of \$7.5 billion (inclusive of the new employment described above) would generate 913 thou-

sand man years of work over a 10-year period.<sup>23</sup> Eighty-four percent of these jobs would be in the 17-state Region.

USRA urges ConRail to recognize opportunities to stimulate minority business involvement in its purchase of materials and supplies. Such a policy would help ensure that the beneficial effects of new investment in the Region's rail system are felt broadly across the economy.

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<sup>22</sup> Induced employment, it should be noted, is a more tenuous estimate than the estimates of direct and indirect employment.

<sup>23</sup> Sum of direct, indirect and induced employment.

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## Environmental Assessment of the Final System Plan

*In performing its assessment of the environmental impact of the Final System Plan, USRA has concluded that the effect of a restructured rail system in the Region will be minimal and in most cases positive.*

*The areas of greatest concern, air quality, energy, noise, water quality and land use, will not be affected appreciably by the implementation of a restructured system. Enforcement of the Clean Air Act of 1970 and new engine performance standards for both truck and locomotive diesel engines should contribute to a healthier environment.*

*In the area of energy, the use of rail for medium and long distance hauls and trucks for shorter trips should make more efficient use of available energy resources and at the same time generally lower the level of harmful air emissions. The restructured system's adherence to the Noise Control Act of 1972 should control adverse effects of noise from line haul operations, while local ordinances can regulate noise from fixed facilities.*

*Water quality in the Region is expected to improve overall as certain rail lines and facilities are abandoned and as upgrading of other track and facilities reduces the hazard of spills. The impact*

*of the restructured system on land will vary by locality. For example, state or local governments may use abandoned rail lines for mass transportation corridors, recreation sites or conservation areas.*

*The Final System Plan poses no threat to the environment and in many cases will prove beneficial in maintaining environmental standards.*

In our technological society, the rate of consumption of natural resources and the contamination of the atmosphere have become matters of major import. Heightened public awareness of the environmental effects associated with different forms of transportation has helped shape current transportation planning. Congress directed that the Final System Plan take into account the environmental implications of actions proposed by USRA.

Section 206(a)(6) of the Act specifies as one of the goals of the Final System Plan, the:

attainment and maintenance of any environmental standards, particularly the applicable national ambient air standards and plans established under the Clear Air Act Amendments of 1970, taking into consideration the environmental impacts of alternative choices of action.

Section 202(b)(2) states that the Association should investigate:

the extent to which available alternative modes of transportation could move such traffic as is now carried by railroads in reorganization; and the relative social, economic, and environmental costs that would be involved in the use of such available alternative modes, including energy resource costs.

Although the Association has considered the environmental effects of railroad operations in the course of its planning process, section 601(c) of the Act specifically exempted the Association from compliance with certain provisions of the National Environmental Policy Act of 1969 regarding any action taken under the authority of the Regional Rail Reorganization Act before the effective date of the Final System Plan.

Transportation has such direct interrelationships with land use and industry location that it must be assessed in terms of its implications on the total environment. Cars, trucks, buses and trains produce sound levels that are often termed "noisy." Transportation facilities, if not properly placed, may foul streams, lakes, potential water supplies, etc. Transportation uses a large share of petroleum energy in the United States and consequently accounts for a large share of air contamination. There is no way to avoid the influence on energy and the environment of transportation actions.

In August 1974, USRA commissioned Battelle Columbus Laboratories to prepare an assessment of environmental impacts expected to accompany implementation of the FSP. The study was to prepare an overview of the environmental problems in the Region with respect to the development of a railroad system plan and to recommend directions for continuous assessments after the FSP was formulated.

The general approach of an environmental impact assessment is to establish existing conditions and assess the effects of changes. At the outset of the study it was recognized that the scope and timing were such that the study would have to be based on an environmental assessment of generic problems which would be typical of any final system plan developed. Various policy directives which USRA might make in developing and implementing the FSP were chosen as the "generic problems" considered. These are:

- Abandonment of buildings and facilities,
- Discontinuance of service,
- Reduced service,
- Consolidation,
- Expansion of service,
- Electrification and
- Rehabilitation, modernization and expansion of facilities and equipment.

Each of the above were assessed to determine their effect on each of the major environmental sectors, which are:

- Energy,
- Air quality,
- Noise,
- Water quality, plant and wildlife and
- Land use, socioeconomic and cultural.

In the large and complex system envisioned in the FSP, it was necessary to devise methods to organize and guide the environmental assessment. To do this a schematic design was developed to show the various consequences of the generic problems which might occur in implementing the FSP. Figure 1 illustrates this design and also summarizes the results of the study. In addition, land use alternatives presented a special case,

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FIGURE 1.—Summary of Environmental Impacts from Implementing the System Plan

Environmental Sectors	Policy Directives						
	Abandonment of Buildings and Facilities	Abandonment of Lines	Reduced Service	Consolidation	Increased Service	Electrification	Rehabilitation, Modernization, and Expansion of Facilities and Equipment
Air Quality.....	Generally improve..	Generally improve..	Little net change....	Little net change....	Generally improve, could be local problem.	Improve along rail operations—Move impacts to power plant location.	Transient impact during construction. New facilities improve quality due to regulations. Impacts at other locations due to producing steel, wood, etc.
Noise.....	Specific with land use, generally improve.	Specific with land use, generally improve.	Possible transfer from rail to track noise, little net change expected. Could be local problems.	Specific with land use. Possible transfer from rail to track noise. Little net change expected. Could be local problems.	Some noise increase and possible negative impact. Probably site specific.	Generally improve..	Transient impacts during construction. Little net change expected.
Land Use, Socio-economic, and Cultural.	Specific with land use.	Specific with land use.	Specific with land use.	Specific with land use.	Little net change....	Little net change at railway sites. Possible negative impacts at power plant and transmission line sites.	Specific to land use adjacent to site.
Energy.....	Generally improve..	Could transfer impacts to other modes. Depends on specific situation and whether other modes already handling bulk of traffic.	Could transfer impacts to other modes. Depends on specific situation and whether other modes already handling bulk of traffic.	Could transfer impacts to other modes on abandoned line. Possibly more efficient operation on retained line. Depends on specific situation.	Depends on design of system plan and operations. Expected to improve efficiency.	Energy requirements generally the same. Transfer basic energy source to coal or nuclear instead of scarce oil.	General improvements.
Water Quality and Biota.	Generally improve..	Generally improve. Different problems may arise due to land use.	Generally improve..	Generally improve. Different problems may arise due to land use of abandoned line.	Expected to be improved if good maintenance and modern pollution control procedures used.	Some transient impacts from construction of power plant and transmission lines. Generally improve.	Improvement expected as modern maintenance and pollution control procedures used.

*Assumptions:* That new or relocated facilities of railroads or industry will be subject to Environmental Regulations which will upgrade environmental quality. Where

trucks replace rail that trucks are already handling a significant portion of traffic. SOURCE: Battelle Columbus Laboratories, *op. cit.*

since they are a controlling factor in many cases of potential environmental impact. A compatibility matrix was developed as a guide for impacts from various railroad-related land use changes.<sup>1</sup>

The results of the study discuss the environmental impact and localized effects of discontinued light density line rail service, as well as comparing the environmental effect of railroads with those of competing modes of the FSP are as follows.

The objective of the study was to develop an assessment of reorganization effects on the environment rather than to prepare a specific impact statement. Some general conclusions regarding the environmental impact of the FSP are as follows.

- Over time, the actions initiated by the FSP will improve environmental conditions.

<sup>1</sup> Battelle Columbus Laboratories, *Final Report on the Environmental Assessment of the System Plan*, for the United States Railway Association, Apr. 30, 1975.

- The light density rail lines of concern already are abandoned or little used, with most freight presently being handled by other modes. Improved operations and facilities, better maintenance and other planned uses of abandoned rights-of-way or property can result only in a better environment.
- The net energy impact will depend upon whether alternative transportation modes replace rail or whether the industries served by the abandoned line are forced to relocate.
- Air quality and energy impact are expected to be insignificant.
- Abandonment of a line reduces air pollution at that location to the extent that subsequent right-of-way use is less polluting and industrial relocations necessitated by the abandonment likewise result in less pollution.
- One of the effects of rail line abandonment is likely to be an increase in the number of motor trucks in use, resulting in increased traffic noise.

- The overall environmental impact on water quality resulting from discontinuance of service on light density lines is negligible.
- Desirable real estate around an abandoned line often is sought by state, local and private groups for recreation and conservation purposes.
- Land use is the key to social impact as well as noise and water quality. The application of land use planning and regulations are expected to improve conditions.

This chapter discusses the findings of the Battelle study as well as citing other studies relevant to environmental impact. Each major environmental sector is discussed in relation to its effect on the generic problems. Also, the material responding to the RSPO testimony has been incorporated in this chapter.

### Energy Conservation

Transportation operations consume over 30 percent of the energy used in the country. The following is the consumption breakdown within the transportation sector.<sup>2</sup>

Percent	Used For
72	Passenger movement (all modes)
14	Local trucking
7	Intercity trucking
3	Rail
4	Water, pipeline and air-freight carriers.

During the past decade, transportation energy use has been increasing by 4 to 5 percent annually, a rate higher than traffic growth. This reflects shifting modal shares. Fully 54 percent of the Nation's oil consumption is in transportation; it is the fuel for automobiles, trucks, virtually all locomotives, etc. Less than 5 percent of all transportation energy used is coal, natural gas or electricity. Thus, it is important that any changes in transportation operations economize on the consumption of oil.

### Comparison of Energy Consumption by Transportation Modes

Although USRA has undertaken various approaches to estimate the energy consumed in transporting freight or passengers, each mode has certain characteristics which make comparison with other modes difficult. For overland vehicles, for example, fuel consumption will vary with speed, the size of the load carried and the route taken. Urban travel, with stops requiring deceleration and acceleration, uses more fuel than continuous movement at a steady pace.

A vehicle carrying a light but bulky load is not as efficient in terms of net tons carried per energy unit

expended as is a vehicle which is carrying its maximum weight load. Both types of loads, however, need to be transported and, in terms of fuel consumption, one mode may be more efficient in handling a certain load than another. A valid comparison should include the entire trip from shipper to receiver, not just the portion along a main-line railroad, an interstate super highway or a cross-country pipeline.

In making comparisons, it generally is assumed that all land transportation modes cover identical routes in terms of terrain and miles traveled. This may not always be true. Between two points, two alternative transportation modes typically follow different routes, one being significantly more direct or more level than the other. In considering railroad branch line operations, it generally can be assumed that truck and railroad routes along the branch line are similar. If the area is a river valley, both routes generally follow the river. If it is in a level area, the only difference in the routes will be in distance traveled. For cross-country travel, a freight car may travel a circuitous route between its origin and destination because it is only one car of many in the train and the destinations of all cars help determine the makeup of the train and the route it follows. Similarly, trucks carrying multiple cargo also may use circuitous routes because of terminal requirements. Trucks or trains carrying a single commodity may have the opportunity to choose a route which is most advantageous for that load from the aspects of time and fuel usage.

In the comparison of transportation traffic for energy consumption, other factors are the percentage of return loads and locomotive or tractor idling time. For some carriers it is impossible to have a return load because no commodity is available for movement the other way or the carrier is licensed to handle only one commodity. Usually, unit coal trains, coal barges and coal trucks return to the mine empty. Many tank trucks can haul only one type of chemical and, thus, spend only half their time loaded.

Locomotives spend considerable time idling at a point of pickup or during switching. This practice consumes energy without producing any return in tonnage transported. The truck tractor also spends some time idling at the points of pickup and delivery. The transfer of a commodity between modes or within a mode will consume additional energy. Switching cars at a railroad terminal, transferring freight from truck to cross-country train or from local truck to cross-country trailer and filling tank trucks at a pipeline terminal all consume energy. For some types of transportation intermodal transfer cannot be avoided. Barges can go only as far as the river extends. Similarly, there are towns and industrial sites which do not have a rail spur.

<sup>2</sup> Peat, Marwick, Mitchell, and Jack Faucett Associates, *Industrial Energy Studies of Ground Freight Transportation*, July 1974, p. III-15.

Estimated fuel consumption of motor versus rail carrier under standardized conditions for short hauls of light traffic for movements up to 220 tons (approximately five carloads) is shown in Table 1. Over short hauls, fuel consumption by rail is greater than fuel consumption by heavy truck. In view of the low density of traffic on the light density lines, abandonment of many of these lines should reduce the direct energy consumption used in transporting cargo (through the substitution of motor carriers for rail carriers) in abandoned-line-segment areas. The analysis presumes substituted truck service for the branch line haul. Where truck will be used all the way, energy consumption usually will be higher.

### Comparisons of Energy Intensiveness of Various Transportation Modes

Peat, Marwick, Mitchell collected the findings of several studies which investigated the energy consumed by various transportation modes. Tables 2 and 3

are adapted from this report. In regard to minimum consumption of energy, findings show that when only cross-country travel is considered and such factors as intermodal transfer or circuitry of route are disregarded, the fuel efficient long intercity train is rivaled only by pipelines and barges. Figure 2 shows relative energy consumption by transport mode. Heavy unit trains, most competitive with barge and pipeline, are more efficient than these modes in ratio of fuel used per ton-mile moved.

A summary of the findings of several other studies which compared the energy consumption of trucks and trains while carrying freight under similar conditions—intercity cross-country travel over level terrain—yields truck/rail energy intensiveness ratios of 2.0 to 6.7 with more than half of the values falling between 3 and 4.<sup>3</sup>

<sup>3</sup> Battelle Columbus Laboratories, *Final Report on the Environmental Assessment of the System Plan, for the United States Railway Association*, Apr. 30, 1975.

TABLE 1.—Estimated Total Fuel Consumed by Rail and Motor Carriers

Net shipments (tons)	Mode	Number of vehicle loads	1-way trip distance (miles includes return trip; gallons)						
			5	10	15	20	25	50	75
44	RR	1	13.3	21.7	30.1	38.5	46.9	93.8	140.7
	MC	2	4.9	9.1	3.4	17.7	22.0	44.0	65.9
88	RR	2	18.9	27.9	37.0	45.9	54.9	109.8	164.7
	MC	4	9.7	18.2	26.8	35.3	43.9	87.8	131.7
132	RR	3	24.5	34.2	43.9	53.5	63.1	126.2	189.3
	MC	6	14.6	27.4	40.2	53.0	65.8	131.6	197.4
176	RR	4	30.1	40.4	50.7	61.0	71.3	142.6	213.9
	MC	8	19.5	36.5	53.6	70.6	87.7	175.4	263.1
220	RR	5	35.6	46.7	57.6	68.5	79.4	158.8	236.2
	MC	10	24.3	45.6	67.0	88.2	109.5	219.0	328.5

SOURCE: U.S. Department of Transportation, *The Environmental Impact Statement on The Transportation Improvement Act of 1973, 1974*, p. 25.

TABLE 2.—Variations in Energy Intensiveness by Mode

Mode	Btu's per net ton-mile				Ton-miles/gallon (Btu/ton-mile at 138,690 Btu/gal)		
	Rand Corp. "Methods for est.vol. energy and demand of freight transportation"	Battelle Laboratories "Energy required for movement of intercity freight"		Oak Ridge National Laboratories	Carnegie- Mellon U.	DOT	FEA
		Emissions analysis basis	Fuel-use basis				
Freight					20		
Inland Waterway	500			680	240 (578)	300 (463)	275
Oil pipelines	1,850			450	267 (519)		307
Air freight	63,000			42,000	110 (13,500)		5
Railroad:							
30,000 gross ton unit train (200 cars) at 25 mph					420 (330)		
3,000 gross ton train (40 cars) at 90 mph					97 (1,430)		
Total freight	750		680	670	180 (771)		197
Intercity		1,475	500				
Trucking:							
Total freight	2,400		2,800	2,800	50 (2,774)		53
Intercity		1,730	1,870				
Local urban trucking							19

<sup>1</sup> Kerosene at 135,000 Btu per gallon.

<sup>2</sup> Excludes fuel spillage and waste.

SOURCE: Preliminary System Plan, Volume I, page 148, February 1975. Peat, Marwick, Mitchell, *op. cit.*, p. IX-4.

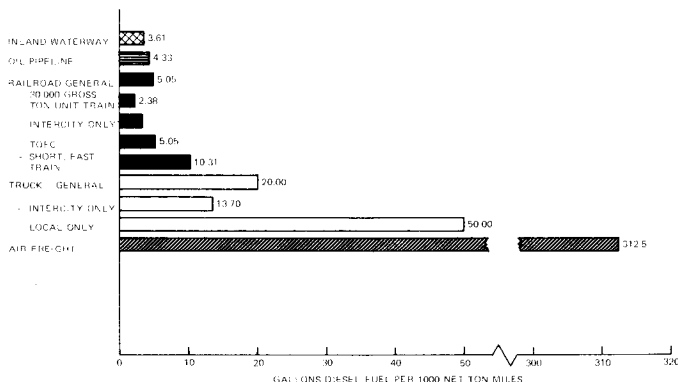
TABLE 3.—Estimated Ranking of Energy Intensiveness<sup>1</sup>

Mode	Approximate Btu Per Net Ton Mile	Net Ton Miles/ Gallon Diesel Fuel	Gallons Diesel Fuel Per 1000 Net Ton Mile
<b>Railroad:</b>			
General.....	700	198.0	5.05
30,000 gross ton unit train.....	330	420.0	2.38
Intercity only.....	500	277.0	3.61
Short, fast train.....	1,430	97.0	10.31
<b>Truck:</b>			
General.....	2,800	50.0	20.00
Intercity only.....	1,900	73.0	13.70
Local only.....	7,000	20.0	50.00
Inland Waterway.....	500	277.0	3.61
Oil pipeline.....	600	231.0	4.33
Air freight.....	42,000	3.2	312.5

<sup>1</sup> Due to different nature of freight, length of haul, and circuitry between modes, modal comparisons are not entirely appropriate.

SOURCE: Peat, Marwick, Mitchell, *op. cit.*, Table IX-2, p. IX-7.

FIGURE 2.—Energy intensiveness



SOURCE: PSP, p. 147.

Many factors affect the relationship of fuel consumption to ton-mile production. Fuel consumption is a function of engine efficiency and power requirements, and the power requirements of the two modes differ considerably. Frequent changes of speed produce kinetic energy requirements; trucks are more sensitive to this than trains although accelerating, decelerating, changing grade and braking characterize both modes. Comparative power requirements also are affected by load factors and optimum cargo densities, which are higher for railroads than trucks. Other considerations are circuitry, empty equipment movement, the relationship between gross weight and payload and the horsepower-to-weight ratios of the tractor and locomotive.

#### Discontinuance of Service

Where a line is abandoned, the energy used for rail purposes is reduced to nothing. The net energy impact will depend on whether alternative transportation modes replace the rail or whether the industries that were served by the line are forced to relocate. The rail-

road right-of-way may be abandoned completely or may be converted to other transportation uses, such as a utility corridor, or to a recreational area. Either of these alternates would have some effect on net energy consumption.

Generally, the abandonment of a branch line will cause trucks to assume whatever traffic was formerly carried by the railroad, at least for a portion of the move. A detailed examination of the net energy gain or loss from such a modal switch comprehends a large number of factors, including:

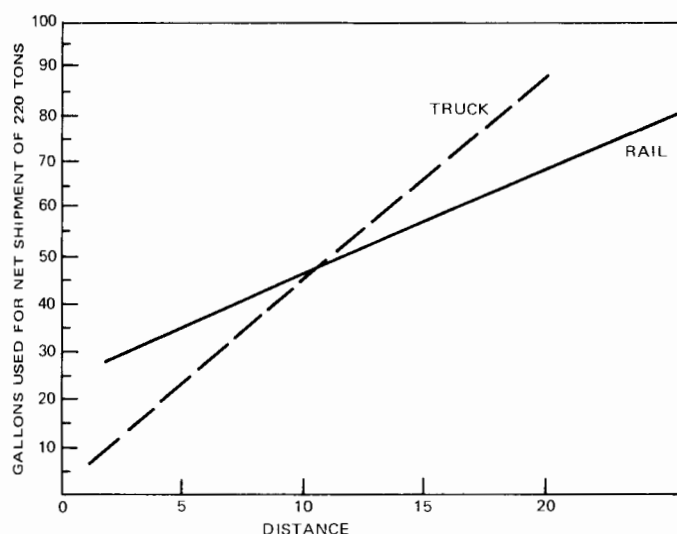
- Highway versus rail distances from origin to destination,
- Present or future delivery systems may waste fuel because a circuitous route must be taken in transporting the shipment,
- Commodity carried,
- Empty backhauls,
- Duty-cycle required for transport by either locomotive or truck, i.e., percentage of time in the various throttle positions, acceleration modes, braking, lugging modes, etc.,
- Ratio of tractor-trailers or trucks required to haul the equivalent of one railcar load,
- Horsepower and characteristics of the locomotive usually used on the line,
- Frequency and length of trains required by the freight shipment schedule of the industries along the branch line,
- Time and energy required for switching cars and
- Time and energy requirements for transmodal transfer of shipments under present rail configuration or under future truck plan. Some energy may be wasted at present or in the future because the cargo must be unloaded from one transportation mode and then loaded onto another mode for delivery.

