zation. Each of them may be said to be a contribution to a very complex subject and should be recognized (with specifics possibly utilized) by future rail network rationalization planning efforts.

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Impacts of Light Density Rail Line Abandonment

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Estimates of the extent of potentially uneconomic light density railroad lines in 31 states outside the Northeast and of the amount and type of traffic on these lines were developed. The analysis utilized the Federal Railroad Administration network model, the 1 percent waybill sample, and a decision rule, derived from U.S. Railway Association planning, of 43.5 annual carloads per kilometer (70 carloads per mile) of line. It was estimated that approximately 41 000 kilometers (25 500 miles) of line, or 18 percent of the route length, in the 31 states are uneconomic. Only 2.4 percent of total traffic originates or terminates on these lines. Only for agriculture is the traffic on these lines significant, but mitigating factors indicate that adjustments after terminating service can be made with relatively little adverse effect. The effects of termination on the highway system, energy consumption, and the environment were also analyzed and found to be generally minor.

The nation's railroad system is currently undergoing considerable restructuring of facilities and services, largely caused by economic effects from shifts in product demand, industry location, competing modes of transportation, and government policies. The low rate of investment return over several decades has plagued the railroad industry as a whole and has brought a number of important railroads, particularly in the Northeast, to bankruptcy.

In an effort to restore vitality to the industry, Congress passed the Regional Rail Reorganization (3R) Act of 1973 and the Railroad Revitalization and Regulatory Reform (4R) Act of 1976. These two acts demonstrate the importance of a strong private railroad industry to the economic well-being of the nation.

The 3R and 4R acts are proof that the private railroad industry is no longer expected to provide deficit services. The 3R Act, in dealing with light density freight lines in the Northeast, indicated that, if it is in the public interest to continue such services, then the government must underwrite part of the losses. A subsidy program was established to provide for the continuation of essential local rail services on a temporary

Figure 1. Regions and states included in the light density line analysis.

basis, until workable alternatives could be implemented. The 4R Act extended government subsidies for essential services to the entire nation and expanded the options for use of subsidy funds to include nonrailroad alternatives when such alternatives are more cost effective.

Congress has, however, clearly indicated that service continuation subsidies are a short-term, transitional measure, not a permanent solution to the problem of light density railroad freight service. The potential cost of the subsidy program, the large capital needs of the mainline railroad system, and the nonaccountability of operational subsidies underscore the importance of analyzing these programs and alternative policies to ensure that public funds are spent effectively. The U.S. Department of Transportation (DOT) is now sponsoring research into whether alternate programs for local freight assistance would be more cost effective and would provide more positive solutions for stabilized freight service than railroad subsidies.

In addressing the matter of light density lines, it is important to estimate (a) the amount of uneconomic light density lines in the railroad system as a whole, and (b) the portion of traffic of the various commodities that originates or terminates on these lines.

The railroad system of the Northeast, especially the bankrupt railroads, has been studied extensively. The United States Railway Association (USRA), in a careful case-by-case analysis, found that 9263 km (5757 miles) of line were uneconomic to operate. These lines accounted for 23 percent of the system's lines but originated or terminated only 2.2 percent of the total system traffic (1). However, the extent of uneconomic light density line distance in the rest of the nation must also be estimated.

Section 904 of the 4R Act, accordingly, mandated that the Secretary of Transportation

> shall submit to the Congress, within 90 days after the date of enactment of this Act, a comprehensive report on the anticipated effect, including the environmental impact, of any abandonment of lines of railroad and any discontinuance of rail service in the States outside the region.

Section 904 deals with the 31 southern and western states (excluding Alaska and Hawaii) shown in Figure 1. This paper summarizes the findings of a research report on abandonment and alternatives submitted to Congress (2). The study responded to the Congress's request for a macroview of current uneconomic service in the 31-state area and a discussion of anticipated effects of relieving the railroad industry of the associated financial burden. The purpose of this study, however, was not to identify or recommend specific line segments for abandonment.