If there are several types of raw materials and manufactured commodities being hauled to or from a number of industries along the branch line, the variables in the energy comparison proliferate.

Figure 3, from a U.S. Department of Transportation study, shows the results of a study comparing fuel usage for trucks and locomotives in branch line operations. Comparison was limited to trucks traveling at an average speed of 30 m.p.h. and trains at an average speed of 8 m.p.h., with one boxcar hauling twice as much as one truck. The results indicate the shorter the trip distance and the lighter the load, the lesser the energy efficiency of rail compared to truck. There is no single break-even point at which rail service becomes more efficient. Depending on factors such as vehicle speed, weight, route geometry, length of haul and idling time, the break-even point will change for every situation.<sup>4</sup>

<sup>4</sup> Public Interest Economics Center, *op. cit.*

FIGURE 3.—Estimated Fuel Usage For Trucks and Locomotives



SOURCE: U.S. Department of Transportation, *The Environmental Impact Statement on the Transportation Improvement Act of 1973*.

In a report on railroad-highway environmental and energy impacts prepared for the New England Regional Commission, Harbridge House<sup>5</sup> made four sample comparisons of three branch line operations and one transcontinental freight movement. The following are the results.

- Manchester to Goffstown, N. H.—Rail consumes twice as much fuel as trucks.
- Winchendon, Mass. to Jaffrey, N. H.—Trucks consume one-fifth more fuel than rail.
- Boston to Newburyport, Mass.—Trucks consume twice as much fuel as rail.
- Goffstown, N. H., to San Francisco, Calif.—Trucks consume 2.5 times as much fuel. (Assumes truck all the way.)

Similarly, sample computations by the RSPO of Line 692/693a near Hillsdale, Mich. concluded that the environmental effects of diversion to truck would be insignificant. As shown in the studies just discussed, when the trip is short and the load is light, more energy is required to ship by rail than by truck.

Table 4 and Figure 4 show a frequency distribution of the abandoned lines (excluded from ConRail in the PSP) and the energy tradeoff between motor carriers and rail carriers at specified weights, distances and lengths of haul. The total estimated fuel consumption increase due to abandonments is approximately 4.75 million gallons.

<sup>5</sup> Harbridge House Inc. *Methodology for Determination of Environmental and Energy Consumption Impacts on Rail versus other Transportation Modes*, report prepared for the New England Regional Commission, Boston, Mass., 1975.

TABLE 4.—Change in fuel requirement due to the abandonment of rail service

Track length <sup>1</sup> (miles)	Number of lines	Annual total number of round trips	Average number <sup>2</sup> of cars per train	Change in fuel <sup>3</sup> consumption per trip (gallons)	Total change in fuel <sup>4</sup> consumption (thousand gallons)
0.1-5.0	59	3,696	2.5	-9.6	-35.5
5.1-10.0	56	5,396	4.5	-2.3	-12.4
10.1-15.0	38	4,902	6.8	7.7	37.7
15.1-20.0	36	4,414	5.8	27.8	122.7
20.1-25.0	28	4,468	11.9	124.5	556.3
25.1-30.0	15	2,583	6.5	66.2	171.0
30.1-35.0	12	2,080	9.0	133.7	278.1
35.1-40.0	9	1,225	10.7	200.3	245.4
40.1-45.0	8	1,830	6.6	113.3	207.3
45.1-50.0	3	832	9.1	205.9	171.3
50.1-55.0	4	1,050	6.2	131.8	138.4
55.1-60.0	5	957	15.8	509.3	487.4
60.1-65.0	6	1,380	8.1	239.6	330.6
65.1 plus	12	2,234	17.8	923.1	2,032.6
Total	291	37,047	7.7		4,730.5

<sup>1</sup> For the 12 tracks with a length of greater than 65.1 miles the average length of abandonment was 90 miles.

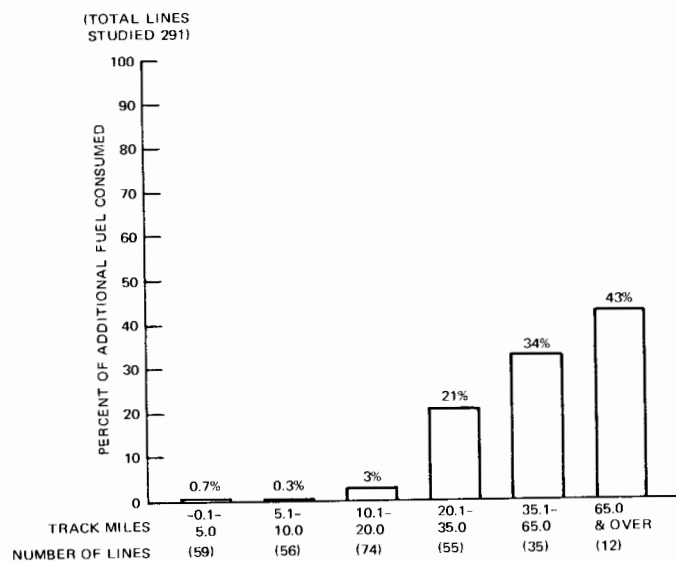
<sup>2</sup> This figure was calculated by dividing annual total number of cars by annual total number of round trips for 1972 as contained in the *Preliminary System Plan* of the USRA. (Table excludes Erie Lackawanna light density lines.)

<sup>3</sup> This figure is the difference in gasoline consumption between a train and a truck for the given distance and freight load. For track abandonments of .1-5.0 miles, for instance, it was assumed that trucks would make an average haul length of 5.0 miles. In cases where trucks will be used to haul the freight from point of origination to final point of termination, rather than from point of origination to nearest operative rail line, this assumption will understate the increase in fuel requirements, but in cases where truck transportation is only used to transport cargo to a rail line this assumption will overstate the increase in fuel requirements.

<sup>4</sup> Change in fuel consumption is equal to increase in fuel consumption per trip times annual number of trips.

SOURCE: Public Interest Economics Center, *The Impact on Communities of Abandonment of Rail Service: Final Report*, June 1975, prepared for the U.S. Railway Association.

FIGURE 4.—Percent of Additional Fuel Consumed Due to Abandonments\* by Line Track Miles



\*SUM OF ADDITIONAL FUEL CONSUMED DUE TO ABANDONMENTS IS 4,700,000 GALLONS OR .002 PERCENT OF ALL FUEL CONSUMED IN 1974

SOURCE: PIE-C *Final Report op. cit.*, p. 108

The estimates of fuel consumption increase due to abandonment represent 0.002 percent of total fuel consumption in the United States in 1974. If actual measures of circuitry, gradient, type of vehicle and other such measures were used, the increase could be greater but still inconsequential. Consequently, if the proposed abandonments increase allocative efficiency of resources by only .002 percent (and assuming the efficiency gains are in industries having average energy intensiveness) the direct fuel consumption costs of abandonment will be counteracted.

The total effect on fuel consumption of rail abandonments, even with the most lenient restrictions, seems of minor significance. Assuming, over time, an increasing ability within the transport industry to curtail waste emissions per gallon of fuel consumed, the effects of abandonments on air pollution should become even more diminished.

The branch line dispositions contained in the FSP result in the continuation of service to much of the traffic not recommended for continued service in the FSP. Table 5 shows a frequency distribution of the lines excluded from the restructured system by the FSP and the energy tradeoff between motor and rail carriers at specified weights, distances and lengths of haul, developed on the same basis as Table 4. The total estimated fuel consumption increase due to the discontinuance of rail service is approximately 2.23 million gallons, 2.52 million gallons less than estimated in Table 4. This estimated increase in fuel consumption represents 0.0009 percent of total fuel consumption in the United States in 1974.

### Expansion of Rail Service

According to a DOT study<sup>6</sup> of branch line operations, two trains each hauling 88 net tons of freight and traveling a distance of 20 miles at 8 m.p.h. would consume a combined total of 91.8 gallons of fuel while one train traveling the same distance and hauling the same amount of freight (176 tons) would consume 61 gallons of fuel, for a net saving of 30.8 gallons. This example demonstrates on a very small scale the fuel saving expected from consolidation of rail traffic on fewer rail lines.

It is conceivable that rerouting mainline traffic may cause some shippers to use trucking for the entire haul. If such a diversion occurs, this increased use of trucks on longer hauls might result in the increased need for fuel at the ratio of three or four as already described. A complete evaluation must recognize that each shipper or receiver's energy use depends upon the commodity being transported, the distance between origin and destination, and the net tons of the commodity being trans-

ported. Thus, a truck hauling a lightweight commodity via a direct route from origin to destination might be saving energy as opposed to a circuitous rail route which required transfers between train and truck at each end of the trip.

TABLE 5.—Change in Fuel Requirement Due to the Abandonment of Rail Service<sup>1</sup>

Track length (miles)	Number of lines	Annual total number of round trips	Average loaded cars per train	Change in <sup>2</sup> fuel consumption per trip (gallons)	Total <sup>3</sup> change in consumption (thousand gallons)
.1-5.0.....	75	2,502	2.5	-9.6	-24.0
5.1-10.0.....	70	4,128	3.7	-4.7	-19.4
10.1-15.0.....	50	3,534	5.5	12.7	44.8
15.1-20.0.....	40	2,549	6.7	36.7	93.5
20.1-25.0.....	23	2,481	5.3	41.8	103.7
25.1-30.0.....	17	1,368	6.1	59.3	81.1
30.1-35.0.....	15	1,304	8.3	119.1	155.3
35.1-40.0.....	8	1,124	5.8	80.6	90.5
40.1-45.0.....	4	462	6.6	116.1	53.6
45.1-50.0.....	6	1,182	8.0	175.9	207.9
50.1-55.0.....	1	156	4.1	60.2	9.3
55.1-60.0.....	5	709	10.8	324.3	229.9
60.1-65.0.....	4	442	16.1	625.7	232.3
65.1+.....	11	1,862	13.6	511.9	953.1
Total.....	329	23,803	6.3		2,231.5

<sup>1</sup> This data is based on the Final System Plan and the PIE-C report cited in Table 4.

<sup>2</sup> This figure is the difference in gasoline consumption between a train and a truck for the given distance and freight load. For track abandonments of .1-5.0 miles, for instance, it was assumed that trucks would make an average haul length of 5.0 miles. In cases where trucks will be used to haul the freight from point of origination to final point of termination, rather than from point of origination to nearest operative rail line, this assumption will understate the increase in fuel requirements, but in cases where truck transportation is only used to transport cargo to a rail line this assumption will overstate the increase in fuel requirements.

<sup>3</sup> Change in fuel consumption is equal to increase in gasoline consumption per trip times annual number of trips.

There is, of course, the reverse situation, where the reorganized rail service will attract some freight that is now being hauled by trucks with greater energy consumption. Part of this switch of truck freight to train freight should result from an increased use of intermodal services (TOFC and COFC). The potential diversion of highway traffic by a rehabilitated and efficient rail system is far greater than any loss of traffic associated from the possible abandonment of lines.

Alternative mode energy efficiency was established in a study<sup>7</sup> which estimates the energy effects of a possible wholesale diversion of traffic from the railroads in reorganization to trucks. Table 6 presents the findings of this study on a state-by-state basis, comparing present rail energy consumption with estimated truck energy consumption. Such a comparison involves ton-mile relationships, load factors and the ratio of gross vehicle ton-miles to net ton-miles for each mode. In developing these figures, Wilbur Smith and Associates estimated

<sup>6</sup> U.S. Department of Transportation, *The Environmental Impact Statement On The "Transportation Improvement Act of 1973,"* 1974, p. 25.

<sup>7</sup> Wilbur Smith and Associates, *Economic Study of Alternative Modes for Rail Traffic and Their Costs,* Jan. 15, 1975, prepared for the U.S. Railway Association.

the rate of energy use at 670 Btu's per ton-mile for rail and 2,700 Btu's per ton-mile for truck.

### Electrification

Railroads currently are the only surface mode of transport which can accommodate the substitution of other fuels for petroleum, such as coal, nuclear, hydroelectric or solar power or other sources.

The electrification of a rail line requires 3 to 5 years. A minimum of 1 year is required to design the system, including safety and signal change requirements, and at least 2 years is required to construct and test the system. Construction of the electric transmission system without interference to traffic is a further complication.

TABLE 6.—Approximations of Energy Costs of Diversion, by State<sup>1</sup>

State	Energy use (Btu in trillions)	
	Rail	Truck
All 6 .....	13.50	51.32
New York .....	1.12	4.27
New Jersey .....	.51	1.94
Pennsylvania .....	5.64	21.45
Michigan .....	1.05	3.98
Ohio .....	4.70	14.06
Indiana .....	1.48	5.62

<sup>1</sup> Wilbur Smith and Associates, *Economic Study of Alternative Modes for Rail Traffic and Their Costs: Final report* prepared for the United States Railway Association Jan. 15, 1975, p. 155. Estimates of the diversion from rail to truck of the intraregional shipments of 11 commodities on the railroads in reorganization in 6 states were prepared. These 6 states accounted for four-fifths of the intraregional shipments of these commodities on the railroads in reorganization in the 17-state Region. These intraregional shipments amounted to one-fifth of the total rail tonnage originating in the Region and one-half of the intraregional shipments of these commodities originating on railroads in the 6 states.

Electrification requires a large initial investment, its major disadvantage. Because of the railroads' difficulties in raising capital, the required investment of \$125,000 to \$200,000 per route mile (not including power stations or transmission facilities) is a formidable obstacle.<sup>8</sup> Overall energy considerations may, however, result in rail electrification projects as part of a comprehensive national program to use nonpetroleum fuels.

### Air Quality

Clean air is essential for public health and welfare. Transportation influences the quality of the air; its impact is most noticeable in urban centers. The pollutants involved are carbon monoxide, nitrogen oxides and hydrocarbons. The latter two react with sunlight to produce photochemical oxidants or smog. While carbon monoxide tends to be a highly localized problem, the oxidant problem is regionwide. For this reason the Environmental Protection Agency has identified many re-

gions as requiring some form of transportation control plan to achieve ambient air quality standards.

The USRA Region includes all or portions of 83 Air Quality Maintenance Control Regions (AQCR). Except for northern New England, most of the Metropolitan areas within the Region are in violation of standards; this is especially true in most of the urbanized areas.

In early 1972 each state submitted to EPA a plan for strategies to reduce air pollutants. Due to many delays, some AQCRs may attain standards around 1978 instead of the 1975 target date.

In addition, in 1974 each state identified Air Quality Maintenance Areas (AQMA) to the EPA. The states are supposed to amend their State Implementation Plans (SIPs) to insure maintenance of air quality through 1985. The SIPs include emission standards for stationary sources like power plants, in addition to highway traffic, etc. To the extent that the expansion of rail or truck activities is offset by improved emission controls, it would assist the AQMA.

Another consideration with respect to emissions relevant to the FSP is the federal standard calling for the reduction in air-pollutant emissions from new diesel engines. For instance, exhaust smoke opacity of model year 1974 diesel engines must not exceed 20 percent during the engine acceleration phase and 15 percent during engine lugging phase. As a result of new engine performance standards such as these, objectionable aspects of both truck and locomotive diesel engines will decrease. Introduction of these new engines will temper the adverse environmental impact of increases in use of both transportation modes.

Transportation's contribution to air polluting emissions when viewed by weight indicates that 45 percent of the aggregate of the five polluting species considered (sulphur oxides, carbon monoxide, hydrocarbons, nitrogen oxides and particulate matter) is due to transportation. A review of estimated relative toxicity of the five species shows transportation creates only 27.5 percent of the Nation's air pollution problem and, as stated earlier, the automobile is the most significant source of pollution in the transportation sector. The relative toxicity is based on the EPA Primary Ambient Air Quality Standards and results mainly in diminishing the significance of carbon monoxide while placing added importance on particulate and sulphur oxide emissions.<sup>9</sup>

The FSP, which is directed mainly at freight transportation, is concerned with the results of substitute modal use on the environment. The truck is the principal alternate mode available in the Region.

The relationship between energy input and pollution output is the same as the energy consumption ratios for intercity freight movement by rail and truck—about

<sup>8</sup> Peat, Marwick, Mitchell, *Industrial Energy Studies of Ground Freight Transportation*, July 1974, p. ix-15.

<sup>9</sup> The Mitre Corp., *Energy and Environmental Aspects of U.S. Transportation, MTP-391*, Washington, D.C., February 1974.

four to one. A 1970 study indicated<sup>10</sup> that with trucks carrying almost half as much freight traffic as railroads, truck emissions were approximately double those of the railroads.

Diesel fuel used by railroads and trucks result in the principal pollutants already mentioned, augmented with sulfur, smoke, other particulates and odor. Comprehensive data on diesel-engine exhaust emissions is not readily available. Battelle Columbus Laboratories, however, estimated that in 1970 American railroads generated about 900,000 tons of gaseous emissions (particulates excluded) and 26,000 tons of smoke emissions.

**Discontinuance of Service**

Generally, the discontinuance of rail service to an industry or locality will mean that additional truck service will be required to transport the freight formerly carried by rail.

A number of approaches have been taken to compare the emissions of pollutants from locomotives and diesel trucks under conditions representing railroad branch-line freight transportation. These investigations have considered differences in net loads, locomotive, trip distance, speed, type of carload and pollutant. Some findings are as follows.

- A four-stroke switch locomotive, frequently used on branch lines, emits more total pollutants per one-way trip than trucks for all net tonnages (up to the 220 ton loads studied) and for all trip-distances at least as great as 20 miles (Table 7 and Figure 5).
- A two-stroke supercharged switch locomotive hauling a 220 net ton load emits fewer total pollutants per one-way trip than the equivalent trucks for trip distances greater than 10 miles. When the net load decreases to 132 tons, the trip distance must increase to 15 miles before the locomotive pollutes less than the truck (Table 8).
- A branch-line train consisting of five or more maximum-loaded hopper cars produces less air pollutant emissions per net ton mile on a round trip than the equivalent of trucks. For trains consisting of 10 fully loaded boxcars or 6 gondolas the locomotive air pollutant emissions are less than those from trucks bearing the same load (Table 9).
- A 1,500-horsepower locomotive pulling a hopper car at 20 m.p.h. requires 0.124 horsepower-hour per ton mile. A 1000-hp locomotive requires 0.083 hp-hour per ton-mile. When the speeds decrease to 8 m.p.h. the horsepower-hour per ton mile requirements and the pollutants produced increase. Use

of less powerful locomotives on branch lines will result in lower air pollutant emissions.

Plans for controlling air pollutants in the Region indicate railroads are a minor source of emissions compared to industrial sources. This is demonstrated in Table 10 for several areas in Indiana. Thus, the changes in total pollutant emissions accompanying the shift in freight from train to truck probably will be small either for a single line of discontinued rail service or for all the lines in any geographical area. The impact of the switch in location of the emission source from railroad to highway also should be considered in relation to the resultant air quality adjacent to the highway or the railroad right-of-way.

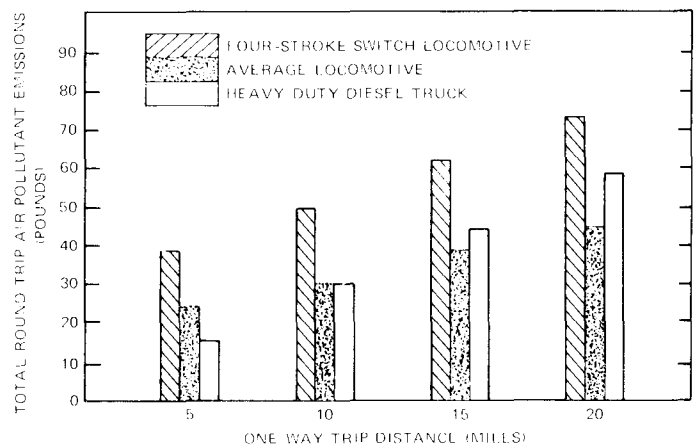
Consequently, the switch in freight from train to truck may have only a slight positive or negative impact on net air pollutant emissions in an area. In addition, federal standards for new diesel truck engines require reduced emissions both of invisible gases and visible smoke. As older trucks are replaced by attrition, now diesel truck engines will help improve air quality.

TABLE 7.—Estimated Total Fuel Consumed, Gallons (Includes Return Trip)

Net shipment weight tons	Mode	Number of vehicle loads	One-way trip distance, miles			
			5 miles—fuel used (gallons)	10 miles—fuel used (gallons)	15 miles—fuel used (gallons)	20 miles—fuel used (gallons)
44	RR	1	13.3	21.7	30.1	38.5
	MC	2	4.9	9.1	13.4	17.7
88	RR	2	18.0	27.9	37.0	45.9
	MC	4	9.7	18.2	26.8	35.3
132	RR	3	24.5	34.2	43.9	53.5
	MC	6	14.6	27.4	40.2	53.0
176	RR	4	30.1	40.4	50.7	61.0
	MC	8	19.5	36.5	53.6	70.6
220	RR	5	35.6	46.7	57.6	68.5
	MC	10	24.3	45.6	67.0	88.2

SOURCE: U.S. Department of Transportation, *The Environmental Impact Statement on "The Transportation Improvement Act of 1973,"* 1974, p. 25.

FIGURE 5.—Locomotive And Truck Air Pollutant Emissions For a 220-Ton Net Shipment Over Various Branch Line Distances



SOURCE: Battelle Columbus Laboratories, *op. cit.*, p. A-30.

<sup>10</sup> Battelle Columbus Laboratories, *A Study of the Environmental Impact of Projected Increases in Inter-City Freight Traffic*, AAR, August 1971.

TABLE 8.—Comparison of Fuel Consumption<sup>1</sup> and Air Pollutant Emissions<sup>2</sup> for Short-Distance Operation of a Diesel Truck, a 2-Stroke Supercharged Switch Locomotive and a 2-Stroke Supercharged Road Locomotive

Net shipment weight (tons)	Mode	Number vehicle loads	5 miles <sup>3</sup>		10 miles		15 miles		20 miles	
			Fuel used (gallons)	Emission (pounds)	Fuel used (gallons)	Emission (pounds)	Fuel used (gallons)	Emission (pounds)	Fuel used (gallons)	Emission (pounds)
11	2-SS	1	13.3	8.1	21.7	13.2	30.1	18.2	38.5	23.3
	2-SR	1	13.3	7.5	21.7	12.2	30.1	16.9	38.5	21.7
	MC	2	4.9	3.3	9.1	6.1	13.4	9.0	17.7	11.9
12	2-SS	2	18.9	11.5	27.9	16.9	37.0	22.4	45.9	27.8
	2-SR	2	18.9	10.6	27.9	15.7	37.0	23.8	45.9	25.9
	MC	4	9.7	6.5	18.2	12.2	26.8	18.0	35.3	23.7
132	2-SS	3	24.5	14.8	34.2	20.7	43.9	26.6	53.5	32.4
	2-SR	3	24.5	13.8	34.2	19.3	43.9	24.8	53.5	30.2
	MC	6	14.6	9.8	27.4	14.4	40.2	27.0	53.0	35.6
176	2-SS	4	30.1	18.2	40.4	24.5	50.7	30.7	61.0	36.9
	2-SR	4	30.1	16.9	40.4	22.8	50.7	28.6	61.0	34.4
	MC	8	19.5	13.1	36.5	24.5	53.6	36.0	70.6	47.4
220	2-SS	5	35.6	21.6	46.7	28.3	57.6	34.9	68.5	41.5
	2-SR	5	35.6	20.09	46.7	26.3	57.6	32.5	68.5	38.6
	MC	10	24.3	16.3	45.6	30.6	67.0	45.0	88.2	59.3

<sup>1</sup> Fuel consumed includes round trip.

<sup>2</sup> Total emissions are particulates, SO<sub>2</sub>, CO, H/C, and NO<sub>x</sub>.

<sup>3</sup> 1-way trip distance.

<sup>4</sup> Locomotive: 2-stroke supercharged switch engine.

<sup>5</sup> Locomotive: 2-stroke supercharged road engine.

<sup>6</sup> Heavy-duty diesel-powered truck.

TABLE 9.—Air Pollutant Emissions From Freight Hauling on Branch Lines by Train and Equivalent Trucks

	1 car			3 cars			5 cars			10 cars		
	Hopper	Gondola	Boxcar	Hopper	Gondola	Boxcar	Hopper	Gondola	Boxcar	Hopper	Gondola	Boxcar
Carbon monoxide (g/net ton-mile):												
Train	1.51	1.82	3.02	0.54	0.64	1.04	0.35	0.40	0.64	0.18	0.21	0.33
Equivalent trucks	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59
Hydrocarbon and nitrogen oxides (g/net ton-mile):												
Train	5.56	6.71	11.18	2.00	2.37	3.84	1.28	1.49	2.35	.66	.79	1.22
Equivalent trucks	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37

ASSUMPTIONS: 1,000 hp locomotive traveling at 20 m. p. h. 36-ton gross weight tractor trailer traveling at 30 m. p. h. Empty backload for both modes. No allowances made

for idling time other than that included in load-speed cycles used in engine emission testing.

TABLE 10.—1970 Locomotive and Diesel Truck Air Pollutant Emissions for Four Indiana Air Quality Control Regions

AQCR (Indiana portion only)	Pollutant Emissions (ton/year)				
	Particulate	SO <sub>2</sub>	CO	HC	NO <sub>x</sub>
Chicago:					
Diesel trucks	231	424	3,063	612	3,204
Locomotives	182	472	509	363	545
All sources	380,797	514,818	730,104	112,721	144,829
Louisville:					
Diesel trucks	71	127	917	184	959
Locomotives	35	90	98	70	104
All sources	35,778	131,024	89,543	18,874	30,182
Cincinnati:					
Diesel trucks	35	63	452	91	473
Locomotives	6	15	16	12	18
All sources	59,432	166,450	25,010	5,499	44,566
Indianapolis:					
Diesel trucks	551	992	7,155	1,431	7,484
Locomotives	224	606	650	466	701
All sources	85,347	179,117	741,369	161,322	114,205

SOURCE: Battelle Columbus Laboratories.

**Consolidation of Lines**

Consolidation is likely to occur when there are two or more under-utilized rail lines between the same points. Assuming traffic between the two points can be

handled by one line, the others may be considered for abandonment. Thus, consolidation brings in aspects of line abandonment as well as reduced service and increased service, depending on which line is being considered.

Neither the net nor the individual impact of consolidation are expected to be great enough to produce violations of state air quality standards in the Region.

Consolidation of operations may result in a greater volume of traffic between given origin-destination pairs for ConRail and for the other railroads in the Region. As a result, less switching will be required, thus reducing fuel consumption and emissions. In those cases where a more direct route replaces a more circuitous route, fuel consumption and emission are reduced further. Consolidation should result in using less energy on right-of-way maintenance and operation of yards.

Consolidation or discontinuing rail traffic along a main or branch line also may result in increased truck traffic. Truck deliveries to the immediate cities on or near the discontinued route must replace the service that formerly was supplied by the railroad if a demand still exists.

### Expansion of Service

An increase in total railroad ton-miles can be expected to result in an increase of total air pollutant emissions from rail operations. Comparisons made of the total emissions of each pollutant, originating from locomotives, diesel trucks and all other sources in typical urban Air Quality Control Regions (AQCR's) show, however, that neither railroads nor trucks are major contributors in terms of percentage to the total AQCR problem. Thus, shifts of freight traffic between those two modes is not expected to cause major concern about increased pollution. If improved rail service results in a shift of freight to other modes, the result is expected to be a net decrease in the transportation sector's emission of air pollutants.

It is expected that emissions will be reduced by using cleaner locomotives, applying dust retardants to open loads of minerals and improving maintenance of tracks. A successful ConRail can have a positive impact on the air quality of the Region as well as on freight transportation generally.

### Rehabilitation, Modernization, and Expansion of Facilities and Equipment

The FSP contemplates major rehabilitation of existing facilities and limited construction of new facilities. No significant pollution impact is anticipated, although any construction activity will produce pollution, as dust is raised or machinery is operated.

There may be secondary impacts from the rehabilitation of the railroads in reorganization such as that caused by the increased demand for steel, gravel and wood. Gravel mining, lumbering, etc., all produce some pollutants in the immediate area where the operations are being performed. It is expected that the load will be spread over many mines and plants so that the increase in any one neighborhood will not be great.

Supplying new rail may require the erection of a new rail mill at some steel mill facility. There would be increased production from all components of the iron and steel manufacturing system, mines, blast furnaces, basic oxygen furnaces, etc. Each of these would have an increase in pollutant emission accompanying the increase in quantity of material being processed.

The rail mill itself will contain a furnace and a scarfer which are major sources of particulates; typical emissions are 60 and 175 tons of particulates per year respectively. Both of these constitute major sources of emissions. Equipment is available for controlling these emissions, however, to meet the requirements of air pollution standards. Thus, consideration should be given to locating the new rail mill in an area where other sources of pollution are meeting standards and installing proper control equipment.

A problem characteristic of the railroads in reorganization is derailments sometimes accompanied by

spillage of toxic materials which produce an emergency pollution problem. Such derailments are general industry problems and the solution is better maintenance of facilities, an objective of the FSP. Rehabilitation funds will be made available to institute a program resulting in fewer derailments and a consequent decrease in air pollution emergencies.

### Noise

The physiological, psychological and economic effects of noise in the environment led to the passage of the Noise Control Act of 1972. Under that Act, the Environmental Protection Agency identified noise sources, prescribes noise levels consistent with public health and welfare and establishes controls to mitigate the adverse effects of noise. The EPA recently issued its standards for railroad noise emissions (40 Code of Federal Regulations, Part 201) which established maximum emission levels for locomotives under stationary and moving conditions and for non-motive power rolling stock moving in interstate commerce. In addition, the EPA coordinates noise control programs in all federal agencies. In this role, EPA reviews the noise standards pertaining to occupational health administered by the Occupational Safety and Health Administration of the Department of Labor and noise-related rule-making of various agencies of the Department of Transportation.

For the most part, concern has focused on occupational noise rather than community noise, to which railroad operations contribute. According to the Commerce Department's Panel on Noise Abatement, "The various modes of transportation, taken collectively, represent the major cause of complaints about noise. Aircraft noise has received the most publicity in recent years and is unquestionably the major source of annoyance for millions of Americans who live near airports. Although the sound levels involved are much lower, many more people are annoyed by surface transportation noise, especially from trucks, buses, motorcycles and sports cars."<sup>11</sup> No mention is made of railroads in this report. This is because the noise produced by their operations appears to be of significance only in a few localized circumstances.

### Discontinuance of Rail Service

One of the effects of rail service discontinuance is likely to be an increased use of trucks. Given their noise generating capabilities and the number of vehicles operating in a given area, the impact will be a function of land use and distance to the people and animals affected.

Nevertheless, motor-carrier operations have a greater noise impact on community residents where more trucks

<sup>11</sup> Department of Commerce, Panel on Noise Abatement, *The Noise Around Us: Findings and Recommendations*, District of Columbia (GPO), 1970.

than rail cars are required to carry the same tonnage. A typical boxcar can carry from 1.6 to 2.8 times the load handled by trailers. Also, since the highway routes that would be used to replace branch line service typically are longer than the rail routes,<sup>12</sup> the total amount of noise pollution generated by transportation would tend to increase as a consequence of discontinuance of rail service.

The problem of quantifying the magnitude of difference in noise effects between the two modes is complex. Unless there are people nearby who experience the noise shock, the decibel level emanating from the vehicle is irrelevant. The important factor in determining the trade-off between rail and motor carriers is the location of the highways and rail lines involved in relation to population centers.

The noise impact from substituting motor for rail carrier in handling branch line traffic is not expected to be significant. Even if accurate methods were available for measuring the psychological distress caused by noise pollution, it is highly unlikely that such minimal increases in the general level of noise would cause measurable alteration in the stress level of individuals. Consequently, no significant effect on noise pollution of rail service discontinuance can be expected.

#### Increasing the Volume of Line and Yard Operations

The source of generated railroad noise can be placed into two categories—line haul (includes branch lines operation) noise and yard noise. Line haul noise accounts for the type of noise with which the general public is familiar. It includes noise from wheel-rail interaction, propulsion, braking and warning system.

The perceived noise level produced by rail operations depends upon many factors, including:

- The location of rail lines relative to residential or other frequented areas.
- The location of major highways and streets,
- The type of equipment in use,
- The number of grade crossings and state laws concerning audible warnings,
- The number and age of motor vehicles replacing rail,
- The types of motor vehicle engines in use (diesel vs. gasoline) and
- The overall level of background noise.

The recently established EPA standards call for rail rolling stock to meet the following decibel (dB) standards.

- Best maintenance standard for locomotives:  
93 dB(A) at any throttle setting except idle, stationary condition at 100 feet,

<sup>12</sup> Public Interest Economics Center, *Community Impacts of Abandonment of Rail Service*, December 1974, p. 132.

73 dB(A) at idle, stationary condition at 100 feet and  
96 dB(A) at any condition while moving at any speed at 100 feet.

- Best maintenance standard for rail cars:  
88 dB(A) at speeds up to 45 m.p.h. at 100 feet and  
93 dB(A) at speeds over 45 m.p.h. at 100 feet.
- Standard for the operation of newly manufactured locomotives effective 31 July 1979:  
87 dB(A) at any throttle setting except idle, stationary condition,  
70 dB(A) at idle, stationary condition at 100 feet and  
90 dB(A) at any condition while moving at 100 feet.

Adverse community reaction may be expected when the energy level of an intruding noise exceeds the residual noise level.<sup>13</sup> A USRA consultant<sup>14</sup> concluded that widespread complaints generally may be expected when the energy equivalent levels exceed the residual level by approximately 17 dB and vigorous community action is likely when the excess is approximately 33 dB. Daytime outdoor residual noise levels vary widely, depending on the type of community, and can be grouped into the following approximate ranges:

• Wilderness and rural	16-35 dB
• Suburban residential	36-45 dB
• Urban residential	46-55 dB
• Very noisy urban residential and downtown city	56-75 dB

Intermittent noises created by multiple single events—such as infrequent passage of a diesel locomotive, aircraft overflights and the infrequent passage of diesel trucks on the highway—constitute an important source of noise pollution. Presumably, people living in quiet rural communities are likely to be more affected and irritated by these events than residents of cities.

Those who live within 1/2 mile of rail lines<sup>15</sup> or yards can hear all facets of railroad noise quite well and those who live or work within 1,000 feet must necessarily adapt their lifestyle to some extent to accommodate the intrusion of this noise. At this distance, noise levels are great enough to interfere with normal activities such as conversation, television viewing and other activities which require ability to hear or communicate.<sup>16</sup> Outside

<sup>13</sup> Environmental Protection Agency, *Community Noise*, Office of Noise Abatement and Control, WR 71-17, Washington, D.C., November 1971.

<sup>14</sup> Consad Research Corp., *Community Impacts Resulting From Loss of Rail Service*, Vol. IV, p. 66.

<sup>15</sup> Battelle Columbus Laboratories, *op. cit.*, p. 29. It is estimated that 18.3 million people live within one half mile of railroads in urban areas. This is about 9 percent of the 1970 population.

<sup>16</sup> For the national average train traffic the day-night equivalent noise level at a distance of 1,000 feet is between 55 dB (A), and 60 dB (A), with maximum levels as high as 70 to 75 dB (A).

of the half-mile radius, the sound from the rail operations may be perceived either as noise or merely as part of the ambient sound level, depending on the nature of the sound and the attitude of the listener. Sounds which are tolerated during the day often are disturbing at night, especially when other activity ceases and the railroad noise is the only intrusive sound.

Predicting the effect of train noise on the noise environment is done by computing the noise level which will exist at a given point as the result of train noise combined with other sounds at that location, and integrating the noise levels over a 24-hour period to arrive at a single number rating (Ldn). The noise impact of implementing the FSP can be characterized by evaluating the change in the width of the corridors in which Ldn exceeds values of 55 dB, in the case of residential and certain institutional uses, or 70 dB in the case of other uses.

Factors to be incorporated in the analysis of train noise include the number of locomotives, the length of the train and the distance to the listener plus the listener's reaction to the noise, time of day, number of trains per day and background noise level. As a first approximation to noise impact, the computations can be made in terms of the area in square miles affected by rail noise. A set of factors, based on a population distribution estimate were applied to the area data to estimate the number of people affected. Tables 11 and 12 present a description of ambient noise levels associated with various types of land use. These levels assume no railroad activity and hence railroad noise would exceed these levels.

*Rail Line Operations.*—Evaluation of the impact of noise from rail line operation at increased traffic volumes requires application of the relationship between noise contour location and rail traffic volume to situations in which ambient noise levels, population density and railroad parameters such as location, schedules and operational data are known.

Table 13 shows traffic and land use data for four representative communities as well as the effect on Ldn contours of adding a 25-percent increment to existing rail traffic. The results of dropping all traffic from one

TABLE 11.—Matrix of Ambient Noise Levels (Assuming No Railroad Activity) According to Land Use Category

Area and Use Type	Ldn dB at Representative Locations		
	Measured Ldn, dB	Location of Measurement	Range Estimated
<b>Rural:</b>			
Undeveloped.....	25-45		20-30
Agricultural.....	44	California tomato farm....	30-55
Residential.....			35-50
Resource production.....		Coal mine (surface).....	
Recreational.....			
Commercial.....			
<b>Suburban:</b>			
Recreational.....			
Residential.....	51	Filmore, Calif.....	48-57
Commercial.....	63	Medford, Mass.....	
Industrial.....	57	Medford, Mass.....	
	60	Illinois Refinery Community.....	
<b>Urban:</b>			
Recreational.....			
Residential.....	68	Boston, Mass.....	58-72
Commercial.....	78	Harlem, N. Y.....	
Industrial.....	70	Amarillo, Tex.....	90

SOURCE: Battelle Columbus Laboratories, *op. cit.*, p. B-5.

dB = decibels.

Ldn = A modified version of the equivalent sound level to yield day-night equivalent sound level to determine equivalent sound level for a 24-hour period.

of the lines also is shown. The data in the table shows that the impact of adding a given percentage increase in traffic produces a smaller impact if the existing rail traffic is high. The effect of doubling the number of trains where the initial traffic is two trains per day affects more people than discontinuing the trains. This occurs because of the marginal annoyance which the initial traffic generates outside the Ldn 55 corridor. Additional traffic increases the likelihood of changing marginal annoyance to definite annoyance. The train noise model assumed that the trains are uniformly distributed with respect to time and trains which operate between 10 p.m. and 7 a.m. have their noise levels weighted by 10 dB to account for the increased annoyance during this period.

In the more densely populated portion of the area affected by rail operations, noise effects are less clearly defined. For example, when the value of the ambient

TABLE 12.—Illustration of the Effect on Noise Environments of Four Communities of Increasing Rail Line Operation Traffic

City	Rail Traffic Volume Trains Per Day		Assumed Speed m.p.h.	Population Density Within 500 Feet (People per Square Mile)	Distance to Specified Ldn, ft.				Added People Per Mile	
	Present	Projected			Ldn 55		Ldn 70		Ldn 55	Ldn 70
					Pres.	Proj.	Pres.	Proj.		
Akron, Ohio.....	20	25	40	1,662	8,000	9,000	1,200	1,250	630	32
Altoona, Pa.....	16	20	40	3,090	6,400	8,000	850	1,200	1,873	410
Columbus, Ind.....	2	4	40	730	700	1,500	110	190	221	25
" ".....	2	0		730	700	0	110	0	-194	-31
Boston, Mass.....	20	25	40	20,660	8,000	9,000	1,200	1,250	7,826	391

<sup>1</sup> Equivalent to eight night trains on a 24-hour basis.

SOURCE: Battelle Columbia Laboratories, *op. cit.*, p. 33.

TABLE 13.—Train Traffic and Community Characteristics Near Typical Railroad Lines

City and State	Popula- tion	Number of freight trains		Maximum freight speed (m.p.h.)	Passenger trains		Passenger speed (m.p.h.)	Land use (percent) <sup>1</sup>			People per square mile within 500 ft.	Mileage studied	
		Day	Night		Day	Night		Resi- dential	Business	Other		Land use	Popula- tion
Akron, Ohio.....	542,775	22	18	55	0	0	-----	40	23	37	1,662	25	31
Altoona, Pa.....	81,795	7	5	50	2	2	70	16	18	65	3,090	6	12
Boston, Mass.....	961,071	0	8	40	0	0	-----	59	9	32	20,660	7	7
Cheyenne, Wyo.....	40,914	NA	NA	NA	2	0	NA	9	11	79	1,471	15	9
Columbus, Ind.....	27,141	1	1	50	0	0	-----	NA	NA	NA	730	-----	20
Denver, Colo.....	1,047,311	24	10	60	4	0	NA	12	3	85	3,027	51	26
Durham, N.C.....	100,764	11	1	65	0	0	-----	NA	NA	NA	1,780	-----	31
Michigan City, Ind.....	39,369	5	2	50	2	0	50	29	15	56	608	17	43
Newton, Mass.....	91,055	7	1	50	0	0	-----	75	21	4	5,320	6	6
Valparaiso, Ind.....	20,020	19	10	60	0	0	-----	43	8	49	1,528	9	9

SOURCE: Background Document/Environmental Explanation for Proposed Interstate Rail Carrier Noise Emission Regulations, Report 500/9-74-005a, Office of Noise Abatement and Control, June 1975; cited Battelle Columbus Laboratories *op. cit.*, p. 32.