Section 803 of the 4R Act calls for a comprehensive federal, state, and local rail planning process to deal with the problem of uneconomic light density lines. This process will be responsible for detailed line-by-line estimates of viability. In addition, Section 804 requires that each carrier prepare, submit to the Interstate Commerce Commission (ICC), and publish a diagram of its system that includes a description of lines potentially subject to abandonment.

ESTIMATING THE EXTENT OF UNECONOMIC LIGHT DENSITY LINES

Because major new research was not possible within the 90-d limitation imposed by the 4R Act, our study relied heavily on available information and findings, particularly the studies of the reorganization of the bankrupt railroads of the Northeast. However, a new computerized network analysis was undertaken to estimate the rail traffic and route length of potentially uneconomic light density railroad service within the 31 southern and western states.

The analysis was performed in three steps. First, the Federal Railroad Administration's (FRA) preliminary network model (3, 4) of the nation's railroad system was used to select a set of light density line segments and to obtain the length of each segment. The segments selected for analysis were those that are directly represented in the network model, are served by a single carrier, and carry just under a million megagrams or less per year. There are no data on terminating traffic for railroads with average annual operating revenues of less than $3 million, so their lines were excluded from the analysis.

Next, estimates of the total traffic originating and terminating on each light density segment were obtained from the FRA waybill files for 1972, 1973, and 1974. These data represent a systematic 1 percent sample of audited revenue waybills for all domestic shipments terminated by railroads with annual operating revenues of $3 million or more. The 3-year period increased the sample size and reduced the effects of the business cycle, weather, and other ephemeral influences on traffic volume.

Finally, each segment was tested for economic viability according to the volume of traffic generated and its importance to the mainline. USRA published data summarizing the results of detailed financial analyses of the economic viability of 344 former Penn Central Transportation Company lines were reviewed (5). Slightly less than half of these lines passed USRA's viability requirement of generating sufficient revenue to cover at least 90 percent of avoidable costs. From these data, a simple viability criterion was developed: Did the line originate or terminate or both an annual average of at least 43.5 carloads/km (70 carloads per mile)?

This criterion classified approximately 90 percent of the individual line segments in the same way as USRA's detailed financial analyses did. Moreover, the criterion produced an almost perfect estimate of the total number of segments found uneconomic by USRA. Of 344 segments tested, the 43.5-carload/km criterion classified 166 as viable, 143 as not viable, 18 incorrectly as viable, and 17 incorrectly as not viable. Although the 43.5-carload/km criterion is in no way an accurate substitute for a careful financial analysis of individual line segments, it did give a good indication of the total number of unprofitable segments and was therefore used in developing estimates of apparently uneconomic lines.

EXTENT OF POTENTIALLY UNECONOMIC LIGHT DENSITY LINES

The computerized network analysis estimated that some 41 000 km (25 500 miles), or 18 percent, of the total route length in the 31 states are potentially uneconomic light density (PULD) lines. However, these lines account for only 2.4 percent of total carloads. These percentages are comparable to those found by the USRA in the Northeast, where 23 percent of route length accounted for only 2.2 percent of the total traffic.

The overall traffic data were grouped into six regions generally conforming to the boundaries shown in Figure 1; tabulations of affected route length and traffic are given in Tables 1 and 2. These regions have varying amounts of PULD lines, ranging from 6 percent of the system in the East South Central region to a high of 28 percent in the West North Central region. Estimated affected traffic on uneconomic lines in these two regions is 0.6 percent and 5.3 percent, respectively.

The commodities originating and terminating on PULD lines are shown in both absolute and relative terms in Table 3. It should be noted that, except for agriculture, the traffic originating and terminating on these lines is quite limited.

Table 1. Route length of PULD lines outside the Northeast.

Region	Existing Lines[a] (km)	Potentially Uneconomic Light Density Lines: No. of Kilometers	Potentially Uneconomic Light Density Lines: Percentage of Existing Kilometers
South Atlantic	26 851	1 800	6.7
East South Central	23 992	1 400	5.8
West South Central	41 153	5 800	14.1
West North Central	77 774	22 000	28.3
Mountain	32 608	5 900	18.1
Pacific	24 430	4 100	16.8
Total	226 808	41 000	18.1

Note: 1 km = 0.62 mile.

[a] From the 1974 Yearbook of Railroad Facts (6).