<sup>1</sup> Average percent land use near railroad lines for reorganization area cities within 500 feet of track: 33.4 residential, 16 business, industrial and other 50; mileage studied, 117.

Ldn approaches the value of the Ldn contribution to rail operations, the exact extent of the area of land affected and the number of people affected becomes very sensitive to small changes in existing conditions. It is also quite likely that the railroad generated contribution to Ldn 55 will be masked in the more densely populated, high-ambient noise area.

Results of a recent study by EPA show that, based on the National Average Train Traffic,<sup>17</sup> the number of people exposed to line operation noise at an Ldn value of 70 is on the order of one-half million and the number exposed to Ldn 55 is in excess of 6 million. Since the traffic on some portions of the reorganized system is expected to be heavier and operate at a nearly uniform four trains per hour around the clock traffic rate, noise exposures in the area can be expected to run higher than the proportional population data would indicate.

**Yard Operations.**—A concomitant result of increasing traffic on rail lines will be an increase in the number of cars handled by switching and classification yards, as well as an increase in the number of cars and locomotives serviced by maintenance facilities. Just as in the case of line-haul service, the peak noise levels produced by rail traffic remains the same regardless of the number of trains or cars handled. However, the frequency of annoyance increases and involves more people, particularly in the case of very objectionable noises, such as the squeal of automatic retarders in hump yards.

One of the principal impact factors is the population density within a radius of 2,000 feet of the noise

centers of the yard. Beyond this distance, the noise contribution of the yearly operations is of the same order of magnitude as an acceptable noise level. Furthermore, other urban noise sources will mask the noise of yard operations, especially in daytime hours.

An estimate of the increase in noise due to increased numbers of cars handled by a typical yard shows that an increase of 15 percent in cars handled by the yard will increase the equivalent day-night noise level, Ldn, on the order of 1 decibel, and increase the distance of the Ldn 55 contour by a factor of 1.07.

The EPA study of railroad yard noise indicated that concern for rail yard noise is more local than national, and substantial reduction in community noise around rail yards would be obtained through implementation of the locomotive noise level regulations. EPA noise regulations apply only to line haul operations as the agency felt that railroad noise generated at a fixed facility best could be controlled by local action.

**Maintenance of Right-of-Way.**—Maintenance of right-of-way is a temporary activity for any particular location and as such, noise effects produce less environmental impact than permanent activities. Activity may range from extensive rebuilding of the roadbed and insertion of ties and new rail to routine grading and ballast tamping.

### Water Quality, Plants and Wildlife<sup>18</sup>

As the population has grown, the sources of water pollution have expanded. General concern with eliminating wasteful use of raw materials has spurred modern technology to reduce waste release and encourage more recycling. Furthermore, government mandates at all levels and educational efforts have been introduced to discourage such pollution.

<sup>18</sup> Battelle Columbus Laboratories, *op. cit.*, Appendix E, *Water Quality and Biota*.

<sup>17</sup> See Battelle Columbus Laboratories, *op. cit.*, p. 34; the National Average Train Traffic (Moody) consists of the following:

**Urban Areas**

4 freight trains by day, 2 by night, 33 m.p.h., 40 cars, 3,800 tons  
2 passenger trains by day, 0 by night, 36 m.p.h., 6 cars

**Nonurban Areas**

3 freight trains by day, 2 by night, 33 m.p.h., 40 cars, 3,800 tons  
0 passenger trains

In general, nonuse of a rail line within a community may produce some minute improvement in local water quality through the elimination of herbicide leaching and runoff.

Several million dollars are spent annually by the railroad industry on water pollution control (Table 14). Efforts are being made to prevent pollution problems through use of improved facilities, more modern techniques and improved management. In the case of railroads, water quality can be affected by accidental spills of chemicals or other harmful substances from train wrecks, herbicide use, drainage disruption and leakage of oil and lubricating fluids. The seriousness of the situation depends on ground water levels, proximity to water surface seepage and the biodegradability of the foreign substances.

TABLE 14.—Funds spent by railroad industry in areas relating to water pollution control

Area	1972	1973	Projected/ year
Weed and brush control.....	\$20,236,000	Same	Same
Pollution from maintenance shops.....	16,590,000	\$30,808,000	\$873,000
Diesel fuel oil pollution.....	9,105,000	8,584,000	.....
Wastewater pollution.....	1,496,000	5,792,000	.....
Hazardous spills.....	1,225,000	.....	.....
Disposal of corrosion inhibitors.....	534,000	218,000	.....
Disposal of sanitary wastes.....	4,763,000	120,836,000	527,000

<sup>1</sup> 1973-74.

SOURCE: Battelle Columbus Laboratories, *Environmental Assessment of the System Plan*, Apr. 30, 1975, prepared for the U.S. Railway Association.

A more serious threat to water quality is posed by the wide application of pesticides to railroad rights-of-way for weed and brush control. This control zone constitutes a firebreak to protect adjacent properties from sparks emitted during running or braking operations by the wheels of the railroad cars. Spillage of fuel used is infinitesimal.<sup>19</sup> Railroads have introduced concrete and steel service platforms, with basins and connected sewer systems, to minimize the principal problem associated with spillage—the generation of fuel-water emulsions and sludge. USRA endorses this practice and suggests its continuance by ConRail.

#### Abandonment of Buildings and Facilities

Abandonment of yards and shops will prevent water pollution from further spillage or dumping of crankcase oil, fuel oil and wastewaters but does not stop the pollution that results from past practices. Problems associated with fuel oil and crankcase oil present in the soil will continue to persist. Measures to prevent and clean up contamination of groundwater and runoff into surface waters still will be needed in those yards that already have this pollution problem.

Abandonment of buildings and facilities will produce

<sup>19</sup> Peat, Marwick, Mitchell, *op. cit.*

an immediate decrease in pollution of the plants and wildlife of a region. Persistent problems as those in water pollution still will be present in terms of runoff.

#### Expansion of Service

For increased service to be possible, there is a need for upgrading and intensified maintenance of the rights-of-way and tracks. This will entail several problems relating to water pollution as well as some benefits. If additional lines are added, weed and brush control will require increased herbicide usage. More trains and cars will increase miscellaneous oil drops and other substances along rights-of-way. Sanitary waste disposal should increase only at the yards and not along the tracks.

One of the positive benefits of increased service resulting from upgrading and maintenance will be a lowering of hazardous spills. Wrecks resulting in hazardous spills are a direct reflection of poor right-of-way and car fleet conditions. Upgrading should lower the incidence of hazardous spills and subsequent hazards to man and biota.

#### Rehabilitation and Expansion of Buildings and Facilities

Rehabilitation and expansion of yards, shops and stations will result in more facilities required for control of spills and waste handling. Significant steps taken toward all types of water pollution abatement will improve conditions.

#### Land Use, Social and Cultural Environment

This section deals with the potential impact of the FSP on the human environment; that is, the social, economic and cultural activities of the affected communities. These effects have been examined from a land use perspective to stress the spatial importance of these changes. Abandonment of lines, buildings and other facilities have the potential of completely changing present patterns of land use. The other potential changes include increased or decreased service, consolidation, electrification and rehabilitation/modernization/expansion of facilities and equipment. These changes may have significant long term effects.

Impacts resulting from these changes upon particular geographic areas, of course, are analyzed best on a community-by-community basis. Implications on the socioeconomic structure are discussed thoroughly in Chapter 2 of this Supplemental Report.

Battelle Columbus Laboratories developed a compatibility matrix showing the relationship and compatibility between existing land use changes and changes that the FSP might engender.<sup>20</sup>

<sup>20</sup> Battelle Columbus Laboratories, *Environmental Assessment of the System Plan*, Apr. 30, 1975, prepared for the U.S. Railway Association. See Appendix C. Compatibility matrix.

The following variables are useful in measuring the changes in compatibility that may occur.

<i>Economic</i>	<i>Social</i>	<i>Cultural</i>
Economic Displacement	Community Cohesion	Historic Interest
Land Value	Demographic	
Employment	Accessibility	
	Safety	

The measurements describe under what conditions low, moderate and high impacts can be anticipated. Potential consequences of FSP changes are shown in Figure 6 and are discussed below. Many of the potential consequences depend on the land use patterns that now exists in the communities and along the rights-of-way.

The disposition of abandoned right-of-way will depend on the actions of other public and private agencies interested in both rail and nonrail uses of the land.<sup>21</sup> A survey was made of all states, municipalities and re-

gional commissions in the 17-state Region and of all federal agencies requesting their recommendations for designations of alternative public uses under Section 206(c) (1) (E) of the Act. These recommendations have been summarized in Chapter 9 of the FSP and the Appendix B to Part III.

There will be efforts to preserve the integrity of the rights-of-way. Many of the states are interested in maintaining the track network as is, under subsidy. If this is not feasible, alternative preservation techniques will be sought. In the future, the rights-of-way may recover market value because of changes in regional development or resource utilization. If the track is abandoned, however, the future utility as a railroad right-of-way declines to zero. There has been considerable discussion of the possibility of "land banking" such rights-of-way for possible future use. USRA has proposed the establishment of a rail bank of branch lines which may provide access to fossil fuel reserves (see Chapter 9).

Railroad rights-of-way, however, may be maintained for other purposes. For instance, a state, the federal

FIGURE 6.—Definition of Impact Parameters

Parameter	Magnitude of impact				
	Low impacts	Low- to moderate-impacts	Moderate impacts	Moderate- to high-impacts	High impacts
Community cohesion	• Mixing of moderate and high income groups.	• Mixing of different cultural/ethnic groups. • Intrusion by outsiders.	• Mixing of low- and moderate-income groups.		• Mixing of low- and high income groups.
Economic displacement	• Motor carrier dependent business loses rail services (at least 90 percent of all shipments are by motor carrier).		• Motor carrier/rail dependent business loses rail service (shipments by motor carrier are between 70 and 90 percent of total shipments).		• Rail-dependent business loses rail service (at least 30 percent of shipments are by rail).
Land value	• Nonrail dependent properties lose rail service (at least 90 percent of all shipments are by motor carrier).		• Rail/motor carrier dependent properties lose rail service (shipments by motor carrier are between 70 and 90 percent of total shipments).		• Completely rail dependent properties lose rail service (at least 30 percent of shipments are by rail).
Safety	• Infrequent or no trains. • Trucks separated from other traffic and/or truck traffic of low density.				• Frequent train passage. • Truck congestion on urban streets.
Accessibility	• If change in land use is within walking distance of the principal users or consumers.	• If change in land use is accessible by mass transit.  • Some inconvenience in gaining access to the changed land use.	• Change in use is within a reasonable driving distance; less than 30 minutes driving time.	• Change in use is adjacent to a linear barrier (such as a rail line).	• Change in use is greater than 2 hours driving time.
Employment	• Few jobs are affected and/or displaced labor rapidly finds other employment.				• Large percentage change in unemployment (greater than 2 percent). (C11)
Demographic	• No significant structural changes in the population of a particular region because of migration.				• Significant structural changes in the population of a particular region because of migration.
Historical significance	• Rail facility is not of an historical nature.	• Rail facility is listed in the Register of Historic Places as having local significance.  • Rail facility is recognized by a local historical society; Chamber of Commerce, etc.	• Rail facility is listed in the Register of Historic Places as having regional significance.	• Rail facility is recognized by a State historical society	• Rail facility is listed in the Register of Historic Places as having national significance.

SOURCE: Battelle Columbus Laboratories, *op. cit.*, p. 38.

government, a local or regional agency or private concern may purchase, lease or otherwise acquire such property for various purposes. These may include such uses as mass transportation corridors, recreation, utility rights-of-way or conservation areas. The impacts of these land use changes will differ by area.

#### **Reduced Service**

Perhaps the major negative impact from the USRA's recommended reorganization will be loss of service to some users. These reductions in service are necessary to improve the economic self-sufficiency of the restructured railroad system. The actual loss of rail service may be less extensive than described in the FSP. Some of the solvent carriers may provide service because of complementary effects on other parts of their system. A shipper also may decide to maintain track and sidings if rail service is required. The consequence of private operation at the same level of service is assumed to have no change from the present system.

*Increased Use of Trucks.*—From an economic point of view, the increased use of trucks can have some beneficial impacts. Increased use of trucks suggests that trucking businesses presently serving operations affected by line abandonments will need to expand their business. If a particular area or region should experience a significant increase in truck activities and competition, this area could incur an expansion of its economy.

#### **Consolidation and Increased Service**

Some areas may receive an increase in service due to their importance (strategic location) as major transfer

terminals or switching yards within the system. This increase may be necessary in order to avoid yard congestion and delay in delivery of freight. There does not appear to be any direct consequences upon land use.

#### **Cultural Issues**

System changes may have impact upon facilities of cultural importance. For instance, architecturally or historically significant terminals or lines may be affected by proposed abandonments. Public interest in forestalling such occurrences finds expression in such legislation as a recent amendment to the Rail Passenger Service Act, passed by the Senate, which would authorize the Secretary of Transportation to provide financial and technical assistance to restore rail passenger terminals. Railroads are an integral part of the history of many communities which owe their very existence to them.

The National Endowment for the Arts estimates that 20,000 of the 40,000 stations built in the United States during the 19th and early 20th centuries are still standing. They are given minimal maintenance and some have been abandoned. Yet they form a significant part of America's heritage. Ranging from Victorian cottages to massive Moorish fortresses, some stations represent irreplaceable architecture which can be restored and converted to accommodate various uses. For example, Union Station in Washington, D.C. was built in 1901. It was now being renovated and will become a visitor's center for tourists. In other cases, stations have been used as educational facilities, museums, shopping plazas and restaurants.

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## Unified ConRail Alternative Structure

*In the Final System Plan, USRA recommended an industry structure which depends on the acquisition by the Chessie System of a substantial part of the railroads in reorganization. Should Chessie not accept USRA's offer of these properties, however, the Association recommends as an alternative structure the creation of a "Unified ConRail," made up of substantially all of the railroads in reorganization.*

*This chapter describes the financial performance, operating plan and rehabilitation program of the Unified ConRail alternative. USRA has concluded that the Unified ConRail structure offers the greatest opportunity for rationalizing the plant and facilities of the railroads in reorganization, increasing their operating efficiency and minimizing government financing. A Unified ConRail, however, would eliminate effective intramodal (rail-rail) competition in a large section of the eastern part of the Region.*

This chapter of the Supplemental Report describes the financial performance, operating plan and rehabilitation program of Unified ConRail, the alternative industry structure to the FSP recommended system proposed by USRA.

Unified ConRail is the system which would result if the Chessie does not accept the offers for the Erie Lackawanna and Reading properties set forth in the FSP. It would include essentially all the rail properties of the railroads in reorganization, now scheduled for transfer and conveyance under the FSP. Unified ConRail would integrate properties and operations of the Penn Central, Erie Lackawanna, Reading, Lehigh Valley, Central of New Jersey, Ann Arbor, Pennsylvania-Reading Seashore Lines and Lehigh & Hudson River, into a single rail system in the Region of approximately 17,000 route miles. Unified ConRail thereby offers the greatest potential to rationalize plant and facilities, increase operational efficiency and minimize government financing. Implementing this option, however, would eliminate effective rail competition in a large and important area in the eastern part of the Region.

As in the case of the FSP recommended system, the financial and operating advantages of the Unified ConRail option can be achieved only if certain preconditions are assured. They include:

- Relief from unprofitable passenger and light density line operations,
- A greater degree of flexibility in freight pricing policies,
- Government financing to supplement private sector financing and internally generated funds to support the rehabilitation program, initial operating losses and working capital requirements and
- Repayment of federal financing and the payment of interest or dividends on government financing. This must be related to ConRail's cash flow and cannot be a burden during the early years of its operations.

By 1985 the net government investment in Unified ConRail could be substantially less than that required by the recommended system in the Final System Plan, even though the increased costs of merging additional rail operations results in Unified ConRail having peak requirement for government funding greater than for the system recommended in the Final System Plan (\$2.026 billion versus \$1.841 billion). The primary advantage of Unified ConRail, its ability to generate excess cash, occurs in the latter half of the planning period and enables it to commence repaying the government investment sooner than under the FSP recommended system. On the other hand, the Unified ConRail structure carries with it disadvantages owing to the fact that it would give great market power to a single rail company. It is unlikely that Unified ConRail would enjoy

a regulatory and legislative environment as favorable as that afforded to enterprises subject to intramodal competition. This disadvantage may prevent Unified ConRail from achieving its projected success. Specifically, the apparent advantage of Unified ConRail would be diminished if it is not able or permitted to achieve, as projected here, the same degree of success in being fully reimbursed for passenger and light density line losses, increased expenses caused by inflation, delays in positive regulatory action on pricing reforms and protection of the freight traffic gateways of the solvent railroads as projected for the FSP recommended system. It is USRA's opinion that the differences in these factors under the two options would be such as to reduce significantly the apparent advantages of Unified ConRail relative to the recommended system. Unified ConRail also may be required to make federal income tax payments sooner than would ConRail under the system recommended in the FSP. This would reduce the amount of excess cash generated by Unified ConRail relative to the recommended system.

The financial forecasts developed for Unified ConRail project a loss<sup>1</sup> of \$359 million in 1976 on total revenues of \$3,302 million. Net income<sup>1</sup> of \$151 million is expected to be realized in 1979 and increase to \$1,009 million by 1985 (this level of income in 1985 could be reduced by as much as \$500 million when income taxes and interest on 7.50% Debentures are taken into account). The program of capital improvements and capitalized maintenance-of-way expenditures proposed for Unified ConRail would total \$6,844 million, including \$4,863 million for roadway and \$1,981 million for equipment acquisition. Maximum government funding would total \$2,026 million for the Unified ConRail system, with no new cash funding required after 1979.

### Operations and Facilities Planning

The same approaches and techniques employed in the preparation of the FSP recommended system were used to prepare an operations plan, equipment program and rehabilitation program for a Unified ConRail.

The major differences between the two systems arise from the greater coverage by Unified ConRail of areas such as Chicago, Akron-Youngstown, Buffalo, northern New Jersey, Harrisburg and Philadelphia. With this greater coverage and resulting larger traffic flows, Unified ConRail would be able to use a more effective blocking strategy, taking advantage of the larger flows moving between similar origins and destinations. Unified ConRail also would have increased opportunities for terminal consolidation.

Unified ConRail, with a larger fleet of cars and locomotives, accordingly would have a larger equipment acquisition and repair program than the FSP recommended system.

<sup>1</sup> Income before income taxes and interest on 7.50% Debentures.

Its requirements for both rehabilitation and normal-ized maintenance would be somewhat higher than under the program outlined in Chapter 1 of this Supplemental Report. The Unified ConRail rehabilitation program, however, would not increase in proportion to the increase in tonnage, as the opportunities would be greater to consolidate main-line routes and terminals. Under Unified ConRail, tonnage is expected to grow by 16 per cent between 1973 and 1985.

The operations and facilities plans proposed for Unified ConRail are designed to:

- Improve loading per car,
- Improve the physical plant,
- Improve rolling stock utilization,
- Improve road and terminal facility utilization and
- Improve management effectiveness.

### Freight Operations Planning

The same operations planning approach and planning tools, including the blocking and train formation models, the yard capacity simulation model and the dispatch simulation model, were used in preparing the projected operating plans for Unified ConRail and the FSP recommended system. Unified ConRail's data base and network design unlike the FSP recommended system, includes in ConRail all the traffic and territory served by the Erie Lackawanna and Reading. The major coordination projects with other carriers and the transfer of the Penn Central markets in the Tri-Cities area of Michigan to the Grand Trunk Western and on the Delmarva Peninsula to the Southern Railway remain the same as in the FSP recommended system. In the Unified ConRail structure, however, the Charleston market would remain in ConRail and would not be transferred to the Chessie System.

*Route Selection.*—The addition of the Reading and Erie Lackawanna systems to the ConRail network results in the following adjustments to the FSP description of main-line routes.