PRIMARY ECONOMIC EFFECTS

The Railroad Industry

One estimate of financial relief to the railroad industry in the 31 states set the reduction in the affected railroads' annual operating losses at approximately $150 million. In addition, the capital committed to this portion of the system has a value of at least $640 million in track facilities alone, exclusive of the value of rights-of-way. Equipment and labor resources devoted to these lines could also be utilized more effectively on the profitable parts of the rail system. Capital formation is a major problem for the industry, and this committed capital is therefore of great importance.

Manufacturing, Retailing, Mining

The effect of a cutback of PULD service on the productive sectors of our economy would be quite small in scale with the exception of agriculture. Petroleum, pulp and paper products, machinery and equipment, metal products, waste and scrap, metallic ore, and coal use well

Table 2. Shipments originating or terminating on PULD lines outside the Northeast.

Region	Originating Carloads (000s): Total[a]	Originating Carloads (000s): On PULD Lines	Originating Carloads (000s): Percentage on PULD Lines	Terminating Carloads (000s): Total[a]	Terminating Carloads (000s): On PULD Lines	Terminating Carloads (000s): Percentage on PULD Lines	Overall Percentage of Carloads Affected[b]
South Atlantic	2 188	21	1.0	2 724	10	0.4	0.6
East South Central	2 490	15	0.6	1 810	10	0.6	0.6
West South Central	2 045	49	2.4	2 344	35	1.5	1.9
West North Central	3 427	260	7.6	3 184	90	2.8	5.3
Mountain	1 296	55	4.2	1 045	17	1.6	3.1
Pacific	1 651	53	3.2	1 665	18	1.1	2.1
Total	13 097	452	3.5	12 772	179	1.4	2.4

[a] Derived from FRA waybill files for 1972-1974.

[b] Carloads originating or terminating on potentially uneconomic light density lines are taken as a percentage of all originations and terminations in the 31 states.

Table 3. Commodity shipment originating or terminating on PULD lines outside the Northeast.

Product Description	Originating Carloads (000s): 31-State Total[a]	Originating Carloads (000s): On PULD Lines	Originating Carloads (000s): Percentage on PULD Lines	Terminating Carloads (000s): 31-State Total[a]	Terminating Carloads (000s): On PULD Lines	Terminating Carloads (000s): Percentage on PULD Lines	Overall Percentage of Carloads Affected[b]
Farm products	1 389	249	17.9	1 278	17	1.3	10.0
Coal	752	6	0.8	560	6	1.1	0.9
Nonmetallic minerals	808	18	2.2	773	16	2.1	2.2
Food products	1 390	43	3.1	1 200	26	2.2	2.7
Lumber and wood products	1 691	78	4.6	1 491	18	1.2	3.0
Pulp and paper products	765	4	0.5	582	9	1.6	1.0
Chemicals	900	8	0.9	806	33	4.1	2.4
Petroleum and related products	550	7	1.3	527	12	2.3	1.8
Clay and concrete products	642	16	2.5	635	13	2.0	2.3
Metal products	364	4	1.1	541	12	2.2	1.8
Machinery and equipment	424	7	1.6	854	9	1.1	1.3
Waste and scrap	308	6	1.9	269	2	0.7	1.4
All others	588	6	1.0	757	6	0.8	0.9
Total	10 571	452	4.3	10 273	179	1.7	3.0

[a] Derived from FRA waybill files for 1972-1974.

[b] Carloads originating or terminating on potentially uneconomic light density lines as a percentage of all originations and terminations in the 31 states.

Table 4. Estimated agricultural shipments sent on PULD lines.

Commodity	Rail Shipments[a,b] (Mg 000 000s) National Total	31-State Total[c]	On PULD Lines	Percentage of 31-State Total on PULD Lines	Percentage of National Production Shipped on PULD Lines
Wheat	40.3	37.1	7.9	21.3	17
Corn	28.6	16.3	2.7	16.6	2
Barley	4.5	4.4	1.0	22.7	12
Sorghum grains	6.2	5.8	0.8	13.8	4
Oats, rye, and other grains	3.5	3.0	0.6	20.0	3
Soybeans	8.5	5.8	0.9	15.5	2
Other field crops	11.9	4.8	0.5	10.4	–
Other farm products	4.4	4.0	0.3	7.5	–

Note: 1 Mg = 1.1 short ton.