The program to remove most through freight from the Northeast Corridor to alternate routes would remain basically the same as that described in Chapter 1 of this report. Unified ConRail, however, would be operating entirely on its own lines north of Philadelphia instead of operating with trackage rights over several lines of the former Reading that now are planned to be part of the Chessie under the FSP recommended system.

Unified ConRail would not be faced with the same operating constraints that under the FSP system preclude ConRail from moving mineral traffic from Philadelphia to Bethlehem, Pa. over the Chessie System (former Reading), necessitating the movement instead over the less desirable Penn Central route via Morrisville, Pa., and Phillipsburg, N.J.

The inclusion of the Erie Lackawanna in Unified ConRail would add an additional east-west main-line route between Chicago and northern New Jersey. This route would be downgraded, with traffic moving between Chicago and the Youngstown area operating over the Penn Central route via Toledo and Cleveland. Former Erie Lackawanna traffic between Chicago and Buffalo would operate on the former Penn Central route via Toledo, Cleveland and Erie. Former Erie Lackawanna traffic between Chicago and northern New Jersey would move to Allentown either via Buffalo and Wilkes-Barre, Pa., or via Pittsburgh and Harrisburg, Pa. The traffic would then be moved to Phillipsburg via the former Lehigh Valley, and then to Hoboken, N.J. via Port Morris, N.J. over the former Erie Lackawanna. Local freight service would be maintained on the former Erie Lackawanna main line as required.

As with the FSP option, between Marion and Dayton, Ohio, former Erie Lackawanna traffic would be rerouted over the former Penn Central, with the exception of the former Erie Lackawanna main line between Bowlsville, Ohio and Dayton. This line would continue to be operated, enabling Unified ConRail to bypass the congested operation through Springfield, Ohio with through freight trains. Between Cleveland and Youngstown, most of the former Erie Lackawanna traffic would be routed over the former Penn Central via Alliance, Ohio.

### Classification Yards and Terminal Operations

The inclusion of the Erie Lackawanna and Reading systems into the ConRail operation presents both an opportunity and a problem. There is the opportunity to realize larger additional savings from consolidating terminal operations than is possible under the FSP system, since inclusion of the Reading and Erie Lackawanna systems creates additional overlapping ConRail terminal operations in Philadelphia, Buffalo, Chicago, Youngstown, Wilkes-Barre-Scranton, Syracuse and Utica which can be rationalized.

Overlapping operations also provide an opportunity to implement a better blocking strategy than that proposed in the FSP recommended system because Unified ConRail would be moving more traffic between common origin-destination locations. This would enable it to sort that traffic more effectively and eliminate some intermediate switching.

The problem associated with realizing these additional opportunities to consolidate operations and to sort cars more effectively is that in so doing, ConRail would be placing an increased workload upon the surviving facilities in the consolidated terminals.

The Association's recommended operating plan for Unified ConRail recognizes the potential capacity overloads and has adjusted them where required. For example, some additional westbound traffic in the Unified

ConRail network would be blocked at Conway Yard in Pittsburgh, Pa., to alleviate congestion at Elkhart Yard.

In Buffalo, where Unified ConRail would have two modern classification facilities, Frontier Yard (former Penn Central) would serve as the eastbound staging area for Rochester, Syracuse, New England and New York City traffic, while Bison Yard (50 percent former Erie Lackawanna and 50 percent Norfolk & Western) would handle the classification requirements for traffic moving to northern New Jersey, Philadelphia, Harrisburg and points south.

In the Youngstown area, where the Penn Central operates through agreement in Pittsburgh & Lake Erie's Gateway Yard and Erie Lackawanna operates in Briar Hill Yard, there is a possible need for a new, modern classification facility to handle the traffic of both on a consolidated basis.

In Philadelphia, where the Reading operates from Port Richmond Yard and Penn Central's operations focus on Greenwich Yard, it is proposed that Unified ConRail consolidate merchandise traffic operations at Port Richmond and mineral traffic operations at Greenwich.

In Harrisburg, where Penn Central operates Enola Yard and Reading operates Rutherford Yard, it is proposed that Rutherford serve as the classification facility for all traffic moving through the Lurgan Gateway. Enola would function as the classification yard for north-south and east-west traffic.

In northern New Jersey, the operations of the Erie Lackawanna are physically quite separate from those of Penn Central, Lehigh Valley and Central of New Jersey, providing little opportunity for additional terminal consolidation in this area. The one exception is the Port Reading Yard of the Reading, which ConRail would own and operate under the Unified ConRail option, while in the FSP recommended system it would be owned by the Chessie System, with ConRail allowed operating rights.

As a result of the changes in classification yard and terminal operations described above, the Erie Lackawanna facilities in Marion, Niles, Mansfield and Dayton, Ohio, Scranton, Pa., and Syracuse and Utica, N.Y., would be downgraded from their present role or closed.

In terms of existing operating problems and potential improvements, the Reading and Erie Lackawanna generally are faced with the same problems of management effectiveness and labor productivity as were discussed in Chapter 1 of this report. Recommended actions in the area of terminal improvement for a Unified ConRail, therefore, would be the same as for the FSP recommended system.

Because of its greater opportunities to consolidate terminal facilities and refine blocking strategy, it is

projected that Unified ConRail would achieve a 15 percent reduction in its terminal operations cost during the next 10 years as compared to 13 percent for the FSP recommended system. Because Unified ConRail would include the operations of two additional railroads and approximately 20 percent more volume, however, it is expected that implementation of any operating improvements would be delayed by one to two years compared to the FSP recommended system. During the initial years, Unified ConRail also would be burdened with additional start-up costs resulting from the increased merger requirements.

### Road Capital Improvement Projects

Road capital projects differ somewhat from the FSP recommended option where different plant configuration, improved facilities, etc., are necessary to support the operation plan for Unified ConRail. Table 1 summarizes the projected Unified ConRail road capital improvement program. A summary of expenditures for the major maintenance-of-way accounts is shown in Table 2.

### Intermodal Operations

Incorporating Erie Lackawanna and Reading intermodal traffic into Unified ConRail would cause relatively few changes to the route and terminal structure developed for the FSP recommended system. Intermodal traffic of these two roads accounted for approximately \$40 million in revenues in 1973 and involved 228,000 loaded trailers (including some which are interchanged with the Penn Central, Lehigh Valley and Central of New Jersey). The Association developed an operating plan that incorporated approximately 80 percent of this traffic. The same general criteria were used in evaluating those traffic flows recommended for retention, including relative profitability, traffic balance and volumes. These additional traffic flows could be accommodated under Unified ConRail by incorporating two additional facilities—the Reading terminal in Philadelphia and the Erie Lackawanna terminal at Croxton, N.J. All other major traffic generating points would be served from terminals to be retained under the FSP recommended system.

Additions to ConRail's intermodal capital program would be required to handle the projected traffic growth, particularly in the Chicago and New York terminals. Projected 1976 traffic volumes would require the addition of two daily trains between New York and Chicago. These trains would operate to and from the Erie Lackawanna's Croxton terminal, over the present Erie Lackawanna line to Montgomery, N.Y., and thence via the Penn Central through Albany, Buffalo and Cleveland

TABLE 1.—Unified ConRail annual road capital program by project (1976-80)

(Dollars in millions)

	1976	1977	1978	1979	1980	5-year total	Estimated 1981-85	10-year total
<b>I. Yard and terminal:</b>								
Number of projects.....	15	15	10	7	4	51	—	—
Investment.....	13	23	14	7	9	66	—	—
<b>II. Communications and signalling:</b>								
Number of projects.....	13	31	14	4	3	65	—	—
Investment.....	4	3	6	4	3	20	—	—
<b>III. Safety and environmental:</b>								
Number of projects.....	16	7	4	—	1	28	—	—
Investment.....	7	1	—	—	—	8	—	—
<b>IV. Service and operating:</b>								
Number of projects.....	11	13	10	7	4	45	—	—
Investment.....	8	8	9	10	3	38	—	—
<b>V. Workshops and machinery:</b>								
Number of projects.....	35	26	26	19	16	122	—	—
Investment.....	13	17	14	11	11	66	—	—
<b>VI. Intermodal facilities:</b>								
Number of projects.....	6	5	8	2	5	26	—	—
Investment.....	2	6	7	2	9	26	—	—
<b>VII. Bridges, buildings and other:</b>								
Number of projects.....	14	4	3	3	1	25	—	—
Investment.....	3	2	6	11	7	29	—	—
VII. 1981-85.....	—	—	—	—	—	—	188	—
VIII. Track improvements.....	9	9	11	14	17	60	87	—
<b>IX. Road additions associated with removing freight service from electrified northeast corridor.....</b>								
	6	22	19	22	32	101	—	—
<b>Total:</b>								
Number of projects.....	110	101	75	42	34	362	—	—
Investment (1973 dollars).....	65	91	86	81	91	414	270	684
Investment (inflated).....	87	132	136	140	169	664	613	1,277

TABLE 2.—Maintenance-of-way expenditures—Unified ConRail

(Millions of 1973 Dollars)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Total
<b>MAJOR ACCOUNTS</b>											
Structures.....	24	24	26	26	26	26	26	26	26	26	256
Ties.....	44	50	53	54	54	55	55	56	56	56	533
Rails.....	18	18	23	31	37	38	39	40	40	41	325
Other track material.....	29	31	33	32	33	34	35	35	35	36	333
Ballast.....	15	15	16	16	16	17	17	17	17	17	163
Track laying and surfacing.....	99	103	93	98	101	103	103	104	104	105	1,013
Communications and signals.....	37	37	38	38	38	39	38	38	38	38	379
Maintaining joint facilities—Net debit.....	4	4	4	5	4	4	5	4	5	5	44
Other M of W accounts.....	121	126	118	123	125	126	126	126	126	126	1,243
Additions and improvements.....	65	91	86	81	91	54	54	54	54	54	684
Total M of W expenditures.....	456	499	490	504	525	496	498	500	501	504	4,973
<b>UNINFLATED</b>											
M of W expenditures capitalized.....	197	238	254	264	282	249	252	254	255	257	2,502
Cost of salvage removal to accumulated depreciation.....	14	16	18	20	22	22	22	22	22	22	200
M of W expenditures charged to operating expenses.....	245	245	218	220	221	225	224	224	224	225	2,271
Total M of W expenditures.....	456	499	490	504	525	496	498	500	501	504	4,973
<b>INFLATED DOLLARS</b>											
M of W expenditures capitalized.....	263	346	403	454	522	494	533	572	614	662	4,863
Cost of salvage removal to accumulated depreciation.....	19	23	29	34	40	43	46	49	53	56	392
M of W expenditures charged to operating expenses.....	328	356	345	379	410	448	474	505	539	579	4,363
Total M of W expenditures.....	610	725	777	867	972	985	1,053	1,126	1,206	1,297	9,618

to Chicago. This would permit the continuation of dedicated intrastate TOFC train service to upstate New York points, which is not economical for the recommended FSP system. It will be necessary to acquire approximately 2,000 highway trailers from the Erie Lackawanna and Reading to handle this additional traffic.

The principal benefits of consolidating intermodal traffic flows under the Unified ConRail concept would be an increase in the size of average TOFC/COFC block sizes. This will facilitate more direct train services, increase the opportunities to balance traffic flows (thus continuing more services) and encourage more interline run-through operations. The addition of Erie Lackawanna long-haul traffic would permit ConRail to initiate transcontinental intermodal run-through train service, avoiding intermediate handling and switching operations.

### Equipment Requirements

Unified ConRail, compared to the FSP recommended system, would have a larger initial and projected 1985 car and locomotive fleet and a somewhat larger car and locomotive repair and acquisition program. In terms of car utilization improvement, it is projected that Unified ConRail would be able to improve its utilization by 28 percent during the next 10 years, the same increase projected for the FSP recommended system.

*Freight Cars.*—The table below summarizes the differences between Unified ConRail and the FSP recommended system in terms of car fleet requirements.

	FSP ConRail	Unified ConRail
Beginning inventory—1975.....	145,246	176,462
Ending inventory—1985.....	94,374	115,609
Retirements—10 yr.....	75,027	85,956
Acquisitions—10 yr.....	24,155	25,103

With the addition of the Reading and Erie Lackawanna freight car fleets, ConRail would acquire in the Reading fleet freight cars that are in good condition relative to the fleets of the other railroads in reorganization. Thus, as can be seen in the above table, Unified ConRail's freight-car acquisition requirements are only 3.9 percent greater than the requirements for the FSP strategic option, even though ending 1985 fleet requirements are 22.5 percent greater in Unified ConRail. In terms of freight-car capital requirements, Unified ConRail is projected to spend \$1.055 billion (inflated dollars) in the next 10 years compared to \$1.0 billion for the FSP recommended system.

*Locomotives.*—The following table summarizes the differences between Unified ConRail and the FSP system in terms of projected locomotive fleet supply.

	FSP ConRail	Unified ConRail
Beginning inventory—1975:		
Road freight.....	1,576	1,936
Road switcher.....	1,565	1,721
Yard switcher.....	902	1,080
Total.....	4,043	4,737
Projected fleet—1985:		
Road freight.....	1,673	2,079
Road switcher.....	1,471	1,631
Yard switcher.....	856	990
Total.....	4,000	4,700
Retirements—10 years:		
Road freight.....	291	355
Road switcher.....	393	488
Yard switcher.....	521	547
Total.....	1,205	1,390
Acquisitions:		
Road freight.....	388	498
Road switcher.....	721	824
Yard switcher.....	45	31
Total.....	1,154	1,353

As the table indicates, Unified ConRail's locomotive acquisition requirements would be proportionately larger than for the FSP systems, indicating that in acquiring the Erie Lackawanna and Reading locomotive fleets, ConRail would be adding locomotives that generally are in the same condition as are the locomotives of the other railroads in reorganization.

*Maintenance-of-Equipment Facilities.*—The facilities for maintaining locomotives and freight cars would require capital improvements at most of the major shops under both systems. Under Unified ConRail, however, additional shops would be acquired. Their projected usage is as follows:

- Reading Locomotive Shop, Reading, Pa. It would be used as a yard switching locomotive repair facility.
- Reading Car Repair Shop, Reading, Pa. It would be used as a supplement to the Samuel Rea shop of the former Penn Central in repairing freight cars.
- Erie Lackawanna Locomotive Shop, Hornell, N.Y. This shop would be closed or its activities curtailed under a Unified ConRail option.
- Erie Lackawanna Car Repair Shop, Meadville, Pa. This shop would be closed or its activities curtailed under a Unified ConRail option.
- Erie Lackawanna Locomotive Shop, Marion, Ohio. It would be phased out under the unified ConRail option.

As was the case with the FSP recommended system, Unified ConRail would be responsible for the maintenance of commuter passenger equipment and locomotives used in commuter passenger operations.

**Maintenance and Rehabilitation of Physical Facilities**

The maintenance requirements, whether accelerated to eliminate deferred conditions or maintained at normal levels to prevent deterioration, are related most directly to the size of the plant and the use it receives. Under Unified ConRail, the additional markets served and the increase in traffic from these markets require a larger plant than that of the FSP recommended system. The additional track mileage, structures, signal systems and other facilities in Unified ConRail have conditions much the same as those examined in the FSP recommended system.

The development of work programs necessary to provision of adequate service levels required an application of the strategies detailed in Chapter 1 of the Supplemental Report. USRA traffic studies provided the gross tons to be carried on the lines in Unified ConRail. From this information, miles of track in each of the tonnage categories were developed and the applicable

rehabilitation and maintenance strategies were applied. A summary of this revised strategy is shown in Table 3.

No significant change in the availability of materials, equipment or manpower is expected from those identified for the FSP recommended system. Development of annual maintenance programs enabled estimation of the requirements for equipment and materials outlined in Table 4.

Assumptions supporting maintenance programs for facilities other than track, communications and signals, structures, etc., remain the same. Increased requirements relate to the size of the plant.

Manpower requirements to support the work programs developed for Unified ConRail are shown below.

<i>Manpower requirements</i>	
<i>Year</i>	<i>Employees</i>
1976 -----	21, 176
1980 -----	18, 703
1985 -----	18,597

TABLE 3.—*Summary of Unified ConRail rehabilitation strategy*

NORMAL MAINTENANCE AND FIRST PRIORITY REHABILITATION PROGRAM	<i>Track miles</i>	ESSENTIAL YARD TRACKS WHICH SUPPORT LINES CARRYING 1 TO 20 MILLION GROSS TONS	<i>Track miles</i>
This is a 10-year program providing for normal maintenance and complete rehabilitation of those lines which are proposed to carry 20 million or more gross tons per track annually plus those lines on which an operating speed of 60 m.p.h. is desired for piggyback trains. These trains are proposed to carry approximately 65 percent of ConRail's projected tonnage.....	5, 775	These yard tracks will be included in the Association's normal maintenance program; however, rehabilitation activities on this trackage will be performed only to the extent such rehabilitation is required to support train operations. (Note: The traffic on these tracks is included in the estimate shown for second priority and 1 to 5 million gross tons categories.)-----	1, 900
This program also includes rehabilitation of major classification yards which support these routes.....	2, 160	HOLDING MAINTENANCE—NO REHABILITATION	
NORMAL MAINTENANCE AND SECOND PRIORITY REHABILITATION PROGRAM		The lines in this category include those lines which are proposed to handle under 1 million gross tons annually plus essential supporting yard and switching tracks. This category will receive the level of maintenance necessary to support operations at 10 m.p.h. These lines are proposed to carry less than 1 percent of ConRail's projected tonnage.	
This program includes those lines which are proposed to carry 5 to 20 million gross tons per track annually. This is a longer range rehabilitation program which will be carried out concurrently with the first priority program as resources become available. These lines are proposed to carry approximately 51 percent of ConRail's projected tonnage.....	7, 574	Running track.....	2, 861
NORMAL MAINTENANCE—RDG AND EL COMMUTER LINES		Yard and switching tracks.....	4, 464
This includes normal maintenance on the lines of the RDG and EL on which passenger service will be operated. (This does not include the EL line from Cleveland to Youngstown on which passenger service will be operated by the Chessie.).....	1, 060	NO MAINTENANCE—NO REHABILITATION	
NORMAL MAINTENANCE—NO REHABILITATION		This includes yards and switching tracks not presently deemed necessary to support ConRail's operations. These lines are proposed to carry approximately less than 1 percent of ConRail's projected tonnage.....	
The lines included in this category are proposed to carry 1 to 5 million gross tons per year. Normal maintenance levels will be applied on such lines, but such lines are not included in the rehabilitation program. These lines are proposed to carry approximately 4 percent of ConRail's projected tonnage.....	5, 456	2, 620	
		Total ----- 32, 810	
		The following trackage will receive holding maintenance on an interim basis:	
		Light density lines available for subsidy.....	<sup>1</sup> 11, 838
		Northeast Corridor (to hold trackage until arrangements are complete for rerouting on the Chessie System) .....	445
		Second main tracks to be maintained on an interim basis until signalling projects allowing for their retirement are complete.....	729

<sup>1</sup> It should be noted that the figure 11,838 includes all track miles associated with the light density lines and not the route miles reported elsewhere in this chapter.

TABLE 4.—*Summary of USRA proposed programs plans for additional material and equipment*

This table lists equipment acquisitions over and above existing roadway work equipment. The capital program also provides for some replacement of existing equipment as it wears out.

Year	USRA programs provide for:
1975 <sup>1</sup>	Initiation of training program 12 new tie gangs 1 new rail gang 12 new surfacing gangs 224 special ballast cars 84 tie cars 480 miles of rail laid under Section 215 (projected) 2.5 million ties installed under Section 215 (projected)
1976	Additional welding line 4 new tie gangs 3 new rail gangs 3 new welded rail trains 400 special ballast cars 40 tie cars 727 miles of rail laid 4.14 million ties installed
1977	Additional welding line 6 new tie gangs 1 new rail gang 400 special ballast cars 40 tie cars 739 miles of rail laid 4.57 million ties installed
1978	Additional welding line New reclamation plant <sup>2</sup> 1 new rail gang 4 new welded rail trains 400 special ballast cars 40 tie cars 934 miles of rail laid 4.23 million ties installed
1979	Major new rail welding facility 2 new rail gangs 4 new welded rail trains 400 special ballast cars 25 tie cars 1,154 miles of rail laid 4.23 million ties installed
1980	2 new rail gangs 4 new welded rail trains 200 special ballast cars 25 tie cars 1,340 miles of rail laid 4.23 million ties installed
1981	4 new welded rail trains 1,340 miles of rail laid 4.23 million ties installed
1982	1,340 miles of rail laid 4.23 million ties installed
1983/4/5	1,340 miles of rail laid per year 4.25 million ties installed per year

<sup>1</sup> Activities in 1975 are included in the Association's Section 215 program discussed in Chapter 1 of the supplemental report.

<sup>2</sup> A reclamation facility reclaims and rebuilds rail material, such as frogs, switch points, joint bars, spikes, bolts, etc., made available from renewals and track retirements for use elsewhere.

## Marketing

The marketing analysis discussed in Chapter 7 of the Final System Plan was based on the Association's preferred structure for the Region, consisting of a rail system comprised of ConRail, an expanded Chessie System, Norfolk & Western and the smaller solvent rail carriers. Unified ConRail, however, would serve a materially larger market and, as a result, it is projected to have additional tonnage and revenue. The following discussion describes and quantifies the significant marketing differences between the FSP recommended system and the Unified ConRail option.

Unified ConRail would serve a larger territory and would generate more traffic and hence more revenues than ConRail as defined in the preferred system. Table 5 contains the forecast of freight revenues for Unified ConRail. By 1985, uninflated freight revenues are expected to be \$2,547 million, reflecting a composite annual growth rate of 1.6 percent over the 12-year period. Similarly, it is expected that 463.8 million tons would be carried by 1985, reflecting an annual tonnage growth of 1.39 percent from 1973 to 1985. Table 6 contains annual tonnage projections for the major commodity groups.

The \$391.7 million increase in freight revenues between 1973 (\$2,155.3 million) and 1985 (\$2,547.0 million) consists of several components.

	(In millions of 1973 dollars)
Basic economic growth.....	\$341.5
Selective rate increases.....	63.0
Diversion to long-haul routes.....	54.8
Light density line abandonments.....	(50.0)
Market transfers to solvent carriers.....	(17.6)
<b>Total increase.....</b>	<b>\$391.7</b>

Each of these components except the last item is larger than the comparable figures in the FSP recommended system and reflect the larger market being served. The market transfers to solvent carriers component is lower for the Unified ConRail option because several important market transfers would not occur. The \$17.6 million remaining reflects the transfers of the Delmarva Peninsula and the Michigan Tri-Cities area markets which would occur under both options.

The selective commodity rate increases included in the Unified ConRail forecast are shown in Table 7. These selective rate adjustments total \$63 million for noncompensatory traffic and services and are included in freight revenues. The assumptions underlying these projections are stated in the FSP, Chapter 7, pages 177-181.

TABLE 5.—Unified ConRail revenue forecast

(In millions of 1973 dollars)

Revenue	1973	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Farm products.....	84.2	61.3	65.7	82.6	73.4	75.5	76.5	77.7	78.9	80.0	81.3
Metallic ores.....	97.5	79.8	85.4	80.5	84.3	96.2	99.0	101.9	104.7	107.7	110.6
Coal.....	242.5	242.5	251.4	250.8	258.1	272.9	283.7	295.1	307.0	319.3	331.9
Nonmetallic minerals.....	60.5	52.0	53.0	50.7	52.9	56.8	57.5	58.1	58.8	59.5	60.3
Food products.....	203.6	186.2	186.0	172.8	169.9	170.4	172.3	174.3	176.2	178.3	180.3
Lumber.....	74.1	61.0	62.8	58.2	65.5	78.4	80.4	81.6	82.8	84.0	85.3
Pulp and paper.....	128.5	117.7	124.7	130.6	133.5	139.6	145.2	150.0	155.0	160.1	165.7
Chemicals.....	169.8	152.9	159.8	152.9	155.2	164.9	168.3	172.0	175.8	179.7	183.7
Stone, clay, and glass.....	82.0	68.8	69.3	64.6	69.6	77.7	79.7	81.4	83.2	85.1	87.0
Primary metals.....	194.2	179.6	192.4	186.2	190.8	208.0	214.8	221.5	228.8	236.2	243.7
Transportation.....	265.3	235.3	265.4	246.0	252.3	287.8	298.3	309.0	320.7	332.5	344.7
Waste.....	83.6	77.3	82.7	89.4	91.3	98.6	101.5	104.6	107.6	110.7	113.9
Coke.....	31.4	29.5	31.4	30.7	31.3	33.4	33.8	34.3	34.7	35.4	35.9
TOFC <sup>1</sup> .....	215.3	183.6	202.6	200.0	208.6	225.9	235.9	246.6	257.9	270.1	282.9
Other (non-TOFC).....	222.8	183.9	193.5	189.8	194.1	208.7	214.5	220.5	226.5	233.2	239.8
Total.....	2,155.3	<sup>1</sup> 1,911.4	<sup>2</sup> 2,026.1	1,985.8	2,030.8	2,195.8	2,261.4	2,328.6	2,398.6	2,471.8	2,547.0

<sup>1</sup> Includes all TOFC movements.<sup>2</sup> Excludes light density line subsidies.

TABLE 6.—Unified ConRail tonnage forecast

(Millions of Tons)<sup>1</sup>

Tonnage	1973	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Farm products.....	14.2	10.7	11.1	11.9	10.5	10.9	11.0	11.2	11.5	11.6	11.7
Metallic ores.....	39.2	32.3	33.7	31.4	32.8	37.5	38.7	39.6	40.9	42.1	43.3
Coal.....	100.3	101.9	104.8	104.5	107.6	113.8	118.3	123.2	128.2	133.5	138.8
Nonmetallic minerals.....	24.8	21.3	21.3	19.6	20.4	22.1	22.2	22.6	22.8	23.3	23.5
Food products.....	31.0	28.7	28.2	25.7	25.1	25.3	25.5	25.6	25.9	26.4	26.5
Lumber.....	10.8	8.9	8.9	7.9	8.9	10.6	10.6	10.9	11.0	11.5	11.6
Pulp and paper.....	24.5	22.3	22.8	22.0	22.3	23.8	24.6	25.5	26.3	27.1	28.1
Chemicals.....	26.8	24.3	24.9	23.5	23.5	25.0	25.5	26.0	26.6	27.2	27.7
Stone, clay and glass.....	19.0	16.2	15.9	14.7	15.7	17.6	17.9	18.2	18.6	19.0	19.5
Primary metals.....	34.6	32.0	33.5	32.0	32.8	35.7	36.9	38.1	39.5	40.8	42.2
Transportation.....	16.3	14.4	15.7	14.3	14.7	16.5	17.2	17.7	18.5	19.3	20.0
Waste.....	19.1	17.8	18.7	17.6	18.0	19.6	20.3	20.9	21.8	22.4	23.1
Coke.....	8.3	7.6	7.9	7.7	7.8	8.5	8.6	8.6	8.7	8.7	8.8
Other TOFC <sup>2</sup> .....	10.3	8.3	9.3	9.0	9.5	10.6	11.2	11.9	12.7	13.5	14.3
Other non-TOFC.....	22.1	20.1	20.7	19.6	19.9	21.7	22.3	22.8	23.5	24.0	24.7
Total.....	401.3	366.8	377.4	361.4	369.5	399.2	410.8	422.8	436.5	450.4	463.8

<sup>1</sup> Tonnage contains some double counting because of joint movements by two or more constituent ConRail carriers; this double counting was eliminated in preparing

pro forma revenue and expense projections for ConRail.

<sup>2</sup> A small amount of TOFC traffic is also included in the other commodity groups.

TABLE 7.—Rate adjustments included in the unified ConRail revenue forecast

Commodity	Increases (Millions)
Farm products.....	\$10.1
Metallic ores.....	.1
Coal.....	2.3
Nonmetallic minerals.....	.1
Food.....	1.3
Lumber.....	1.8
Pulp and paper.....	10.5
Stone, clay and glass.....	.9
Primary metals.....	.2
Transportation equipment.....	2.8
Waste.....	10.3
Other.....	5.3
Subtotal.....	\$45.7
Ancillary Services.....	17.3
Total.....	\$63.0

## Financial and Cause of Change Analyses

The assumptions concerning the future state of the economy, rates of inflation, freight revenue rate relief and improvements in operating efficiency used in developing the Unified ConRail financial forecasts are identical to those used in Volume 1 of the Final System Plan (issued July 26, 1975).

The "cause of change analysis" reconciles Unified ConRail's financial performance to the 1973 performance of the railroads in reorganization and appears in Tables 8 and 9. The analysis was calculated on an uninflated (1973 dollar) basis to separate the effects of inflation from changes associated with the reorganization and rehabilitation of the plant. A discussion of the specific factors responsible for the changes follows.

*Unified ConRail pro forma statements of income (loss) before interest on 7.50% Debentures, income taxes and extraordinary item*

[Millions of inflated dollars]

	Years ending December 31,									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>Operating revenues:</b>										
Freight.....	2,646	3,018	3,143	3,461	3,999	4,397	4,784	5,186	5,622	6,101
Other.....	131	149	144	147	159	164	168	173	179	185
Freight revenues.....	2,777	3,167	3,287	3,608	4,158	4,561	4,952	5,359	5,801	6,286
Passenger revenues and operating loss subsidies.....	525	567	611	658	707	756	801	851	904	964
Total railway operating revenues.....	3,302	3,734	3,898	4,266	4,865	5,317	5,753	6,210	6,705	7,250
<b>Operating expenses:</b>										
Maintenance-of-way.....	349	390	393	443	493	550	596	647	704	768
Maintenance of equipment.....	477	503	541	566	593	648	677	727	781	842
Transportation.....	1,467	1,599	1,541	1,576	1,712	1,825	1,930	2,052	2,194	2,351
General and administrative and other expenses.....	207	224	217	219	234	253	271	290	316	343
Freight operating expenses.....	2,600	2,716	2,692	2,803	3,032	3,276	3,474	3,716	3,995	4,303
Passenger operating expenses.....	525	567	611	658	707	756	801	851	904	964
Total railway operating expenses.....	3,025	3,283	3,303	3,461	3,739	4,032	4,275	4,567	4,899	5,267
Net railway operating revenues.....	277	451	595	805	1,126	1,285	1,478	1,643	1,806	1,983
<b>Other income (expenses):</b>										
Net car hire.....	(282)	(325)	(308)	(281)	(286)	(271)	(301)	(341)	(381)	(427)
Payroll taxes.....	(243)	(265)	(257)	(263)	(282)	(301)	(315)	(334)	(358)	(384)
Other taxes.....	(64)	(68)	(72)	(76)	(80)	(84)	(88)	(93)	(98)	(104)
Other income and expenses.....	(27)	(14)	(14)	(18)	(17)	(9)	(7)	5	18	5
Total other expenses, net.....	(616)	(672)	(651)	(638)	(665)	(665)	(711)	(763)	(819)	(894)
Income (loss) before interest expense, income taxes, and extraordinary item.....	(339)	(221)	(56)	167	461	620	767	880	987	1,092
Interest expense (excluding interest on 7.50% Debentures).....	20	17	15	16	21	26	34	49	65	83
Income (loss) before interest on 7.50% Debentures, income taxes and extraordinary item.....	\$(359)	\$(238)	\$(71)	\$151	\$440	\$594	\$733	\$831	\$922	\$1,009

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes, and 7.50% Debentures and other securities and the related interest and dividends thereon.

*Unified ConRail pro forma balance sheets*

[Millions of inflated dollars]

	December 31,									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>ASSETS</b>										
<b>Current assets:</b>										
Cash.....	\$26	\$28	\$28	\$29	\$58	\$219	\$324	\$398	\$474	\$535
Temporary cash investments.....	191	207	206	215	231	249	264	282	302	325
Accounts receivable less allowance for doubtful accounts.....	361	412	427	469	541	593	644	697	754	817
Material and supplies, at average cost.....	268	288	303	325	345	377	398	423	451	482
Special funds.....	44	51	53	58	67	73	79	86	93	101
Other current assets.....	24	25	25	26	29	31	33	35	37	40
Total current assets.....	914	1,011	1,042	1,122	1,271	1,542	1,742	1,921	2,111	2,300
<b>Property and equipment, at cost:</b>										
Road and facilities.....	592	937	1,338	1,791	2,311	2,804	3,335	3,905	4,517	5,177
Transportation equipment.....	388	499	576	657	812	902	1,154	1,479	1,828	2,215
Less accumulated depreciation.....	980	1,436	1,914	2,448	3,123	3,706	4,489	5,384	6,345	7,392
Land.....	45	106	183	278	401	555	741	966	1,235	1,550
Net property and equipment.....	935	1,330	1,731	2,170	2,722	3,151	3,748	4,418	5,110	5,842
Other assets.....	55	55	55	55	55	55	55	55	55	55
Net passenger assets.....	990	1,385	1,786	2,225	2,777	3,206	3,803	4,473	5,165	5,897
Other assets.....	65	74	77	84	97	106	114	124	134	146
Net passenger assets.....	173	187	205	240	277	315	356	398	442	488
Total assets.....	\$2,142	\$2,657	\$3,110	\$3,671	\$4,422	\$5,169	\$6,015	\$6,916	\$7,852	\$8,831

## Unified ConRail pro forma balance sheets—Continued

(Millions of inflated dollars)

	December 31,									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>LIABILITIES AND EQUITY</b>										
<b>Current liabilities:</b>										
Accounts and wages payable.....	\$183	\$198	\$198	\$206	\$222	\$239	\$253	\$270	\$290	\$312
Accrued liabilities.....	379	410	409	427	459	496	525	560	601	646
Other current liabilities.....	117	133	138	152	175	192	208	225	244	264
Current portion of equipment obligations.....	42	41	41	36	36	39	48	64	80	93
<b>Total current liabilities.....</b>	<b>721</b>	<b>782</b>	<b>786</b>	<b>821</b>	<b>892</b>	<b>966</b>	<b>1,034</b>	<b>1,119</b>	<b>1,215</b>	<b>1,315</b>
Long-term debt (excluding 7.50% Debentures), less current portion of equipment obligations.....	197	157	151	163	263	309	474	682	803	1,120
<b>Other noncurrent liabilities (excluding deferred income taxes):</b>										
Pension liability.....	44	40	36	32	27	23	17	12	6	.....
Casualty reserve.....	32	71	106	111	125	132	137	138	144	149
Other.....	73	126	173	189	221	237	260	284	303	331
<b>Total liabilities (excluding 7.50% Debentures and deferred income taxes).....</b>	<b>1,067</b>	<b>1,176</b>	<b>1,252</b>	<b>1,316</b>	<b>1,528</b>	<b>1,667</b>	<b>1,922</b>	<b>2,235</b>	<b>2,561</b>	<b>2,915</b>
Commitments and contingencies.....										
Excess of passenger assets over liabilities and freight equity.....	151	165	183	218	255	293	334	376	420	466
Passenger corridor expenditures—contra.....	9	62	114	152	211	211	211	211	211	211
Additional funding requirement—government.....	800	1,376	1,753	2,026	2,026	2,026	2,026	2,026	2,026	2,026
Funds available for distribution.....					(24)	(206)	(493)	(849)	(1,279)	(1,766)
<b>Amount assigned to conveyance assets for pro forma purposes:</b>										
Freight.....	452	452	452	452	452	452	452	452	452	452
Passenger.....	22	22	22	22	22	22	22	22	22	22
Excess of assets over liabilities and equity (excluding 7.50% Debentures and deferred income taxes)...	(359)	(596)	(666)	(515)	(48)	704	1,541	2,443	3,439	4,505
<b>Total liabilities and equity.....</b>	<b>2,142</b>	<b>2,657</b>	<b>3,110</b>	<b>3,671</b>	<b>4,422</b>	<b>5,169</b>	<b>6,015</b>	<b>6,916</b>	<b>7,852</b>	<b>8,831</b>

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes, and 7.50% Debentures and other securities and the related interest and dividends thereon.

## Unified ConRail pro forma sources and uses of funds and required financing

(Millions of inflated dollars)

	Years ending December 31,									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>Sources of funds:</b>										
Income (loss) before interest on 7.50% Debentures, income taxes, and extraordinary item....	(\$359)	(\$238)	(\$71)	\$151	\$440	\$594	\$733	\$831	\$922	\$1,009
<b>Add expenses not requiring outlay of funds:</b>										
Depreciation—road and facilities.....	22	34	48	64	83	103	122	143	165	189
Depreciation—transportation equipment.....	29	32	37	40	46	52	61	76	93	112
<b>Funds provided from (used in) operations before interest on 7.50% Debentures, income taxes, and extraordinary item.....</b>	<b>(308)</b>	<b>(172)</b>	<b>14</b>	<b>255</b>	<b>569</b>	<b>749</b>	<b>916</b>	<b>1,050</b>	<b>1,180</b>	<b>1,310</b>
Net proceeds from road and facilities retired.....	6	7	4	2	4	7	10	12	14	17
Net proceeds from transportation equipment retired.....	4	6	6	6	7	9	10	11	12	13
Increase (decrease) in other noncurrent liabilities..	149	87	78	17	39	23	21	18	22	24
<b>Total sources of funds, excluding financing, interest on 7.50% Debentures, income taxes and extraordinary item.....</b>	<b>(149)</b>	<b>(72)</b>	<b>102</b>	<b>280</b>	<b>619</b>	<b>788</b>	<b>957</b>	<b>1,091</b>	<b>1,228</b>	<b>1,364</b>

## Unified ConRail pro forma sources and uses of funds and required financing—Continued

[Millions of inflated dollars]

	Years ending December 31,									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>Uses of funds (excluding repayment of 7.50% Debentures and dividends):</b>										
Additions to road and facilities.....	648	346	403	453	522	494	533	572	614	662
Additions to transportation equipment.....	403	127	93	96	171	106	266	339	363	401
Increase in net passenger assets.....	173	14	18	35	37	38	41	42	44	46
Repayment of equipment obligations.....	48	41	41	41	37	36	39	47	64	81
Increase (decrease) in other assets.....	65	8	4	9	10	13	7	9	12	9
Increase in working capital (excluding current portion of equipment obligations).....	235	35	27	40	78	200	141	110	110	102
<b>Total uses of funds (excluding repayment of 7.50% Debentures and dividends).....</b>	<b>1,572</b>	<b>571</b>	<b>586</b>	<b>674</b>	<b>855</b>	<b>887</b>	<b>1,027</b>	<b>1,119</b>	<b>1,207</b>	<b>1,301</b>
<b>New financing required (excluding income taxes, repayments, and interest on 7.50% Debentures and dividends).....</b>										
	<b>\$1,721</b>	<b>\$643</b>	<b>\$484</b>	<b>\$394</b>	<b>\$236</b>	<b>\$99</b>	<b>\$70</b>	<b>\$28</b>	<b>(\$21)</b>	<b>(\$63)</b>
<b>Sources of financing:</b>										
Equipment obligations.....	\$287		\$35	\$48	\$137	\$85	\$213	\$271	\$291	\$321
Excess of passenger assets over liabilities and freight equity.....	151	14	18	35	37	38	41	42	44	46
Additional financing provided by capital stock and 7.50% Debentures, net of interest on 7.50% Debentures, income taxes and extraordinary item.....	1,283	629	431	311	62	(24)	(184)	(285)	(356)	(430)
<b>Total financing.....</b>	<b>\$1,721</b>	<b>\$643</b>	<b>\$484</b>	<b>\$394</b>	<b>\$236</b>	<b>\$99</b>	<b>\$70</b>	<b>\$28</b>	<b>(\$21)</b>	<b>(\$63)</b>
<b>Increase (decrease) in working capital (excluding current portion of equipment obligations):</b>										
<b>Increase (decrease) in current assets:</b>										
Cash.....	\$26	\$2	\$—	\$1	\$29	\$161	\$105	\$74	\$76	\$61
Temporary cash investments.....	191	16	(1)	9	16	18	15	18	20	23
Accounts receivable less allowance for doubtful accounts.....	361	51	15	42	72	52	51	53	57	63
Material and supplies.....	268	20	15	22	20	32	21	25	28	31
Special funds.....	44	7	2	5	9	6	6	7	7	8
Other current assets.....	24	1	—	1	3	2	2	2	2	3
<b>(Increase) decrease in current liabilities:</b>										
Accounts and wages payable.....	(183)	(15)	—	(8)	(16)	(17)	(14)	(17)	(20)	(22)
Accrued liabilities.....	(379)	(31)	1	(18)	(32)	(37)	(29)	(35)	(41)	(45)
Other current liabilities.....	(117)	(16)	(5)	(14)	(23)	(17)	(16)	(17)	(19)	(20)
<b>Increase in working capital (excluding current portion of equipment obligations).....</b>	<b>\$235</b>	<b>\$35</b>	<b>\$27</b>	<b>\$40</b>	<b>\$78</b>	<b>\$200</b>	<b>\$141</b>	<b>\$110</b>	<b>\$110</b>	<b>\$102</b>

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes and 7.50% Debentures and other securities and the related interest and dividends thereon.

## Revenues

Total freight operating revenues are expected to increase \$427 million from 1973 to 1985. The major reasons for the improvement are increases in selective rates, light density line subsidies in 1976 and 1977, Unified ConRail's increased share of long-haul traffic in the Region and a substantial increase in physical volume of traffic. These revenue increases are detailed in Table 9 and highlighted below.

The Association again assumes that the ICC will grant selective freight rate increases on shipments of specific commodities which move under rates not fully covering their costs. These selective rate increases are expected to add \$24 million in revenues in 1977, \$62 million in 1978 through 1980 and \$63 million thereafter.

Light density line subsidy receipts by Unified ConRail are estimated to be \$39 million in 1976 and \$41 million in 1977. This subsidy does not include a return on investment because, consistent with the Act as it now stands, the Association assumed that title to the light density line assets will not be acquired by ConRail.

Revenue increases associated with diversions of long haul traffic to ConRail are estimated to rise \$9 million over the 1973 level in 1976 and ultimately to increase \$55 million in 1979.

Changes in traffic volume and commodity mix are estimated to reduce revenues by \$272 million in 1976 compared to 1973, but to increase revenues by \$309 million over 1973 by the final year of the planning period.

Total freight revenues will be \$224 million less in 1976 than in 1973, but are projected to be \$427 million more by 1985 than in 1973. (See Table 9.)

### Expenses

*Maintenance-of-way* (MOW) expenses appear in the cause of change as expenses requiring cash and noncash charges, i.e., depreciation. The MOW expenses requiring cash are lower throughout the planning period than 1973, reflecting the impact of depreciation accounting. MOW expenses are relatively higher in 1976 and 1977 than in later years because ConRail will operate over light density lines which will require some maintenance. Depreciation expense in 1976 will be less than in 1973 because the road assets acquired have a lower book value. During the planning period, net income reflects the impact of capitalizing and subsequently depreciating assets under depreciation accounting.

*Maintenance-of-equipment* (MOE) expenses are separated into two categories and are displayed in Table 8 as expenses requiring cash and noncash charges, i.e., depreciation. MOE expenses are expected to be higher throughout the planning period than in 1973, reflecting a higher level of heavy repair expense. Since equipment assets acquired by ConRail have a lower book value, the depreciation expense associated with these assets will be lower than the 1973 figures throughout the planning period.

*Transportation* expenses are expected to be significantly lower throughout the planning period than in 1973. The expense is higher in 1976 and 1977 relative to later years, primarily due to the costs of merging the eight rail carriers. The reduction in these expenses from 1973 levels are expected to range from \$39 million in 1977 to a high of \$209 million in 1979.

*Net car hire paid* is expected to decline in 1976 compared to 1973 due to reduced volume and is expected

to remain lower from 1978 through 1985, reflecting the implementation of improved equipment utilization systems. The largest reduction is estimated to be \$96 million in 1981.

*Payroll taxes* in 1976 through 1978 are greater than in 1973, reflecting the operation of light density rail lines and increased maintenance and rehabilitation efforts. The decline in expenses for the last 7 years is due to decreased direct labor costs.

*Income tax credit* represents a reduction in operating expenses on the 1973 financial statements of Penn Central (PC), stemming from tax allocation agreements between PC and its various subsidiaries and other miscellaneous adjustments of the parent company's income tax liability.

*Property and other taxes* are estimated to be \$6 million less than in 1973 throughout the planning period.

*Other rents, interest and miscellaneous income and expenses* are expected to reduce net income from the 1973 level because Unified ConRail will not have the income from nonoperating real estate properties of the PC. In later years, ConRail's interest income from short-term investments reduces this difference.

*Defaulted interest* is \$93 million less than was incurred by the railroads in reorganization, since ConRail would not be assuming their outstanding debt, currently in default.

*Equipment interest* should decline in ConRail's first years as a result of lower equipment indebtedness. As ConRail acquires new equipment under traditional methods from the private capital markets, equipment interest expense increases.

*Leased line payments* are \$32 million less than the amount incurred by the railroads in reorganization in 1973, since the underlying assets rather than the leases themselves will be conveyed to ConRail.

TABLE 8.—Unified ConRail, cause of change analysis, reconciliation of income statement with bankrupt carriers

(Millions of 1973 dollars)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Income before government financing costs, income taxes and extraordinary item:										
1976-85 period (depreciation basis).....	(\$225)	(\$117)	(\$7)	\$129	\$296	\$368	\$422	\$462	\$499	\$533
1973—base year.....	(183)	(183)	(183)	(183)	(183)	(183)	(183)	(183)	(183)	(183)
Difference.....	(\$42)	\$66	\$176	\$312	\$479	\$551	\$605	\$645	\$682	\$716
Operating revenue.....	(\$224)	(\$88)	(\$176)	(\$128)	\$49	\$120	\$192	\$267	\$346	\$427
Operating expenses:										
Maintenance-of-way:										
Expenses.....	6	5	33	29	29	25	26	27	25	25
Depreciation.....	9	1	(0)	(18)	(29)	(39)	(48)	(58)	(67)	(77)
Total.....	15	6	24	11	—	(14)	(22)	(31)	(42)	(52)

TABLE 8.—*Unified ConRail, cause of change analysis, reconciliation of income statement with bankrupt carriers—Continued*

(Millions of 1973 dollars)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Maintenance of equipment:										
Expenses.....	(46)	(38)	(37)	(27)	(19)	(26)	(19)	(19)	(19)	(18)
Depreciation.....	40	38	36	34	31	29	25	18	11	3
Total.....	(6)	—	(1)	7	12	3	6	(1)	(8)	(15)
Traffic.....	6	5	6	5	3	2	1	1	—	(1)
Transportation.....	50	39	168	209	199	202	205	204	199	194
Miscellaneous.....	—	—	—	—	—	—	—	—	—	—
General.....	(18)	(18)	—	9	12	13	12	11	10	9
Operating expenses.....	47	32	187	241	226	206	202	184	159	135
Net car hire.....	46	20	43	73	78	96	83	65	49	30
Payroll taxes.....	(19)	(18)	(3)	3	4	3	4	4	3	3
Income tax credit <sup>1</sup> .....	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
Property taxes.....	6	6	6	6	6	6	6	6	6	6
Other rents, interest and miscellaneous income and expenses <sup>1</sup> .....	(31)	(22)	(19)	(22)	(22)	(16)	(15)	(7)	—	2
Interest expense:										
Defaulted interest <sup>1</sup> .....	93	93	93	93	93	93	93	93	93	93
Equipment and miscellaneous interest.....	16	19	21	22	21	19	16	9	2	(4)
Leased line payments <sup>1</sup> .....	32	32	32	32	32	32	32	32	32	32
Total other.....	135	122	165	199	204	225	211	194	177	154
Total difference.....	(\$42)	\$66	\$176	\$312	\$479	\$551	\$605	\$645	\$682	\$716

<sup>1</sup> Changes due primarily to reorganization and restructuring of bankrupt roads.

NOTE.—All amounts shown increase (or decrease) net income, i.e., positive values increase net income and negative values ( ) decrease income.

TABLE 9.—*Unified ConRail, cause of change analysis, derivation of increase in revenues, due to changes in volume/mix and other factors*

(Millions of 1973 dollars)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
FREIGHT ONLY										
Total gain in operating revenue...	(\$224)	(\$88)	(\$176)	(\$128)	\$49	\$120	\$192	\$267	\$346	\$427
Gains not related to volume:										
Selective rate increases.....	\$—	\$24	\$62	\$62	\$62	\$63	\$63	\$63	\$63	\$63
Light line subsidy.....	39	41	—	—	—	—	—	—	—	—
Total.....	39	65	62	62	62	63	63	63	63	63
Revenue increase due to diversions.....	9	28	47	55	55	55	55	55	55	55
Revenue increase due to volume/mix.....	(272)	(181)	(285)	(245)	(68)	2	74	149	228	309
Total gain in operating revenues.....	(\$224)	(\$88)	(\$176)	(\$128)	\$49	\$120	\$192	\$267	\$346	\$427

NOTE.—All amounts shown increase (or decrease) net income.

Unified ConRail pro forma statements of income (loss) before interest on 7.50% Debentures, income taxes and extraordinary item

(Millions of 1973 dollars)

	Years ending December 31									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>Operating revenues:</b>										
Freight.....	\$1,950	\$2,067	\$1,986	\$2,031	\$2,196	\$2,261	\$2,329	\$2,399	\$2,472	\$2,547
Other.....	131	150	143	146	158	164	168	173	179	185
Freight revenues.....	2,081	2,217	2,129	2,177	2,354	2,425	2,497	2,572	2,651	2,732
Passenger revenues and operating loss subsidies.....	377	377	374	375	376	376	377	377	378	379
<b>Total railway operating revenues.....</b>	<b>2,458</b>	<b>2,594</b>	<b>2,503</b>	<b>2,552</b>	<b>2,730</b>	<b>2,801</b>	<b>2,874</b>	<b>2,949</b>	<b>3,029</b>	<b>3,111</b>
<b>Operating expenses:</b>										
Maintenance-of-way.....	265	274	256	269	280	294	302	311	322	332
Maintenance of equipment.....	365	359	360	352	347	356	353	360	367	374
Transportation.....	1,033	1,044	925	875	884	881	878	879	884	889
General and administrative and other expenses.....	157	158	139	130	129	131	132	133	135	137
Freight operating expenses.....	1,820	1,835	1,680	1,626	1,640	1,662	1,665	1,683	1,708	1,732
Passenger operating expenses.....	377	377	374	375	376	376	377	377	378	379
<b>Total railway operating expenses.....</b>	<b>2,197</b>	<b>2,212</b>	<b>2,054</b>	<b>2,001</b>	<b>2,016</b>	<b>2,038</b>	<b>2,042</b>	<b>2,060</b>	<b>2,086</b>	<b>2,111</b>
<b>Net railway operating revenues.....</b>	<b>261</b>	<b>382</b>	<b>449</b>	<b>551</b>	<b>714</b>	<b>763</b>	<b>832</b>	<b>889</b>	<b>943</b>	<b>1,000</b>
<b>Other income (expense):</b>										
Net car hire.....	(240)	(266)	(243)	(213)	(208)	(190)	(203)	(221)	(237)	(256)
Payroll taxes.....	(147)	(146)	(131)	(125)	(125)	(125)	(124)	(124)	(125)	(125)
Other taxes.....	(55)	(55)	(55)	(55)	(55)	(55)	(55)	(55)	(55)	(55)
Other income and expenses.....	(24)	(15)	(12)	(15)	(15)	(8)	(8)	—	7	9
<b>Total other expenses, net.....</b>	<b>(466)</b>	<b>(482)</b>	<b>(441)</b>	<b>(408)</b>	<b>(403)</b>	<b>(378)</b>	<b>(390)</b>	<b>(400)</b>	<b>(410)</b>	<b>(427)</b>
<b>Income (loss) before interest expense, income taxes, and extraordinary item.....</b>	<b>(205)</b>	<b>(100)</b>	<b>8</b>	<b>143</b>	<b>311</b>	<b>385</b>	<b>442</b>	<b>489</b>	<b>533</b>	<b>573</b>
<b>Interest expense (excluding interest on 7.50% Debentures).....</b>	<b>20</b>	<b>17</b>	<b>15</b>	<b>14</b>	<b>15</b>	<b>17</b>	<b>20</b>	<b>27</b>	<b>34</b>	<b>40</b>
<b>Income (loss) before interest on 7.50% Debentures, income taxes and extraordinary item.....</b>	<b>(\$225)</b>	<b>(\$117)</b>	<b>(\$7)</b>	<b>\$129</b>	<b>\$296</b>	<b>\$368</b>	<b>\$422</b>	<b>\$462</b>	<b>\$499</b>	<b>\$533</b>

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes and 7.50% Debentures and other securities and the related interest and dividends thereon.

## Unified ConRail pro forma balance sheets

(Millions of 1973 dollars)

	December 31									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>ASSETS</b>										
Current assets:										
Cash.....	\$19	\$19	\$18	\$17	\$104	\$198	\$249	\$295	\$343	\$385
Temporary cash investments...	139	140	128	124	125	126	126	127	128	129
Accounts receivable less allowance for doubtful accounts...	270	288	277	283	306	315	325	334	345	355
Materials and supplies, at average cost.....	201	199	193	192	190	195	193	194	194	195
Special funds.....	33	35	34	35	38	39	40	41	42	44
Other current assets.....	17	17	16	15	15	16	16	16	16	16
Total current assets.....	679	698	666	666	778	889	949	1,007	1,068	1,124
Property and equipment, at cost:										
Road and facilities.....	526	762	1,015	1,278	1,558	1,806	2,056	2,308	2,562	2,817
Transportation equipment.....	383	453	498	539	612	650	770	917	1,065	1,218
Subtotal.....	909	1,215	1,513	1,817	2,170	2,456	2,826	3,225	3,627	4,035
Less accumulated depreciation.....	42	94	156	230	317	416	529	659	805	969
Total.....	867	1,121	1,357	1,587	1,853	2,040	2,297	2,566	2,822	3,066
Land.....	55	55	55	55	55	55	55	55	55	55
Net property and equipment.....	922	1,176	1,412	1,642	1,908	2,095	2,352	2,621	2,877	3,121
Other assets.....	49	52	50	51	55	57	58	60	62	64
Net passenger assets.....	141	143	187	176	194	211	228	244	259	274
Total assets.....	\$1,791	\$2,074	\$2,285	\$2,535	\$2,935	\$3,252	\$3,587	\$3,932	\$4,266	\$4,583
<b>LIABILITIES AND EQUITY</b>										
Current liabilities:										
Accounts and wages payable...	\$133	\$134	\$123	\$119	\$120	\$121	\$121	\$121	\$123	\$124
Accrued liabilities.....	276	277	255	247	248	250	250	251	254	257
Other current liabilities.....	88	93	90	92	98	101	104	109	111	115
Current portion of equipment obligations.....	42	40	40	34	30	30	31	38	44	44
Total current liabilities.....	539	544	508	492	496	502	506	519	532	540
Long-term debt (excluding 7.50% Debentures), less current portion of equipment obligations.....	197	157	140	133	175	188	265	356	442	532
Other noncurrent liabilities (excluding deferred income taxes):										
Pension liability.....	44	41	36	32	27	23	17	12	6	—
Casualty reserve.....	24	50	69	67	71	70	69	66	66	65
Other.....	55	87	112	114	124	127	131	135	139	143
Total liabilities (excluding 7.50% Debentures and deferred income taxes).....	859	879	865	838	893	910	988	1,088	1,185	1,280
Commitments and contingencies.....	—	—	—	—	—	—	—	—	—	—
Excess of passenger assets over liabilities and freight equity.....	119	126	135	154	172	189	206	222	237	252
Excess of assets over liabilities (excluding 7.50% Debentures and deferred income taxes).....	813	1,069	1,285	1,543	1,870	2,153	2,393	2,622	2,844	3,051
Total liabilities and equity...	\$1,791	\$2,074	\$2,285	\$2,535	\$2,935	\$3,252	\$3,587	\$3,932	\$4,266	\$4,583

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes, and 7.50% Debentures and other securities and the related interest and dividends thereon.

## Unified ConRail pro forma sources and uses of funds and required financing

(Millions of 1973 dollars)

	Years ending December 31									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<b>Sources of funds:</b>										
Income (loss) before interest on 7.50% Debentures, income taxes and extraordinary item.....	(\$225)	(\$117)	(\$7)	\$129	\$296	\$368	\$422	\$462	\$490	\$533
Add expenses not requiring outlay of funds:										
Depreciation—road and facilities.....	21	29	39	48	59	69	78	88	97	107
Depreciation—transportation equipment.....	29	31	33	35	38	40	44	51	58	66
Funds provided from (used in) operations before interest on 7.50% Debentures, income taxes and extraordinary item.....	(175)	(57)	65	212	393	477	544	601	654	706
Net proceeds from road and facilities retired.....	5	5	8	3	4	3	3	3	3	3
Net proceeds from transportation equipment retired.....	4	4	4	4	4	4	4	4	4	4
Increase (decrease) in other noncurrent liabilities.....	123	55	39	(4)	9	(2)	(3)	(4)	(2)	(3)
<b>Total sources of funds, excluding financing, interest on 7.50% Debentures income taxes and extraordinary item.....</b>	<b>(43)</b>	<b>7</b>	<b>111</b>	<b>215</b>	<b>410</b>	<b>482</b>	<b>548</b>	<b>604</b>	<b>659</b>	<b>710</b>
<b>Uses of funds (excluding repayment of 7.50% Debentures and dividends):</b>										
Additions to road and facilities.....	582	238	254	264	282	249	252	254	255	257
Additions to transportation equipment.....	399	86	60	56	89	53	135	161	163	167
Increase in net passenger assets.....	141	7	9	19	18	17	17	16	15	15
Repayment of equipment obligations.....	47	42	40	40	34	30	30	31	38	44
Increase (decrease) in other assets.....	49	2	(1)	1	4	2	1	2	2	-
Increase in working capital (excluding current portion of equipment obligations).....	182	12	4	12	104	105	57	52	54	48
<b>Total uses of funds (excluding repayment of 7.50% Debentures and dividends).....</b>	<b>1,400</b>	<b>387</b>	<b>366</b>	<b>392</b>	<b>531</b>	<b>456</b>	<b>492</b>	<b>516</b>	<b>527</b>	<b>533</b>
<b>New financing required (excluding income taxes, repayments, and interest on 7.50% Debentures and dividends).....</b>	<b>\$1,443</b>	<b>\$380</b>	<b>\$255</b>	<b>\$177</b>	<b>\$121</b>	<b>(\$26)</b>	<b>(\$56)</b>	<b>(\$88)</b>	<b>(\$132)</b>	<b>(\$177)</b>
<b>Sources of financing:</b>										
Equipment obligations.....	\$287	\$—	\$23	\$28	\$71	\$42	\$108	\$129	\$130	\$134
Excess of passenger assets over liabilities and freight equity.....	119	7	9	19	18	17	17	16	15	15
Additional financing provided by capital stock and 7.50% Debentures, net of interest on 7.50% Debentures, income taxes and extraordinary item.....	1,037	373	223	130	32	(85)	(181)	(233)	(277)	(326)
<b>Total financing.....</b>	<b>\$1,443</b>	<b>\$380</b>	<b>\$255</b>	<b>\$177</b>	<b>\$121</b>	<b>(\$26)</b>	<b>(\$56)</b>	<b>(\$88)</b>	<b>(\$132)</b>	<b>(\$177)</b>

## Unified ConRail pro forma sources and uses of funds and required financing—Continued

(Millions of 1973 dollars)

	Years ending December 31									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Increase (decrease) in working capital (excluding current portion of equipment obligations):										
Increase (decrease) in current assets:										
Cash.....	\$19	\$—	(\$1)	\$1	\$87	\$94	\$51	\$46	\$48	\$42
Temporary cash investments.....	139	1	(12)	(4)	1	1	—	1	1	1
Accounts receivable less allowance for doubtful accounts.....	270	18	(11)	6	23	9	10	9	11	10
Material and supplies.....	201	(2)	(6)	(1)	(2)	5	(2)	1	—	1
Special funds.....	33	2	(1)	1	3	1	1	1	1	2
Other current assets.....	17	—	(1)	(1)	—	1	—	—	—	—
(Increase) decrease in current liabilities:										
Accounts and wages payable.....	(133)	(1)	11	4	(1)	(1)	—	—	(2)	(1)
Accrued liabilities.....	(276)	(1)	22	8	(1)	(2)	—	(1)	(3)	(3)
Other current liabilities.....	(88)	(5)	3	(2)	(6)	(3)	(3)	(5)	(2)	(4)
Increase in working capital (excluding current portion of equipment obligation).....	\$182	\$12	\$4	\$12	\$104	\$105	\$57	\$52	\$54	\$48

NOTE.—These forecasts are presented primarily for the purpose of comparing operating results and, therefore, exclude income taxes and 7.50% Debentures and other securities and the related interest and dividends thereon.

## APPENDIX

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# Contribution of Selected Traffic to Financial Performance

The high cost of performing rail terminal operations, including car classification and blocking, interline connection with other carriers and local freight switching, is widely believed to be one of the reasons for the poor financial performance of the railroads in reorganization. Such operations represent a considerable cost problem for all railroads, but congestion, high labor costs and shorter average hauls make terminal problems particularly severe in the Region. While railroad companies usually view terminals as cost centers, they seldom analyze rail terminal operations in the context of both costs and revenues, i.e. in terms of contribution to the financial health of the railroad. Such studies can be very useful in developing long range operating plans, capital improvement programs and marketing decisions. The traffic contribution studies completed by the Association serve to identify areas where marketing studies must be initiated immediately. Where it is determined that certain traffic does not contribute to ConRail's viability, corrective actions should be taken. These actions may involve adjustments in operating practices, improved cost control and requests for increased rates or tariff rule changes.

This appendix describes analyses of the contribution<sup>1</sup> generated by selected traffic on the ConRail network. These studies add to the financial planning and marketing studies described in Chapters 3 and 7 of

the Final System Plan. The analyses matched combinations of site-specific and average unit costs and operating characteristics to known revenues to determine the contribution of traffic movements through selected terminal areas.

In the Final System Plan, the Association recommended that ConRail devote immediate attention to the implementation of a revenue enhancement program in the form of selective rate increases and a minimum per car charge. Since the release of the FSP, the Association has completed a traffic contribution case study analysis designed to identify more precisely areas where ConRail should act to enhance the accuracy of present cost-revenue analysis methods. While the results of these studies indicate that the selective rate changes recommended in the FSP are required, ConRail management should conduct an in-depth marketing analysis to identify other needed rate adjustments and evaluate the impact of such changes on traffic levels and other rates.

It is recognized that rate changes are but one aspect of an effective profit improvement program. Other aspects include tariff rule changes service levels, car supply and cost control. All of these components are important because preliminary analyses indicate that a significant volume of traffic on the restructured systems will be moving at rates which are below variable cost.

The results of the Association's profit contribution studies indicate that, based on 1974 Penn Central operations and costs and revenue levels, a significant portion of the traffic in the sample failed to generate rev-

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<sup>1</sup> Contribution is revenue less variable cost. In general, traffic with a positive contribution warrants retention, but may not justify future investment in plant and equipment.

venues adequate to cover estimated variable costs. Approximately 30 percent of all carloads studied generated losses.

Significant improvements in revenue levels and operating efficiency are projected for ConRail by 1985. The combined impact of selective rate increases and projected operating efficiencies reduced the proportion of sample traffic not covering variable costs from 30 to 16 percent.

The study also illustrates the relationship between operating and marketing programs and demonstrates the need for simultaneous improvements in both areas. Cooperation by the shipping public also could enhance the contribution generated by traffic through programs that would increase average freight car loadings (and thereby revenue per carload), minimize empty car miles and reduce terminal detention time. A joint shipper-railroad program with these objectives would contribute to ConRail's long term viability and would help in preserving efficient, low-cost rail service for the shipping public. Accurate information on the contribution generated by specific traffic is important to the development of effective programs for freight car acquisition, cost control, responsive service levels and patterns and effective rate levels and structures.

### Study Objectives, Scope and Method

The primary purpose of the Association's analysis of traffic contribution was to identify areas where profit improvement efforts should be concentrated. The study sought to:

- Estimate the current levels of contribution,
- Identify the key factors influencing profitability,
- Estimate the impact of improvements in operating efficiency on contribution,
- Estimate the impact on the level of contribution of current freight car replacement costs and
- Develop guidelines and recommendations for a program designed to enhance contribution.

The study focused on the cost and revenues related to carload shipments originated or terminated at 13 individual terminal areas on the Penn Central. Limiting the scope of the analysis to selected terminals enabled the development of the required depth of detail concerning traffic flow patterns, operating methods and equipment utilization at the yard and station level within the limited time available to the Association.

The 13 terminal areas selected for analysis are typical of those on the Penn Central system in terms of location, size, nature of traffic and switching complexity, but the sample was not chosen to achieve exactly proportional representation of all traffic. The terminal areas chosen for study included the following.

Bedford (Motor Yard), Ohio  
Canton, Ohio

Edgemoor, Del.  
W. Albany, N. Y.  
Midvale Yard (Philadelphia), Pa.  
W. Springfield, Mass.  
Kenmore, N. Y.  
Burns Harbor, Ind.  
Indianapolis, Ind.  
Mingo Junction, Ohio.  
Oil City, Pa.  
Rochester, N. Y.  
Weirton, W. Va.

This study was based on a detailed analysis of the 54,813 carloads originated or terminated at the 13 terminals in June of 1974. These terminals generated approximately 14 percent of all carloads originated or terminated on the Penn Central during that month. No overhead traffic<sup>2</sup> was included in the analysis.

The analysis required the development of the specific characteristics of each movement, including the car and commodity type, the method of handling each car, car detention time, length of haul and the revenue generated by each car, including demurrage and accessorial revenues.

Costs were developed under both present levels of efficiency and those expected to prevail on ConRail by 1985, on both a variable and fully allocated cost basis. The model was programmed to develop equipment costs on both an historical *per diem* basis as well as on a current replacement cost basis.

The traffic contribution case studies required the development of a movement-specific data base for each terminal area. The originating or terminating freight station of each shipment was assigned to a serving yard based on current Penn Central operating practices. A record then was generated for each movement, using information extracted from the Penn Central's Freight Revenue Accounting (FRA) data base for the month of June 1974. Each movement record then was coded manually to include the number and type of yard handlings involved, intermediate movements required and actual miles moved according to existing PC classification manuals.

The revenue associated with each carload movement in the FRA data base was enhanced to reflect the impact of rate increases that became effective during the latter half of 1974. In addition, demurrage and switching revenues were included on a terminal-specific basis using actual customer billings at each study terminal for June 1974. Advance charges and storage revenues were determined on a systemwide per-car basis and the revenues were adjusted accordingly.

To assess traffic contribution properly, it was necessary to develop specific operating and equipment ownership costs for each terminal and, in some cases, for

<sup>2</sup> Overhead traffic is that received from connection and delivered by Penn Central to other connections.

individual customers. The Association developed a computerized freight traffic analysis model to relate estimates of these expenses to individual carload movements. This model improves on generally used costing procedures by combining site-specific yard and switching expenses with customer-specific equipment costs, based on actual detention time by car type, and line-haul costs based on commodity, shipment size and length of haul. Variable unit costs are shown in Table 1.

Terminal operating costs for each specific site were developed from the PC's management center cost reports for 1974. Terminal costs for nonstudy terminals were estimated for several types of terminal switching operations.

Car detention time in the 13 terminals was developed for each customer (by location and car type), using data extracted from Penn Central demurrage reports. These detention times then were matched with revenue loads for each customer by car type. Detention times at intermediate terminals not included in the study were based on system yard averages and standards developed by USRA.

Empty movement equipment factors were developed on a site-specific basis using Penn Central car movement tapes. Ratios of loaded-to-empty car miles were developed for each car type in each yard studied.

TABLE 1.—Unit operating costs

<i>Yard switching</i>	<i>Variable cost basis</i>
1st locomotive unit-----	\$66.21 per switch engine hour (includes labor, supplies and M/W).
2d locomotive unit-----	\$8.33 (does not include labor, supplies, or M/W).
Couple, set over and move to departure.	\$2.39 per car (30 cars per hour, 1 unit).
Flat switch-----	\$2.39 per car (30 cars per hour, 1 unit).
Hump switch-----	\$1.71 per car (50 cars per hour, 2 units).
Transfer or interchange----	\$8.57 per car (10 cars per hour, 2 units).
Pickup or delivery-----	\$20.51 per car (3.5 cars per hour, 1 unit).
 <i>Line haul</i>	
Locomotive capital costs----	\$0.0167 per car mile. <sup>1</sup>
Gross ton mile costs-----	\$0.0477 per car mile.
Freight car mile costs-----	\$0.0413 per car mile.
Freight train mile costs----	\$0.1342 per car mile.
Per ton costs-----	\$0.8321 per net ton.
Loss and damage-----	Specific costs for 35 two-digit STCC classes, system average, \$0.1771 per net ton.

<sup>1</sup> Average train size: 3,812 gross tons, 62.9 cars, 2.8 locomotive units, current replacement costs.

SOURCE: All operating costs derived from PC R-1 Report, 1974.

Line-haul unit costs were derived from the Penn Central Annual Report (ICC Form R-1), based on system average train size. Loss and damage costs were developed on a commodity-specific basis for 1974 and

applied to the shipments studied. Costs in the model include direct operating costs, equipment costs and taxes, but exclude costs associated with TOFC, floating operations and the operation and maintenance of coal and ore wharves and docks. Costs exclude federal income taxes and interest expenses on funded debt.

The model was designed to estimate terminal, line-haul and equipment ownership costs for each movement and to compare the costs to the associated revenue. Reports were prepared incorporating revenues and costs (either variable or fully-allocated) reflecting selective rate increases and projected 1985 efficiency levels. (Variable costs provide the basis for evaluating the contribution generated by individual shipments and form the basis for minimum rate levels.) Costs were then related to revenues to develop a "contribution" ratio indicating the relative contribution of individual traffic movements under each costing formula.

Two basic reports were generated for each terminal: a customer contribution report and a deficit traffic report. These reports portray the contributions of individual carloads and thereby identify potentially non-viable movements. Additional reports were prepared to indicate contribution by commodity and traffic type, segregating inbound and outbound transit and regular traffic. These reports were prepared for each cost level specified.

Freight car equipment costs were developed on both a replacement cost and *per diem* cost basis. Equipment ownership costs were based on mid-1974 replacement costs; *per diem* rates by car type were obtained for June 1974 from the Penn Central Car Accounting Department. Table 2 summarizes equipment costs by car type per hour and per mile, on both a replacement cost and *per diem* cost basis. (Unless otherwise noted, all costs discussed in this chapter are based on current Penn Central *per diem* costs.) *Per diem* costs are generally representative of present day equipment ownership costs, while replacement costs represent costs that are required to replace or expand assets in the future.

## Findings

The traffic studies indicated that (within the limits of accuracy of the studies) a significant portion of Penn Central traffic in the sample does not cover its variable costs. Based on 1974 operating efficiency, costs and revenues of the traffic analyzed:

- The deficit traffic generated variable costs exceeding revenues by \$1,090,750,
- 30 percent of the carloads apparently do not generate revenues adequate to cover short-run variable costs (variable costs determined on a *per diem* equipment cost basis) and
- 70 percent of the traffic covers short-run variable costs and contributes to full costs and profits.

Over the long term, if these findings are borne out by more detailed analysis, ConRail should strive to make necessary adjustments in rates and interline divisions and reductions in operating expenses to eliminate deficit traffic.

In many cases, these marginal movements consist of traffic not readily amenable to movement by alternate modes. The railroads should capitalize on such traffic and, in cooperation with shipper groups and regulatory agencies, develop programs to improve its contribution.

The detailed traffic reports revealed significant variations in traffic profitability depending on yard of origin or destination, type of freight car, type of traffic (local or interline) and revenue. Table 3 summarizes revenues and expenses for each study terminal, and shows the contribution ratio on both a variable and

full-cost basis. These ratios were 80.3 and 96.9, respectively.

As indicated below, 42.3 percent of interline traffic did not cover short-run variable costs. This is twice the corresponding local traffic percentage (e.g. traffic which originates and terminates on Penn Central) and may indicate a potential problem with the interline rate divisions. Clearly, traffic profitability must be an immediate concern of ConRail management and subsequent studies should be made to test the sample results.

*Interline vs. local traffic*

Percent of traffic which:	Interline traffic	Local traffic
Does not cover variable costs on <i>per diem</i> basis.....	42.3	21.0
Covers short-run variable costs.....	57.7	79.0

TABLE 2.—Equipment ownership costs

Type equipment	Replacement cost	Ownership cost		Car hire cost	
		Per active hour	Per mile	Per hour	Per mile
Equipped box car.....	\$26,000	\$0.54	\$0.0353	\$0.200	\$0.029
Unequipped box car.....	22,500	.47	.0307	.298	.026
Covered hopper.....	23,500	.49	.0321	.159	.027
Gondolas.....	22,000	.46	.030	.180	.027
Unequipped gondolas, ore jennys, M/W cars.....	22,000	.46	.030	.119	.024
Flats.....	26,000	.54	.0353	.333	.023
Refrigerator car.....	36,000	.75	.0491	.213	.031
Unequipped hopper.....	19,000	.40	.0262	.115	.024
Equipped hopper.....	19,000	.40	.022	.073	.022
Tank car.....	34,000	.71	.0464	.225	.031
Stock car.....	26,000	.54	.035	.035	.017
Yard locomotive.....	250,000	5.46	.....	.....	.....
Road locomotive.....	300,000	5.59	.3661	.....	.....

Assumptions:

1. Car availability—80 percent (allows for patron holding, shopping, holding for claims, inspection, modifications, assignment and for prospective loads).
2. Locomotive availability—road locomotive—90 percent, yard locomotive—77 percent (allows for repairs, inspections, servicing, breakdown).
3. Ownership costs based on capital recovery factor method—equal annual payments for principal and interest.

(a) Cost of capital—12 percent.

(b) Amortization period—15 years, no salvage.

(c) Equipment costs based on estimated 1974 prices.

4. Train miles per train hour: 15.27 (1974 PC average for road and local trains).

5. Car hire cost—Based on Penn Central data for June 1974.

SOURCE: USRA staff analysis.

TABLE 3.—Case study analysis results—summary of revenues, expenses and contributions

Yard	Loaded cars	Total revenue (thousands)	Short-run variable cost (thousands)	Contribution ratio	Full <i>per diem</i> cost (thousands)	Contribution ratio
Bedford.....	3,389	\$1,565	\$1,411	90.2	\$1,587	101.5
Burns Harbor.....	5,151	2,893	1,845	63.8	2,289	79.1
Canton.....	3,112	1,050	833	79.3	1,020	97.2
Edgemoor.....	4,722	2,974	2,037	70.2	2,448	82.3
Indianapolis.....	8,397	3,338	3,239	97.0	3,750	112.4
Kenmore.....	5,018	1,915	1,608	84.0	1,955	102.1
Midvale.....	1,077	542	434	80.3	494	91.3
Mingo Junction.....	3,577	1,294	1,106	85.4	1,377	106.4
Oil City.....	761	344	300	87.0	357	103.7
Rochester.....	3,012	1,265	1,141	90.1	1,350	106.7
West Springfield.....	1,587	845	725	85.8	859	101.7
Weirton.....	13,894	5,004	3,713	74.2	4,766	95.2
West Albany.....	1,116	565	515	91.1	605	107.1
Total.....	54,813	23,593	18,956	80.3	22,857	96.9

Revenues per ton mile are 30 percent higher for traffic that generates a positive contribution than for traffic that does not cover variable costs. Traffic generating a positive contribution has greater average tons per car and average length of haul than the traffic generating losses (longer hauls and heavier loads normally result in higher revenues per ton).

As previously noted, this analysis is based on a traffic sample representing 14 percent of Penn Central's car loads (except overhead) generated in June 1974. The Association compared average tons per car and average revenue per load for the 13-yard traffic sample with all Penn Central traffic for June 1974. This comparison indicated that the revenue per car in the sample was 11 percent higher than the average for all traffic and average tons per car were 15 percent higher. The sample, therefore, may not be fully representative of total traffic.

### Alternatives for Profit Improvement

In the short run, contribution to system financial performance may be improved through rate increases. As noted in the Final System Plan, across-the-board increases can be self-defeating because anticipated revenue gains might be offset by diversion of profitable traffic to other modes. The alternative proposed in the Final System Plan is to seek approval of specific increases on selected commodities and to develop and implement a minimum per-car charge (see Chapter 7 of the Final System Plan).

To test the effect of the proposed selective rate adjustments on contributions, revenues were adjusted in the sample on a commodity basis. This adjustment reduced the loss by \$247,815 (as shown in Table 4) but did not result in all traffic meeting its variable costs. If the proposed minimum per car charge had been in effect, revenue would have been increased by an additional \$763,300 (assuming no traffic diversion). Even with this additional revenue, however, some traffic still would fail to cover variable costs. This suggests that the proposed minimum rate levels may be inadequate to eliminate the problem. The proposed minimum charges are based on national average costs and were not adjusted to reflect higher cost levels in the Region.<sup>3</sup>

The diversion of traffic that might result from the minimum per-car charge, however, has not been evaluated. Before changes in the rates are proposed, careful indepth marketing analysis must be completed. This analysis should address not only potential diversion but the interrelationships, to the extent they exist, of rates on other movements and commodities.

While rate adjustments represent the short run avenue to increase profitability, increases in efficiency

TABLE 4.—Impact on contribution of revision in rates and projected operating efficiency

Based on study sample of 54,813 loads	Present rates and cost	Selective rate increases	Selective rate increases plus 1985 operating efficiency <sup>1</sup>
Cars incurring loss:			
Number of cars.....	16,381	13,812	8,811
Percent of total sample.....	29.9	25.2	16.1
Total loss, variable cost <i>per diem</i> basis.....	\$1,090,750	\$842,935	\$443,285
Percent of cars:			
Covering variable costs on <i>per diem</i> basis.....	70.1	74.8	83.9
Contribution index (variable costs divided by revenue):			
<i>Per diem</i> basis.....	80.3	75.8	67.5
Equipment replacement basis.....	101.2	95.4	82.1

<sup>1</sup> As projected in Final System Plan.

could improve viability over a longer period. To test the impact of changes in this area, the Association adjusted cost factors in the model to reflect the efficiencies expected to be realized by ConRail during the next 10 years. Specifically, the following adjustments were made.

- Equipment costs were reduced to reflect the estimated 28 percent improvement in utilization,
- Terminal costs were reduced to reflect an improvement in efficiency due to rehabilitation and improved blocking strategies, increased car sizes and more effective management control (with increased costs of direct supervision),
- Line haul costs were adjusted to reflect increases in train and car size and reduced running times due to plant rehabilitation,
- Maintenance-of-way costs were increased to reflect normalized expenditures.

Individual car utilization factors for 1985, detailed below, were based on projections developed by Strong, Wishart & Associates and were applied to each car type.

#### 1985 car utilization efficiency factors

Car type	Percent reduction in car cycle time
Equipped box.....	34
Plain box.....	31
Flat car.....	37
Unequipped hopper.....	27
Covered hopper.....	33
Gondolas.....	32
All other car types.....	6

<sup>3</sup> The Association based its minimum per-car charges on national average costs on the assumption that industrywide concurrence in the program was essential for its implementation.

The combined effect on contribution of revised rate levels and projected operating efficiencies was dramatic.

- The projected loss was reduced, in addition to the reduction in the loss attributable to the selective rate adjustments, by \$399,650 (to \$50.31 per deficit car). The variable cost contribution ratio was reduced to 67.5 on a *per diem* basis and 82.1 on a replacement cost basis, as shown in Table 4.
- However, 16 percent of sampled traffic still failed to cover variable costs.
- Were it possible to eliminate this loss by increasing revenues (through a minimum per-car charge) on all traffic sufficient at least to cover variable costs, profitability would be increased by an additional \$443,285.

The impact of utilizing equipment replacement costs instead of *per diem* rates at 1985 efficiency levels with selective rate increases results in an increase in costs per sample carload by an average of \$66. The variable cost contribution ratio is increased from 67.5 to 82.1 due to the higher cost of equipment ownership, as shown in Table 4. Future studies of traffic profitability by ConRail should incorporate replacement costs when new investment in equipment is required to handle projected traffic. Furthermore, the impact of the use of fully allocated costs is an increase of \$72 per carload by 1985.

### Conclusions

While several steps can be taken to reduce traffic losses and to eliminate cross-subsidies between traffic, a wider-ranging program should be undertaken. Such studies would be of value throughout the industry but are of critical importance to ConRail. Improved methods and procedures for determining contribution and profitability need to be implemented in order to identify particular problem areas and to focus and direct profit improvement and marketing efforts.

On the cost side, refined procedures for determining operating expenses are essential. Present methods of rail costing using broad system average costs are inadequate for investment, operations planning and marketing analyses. Such procedures might capture and report activity and expense units by location routinely. On the revenue side, better information for pricing decisions is needed. More precise cost and pricing information also can lead to improved decisions on equipment acquisition, terminal and line-haul facility modernization, interline routings and possible future labor negotiations.

In keeping with these recommendations, ConRail should enhance the present Penn Central freight profitability reporting system, incorporating location specific load/empty mileage ratios, equipment detention times and terminal costs. One of the prime goals of the ConRail marketing effort must be to generate the maximum contribution from each class of traffic. This must take place in a difficult environment of interlocking and complementary rail traffic patterns, regulation and competitive modes. With careful analysis of component costs, changes can be made in the marketing and production of rail transportation that will enhance the viability of the ConRail System. It is important to isolate the factors contributing to deficit-producing traffic and to initiate corrective actions. Traffic which generates a positive contribution should be retained. Unless such traffic produces revenues which cover full replacement costs, however, new investment for such traffic will be jeopardized.

With improved management information systems and a better understanding of those factors contributing to profit or loss, ConRail should develop a structured sales and marketing program which emphasizes the solicitation and development of profitable traffic flows. At the same time, cooperative efforts with shippers are needed to improve contributions of nonviable and marginal traffic.

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