[a] All production figures are national estimates; figures given for rail shipments on PULD lines are restricted to lines in the 31 southern and western states.
[b] Total shipments may exceed total production because of reshipment.
[c] Derived from FRA waybill files for 1972-1974.

under 2 percent of all carload originations and terminations in the 31 states on PULD lines; manufacturing, retailing, and mining, use much less than 1 percent. Lumber and wood products originate and terminate approximately 3 percent of total carloads on these lines. For food processors, the figure is 2.7 percent.

Agriculture

Most light density lines are located in rural areas, and, as shown in Table 3, agricultural products account for a significant share of the traffic outside of the Northeast.

While many agricultural supplies and products are moved by truck, certain products, particularly grain, fertilizer, and feed, are commonly transported by railroad. The issue is whether discontinuing service on some railroad lines in agricultural areas will force farmers, suppliers, and marketing cooperatives to shift to alternate, perhaps more expensive modes.

The agricultural traffic originating and terminating on PULD lines has been analyzed in some detail and is shown in Table 4. All production and consumption figures are national estimates; figures given for rail shipments and receipts on PULD lines are restricted to lines in the 31 southern and western states.

When the traffic moving over PULD lines is compared to total national production, only wheat and barley are substantially affected. However, even though 17 percent of wheat and 12 percent of barley move over these lines, light density lines could be selectively abandoned with only a slightly adverse effect on grain shipments, because much of the potentially affected distance is located in areas with comparatively dense rail networks and because grain shipments are initially moved by truck from the farm to the elevator, leaving some flexibility as to which elevator might be used.

Another component of agricultural railroad traffic is the inbound shipment of agricultural supplies. Table 5 shows that abandoning unprofitable light density lines would have only a minor effect on receipts of fertilizer, feed, and farm machinery and equipment.

The effects of reduced service are most acute locally. Here the problem can best be approached by separately assessing the impacts of abandonment on several distinct types of agricultural users: grain elevator operators, feed and fertilizer producers and distributors, and the farmer.

Grain Elevators

Numerous country elevators that serve as collection, storage, and shipping facilities for local farmers are situated on light density lines. Complicating the matter is the fact that poor track conditions frequently prevent these elevators from using modern 91-Mg (100-short ton) covered hopper cars. Many of them still ship in one-to-three boxcar quantities. Larger subterminal elevators, those that receive most or all of their grain from country elevators, typically receive and ship grain in sufficient volume to raise the rail line on which they are located out of the light density category.

The best alternative, which would avoid the problems associated with the collection of grain from country elevators, would be to construct larger grain subterminals on nearby high density rail lines that could handle 91-Mg (100-short ton) cars in unit-train service. Grain could be trucked from the country elevators to the subterminals and shipped in unit trains of 50 or more cars at a time. Studies have indicated that, in corn-growing areas, the resulting saving in rail freight charges would more than pay for the construction costs of the new facility as well as for the additional handling and trucking costs (7, 8, 9).

Shipments to terminals or subterminals no more than 300 to 600 km (200 to 400 miles) away would generally be made completely by truck. Baumel (7, 8, 10) and a USDA study (11) indicate using 28-m^3 (800-bushel) tractor-trailers would increase the costs about 0.25 to 0.60 cents/m^3-km (0.015 to 0.035 cents/bushel-mile). This would be about \$0.75 to \$1.80/m^3 for a 300-km shipment (or 3 to 7 cents/bushel for a 200-mile shipment).

Other transport alternatives to country elevators include truck and rail (without the use of subterminals) and truck and barge. Previous abandonments, incidentally, have not prevented the continued expansion of country elevators (7, pp. 138-144).

Feed Producers and Distributors

Feed producers and distributors in grain surplus areas (more grain is grown than is used locally) also frequently use grain elevators. Feed sold in these areas is grown, ground, and mixed locally and is rarely shipped by rail. There should be no adverse effects from abandonment here.

Feed producers and distributors in grain deficit areas, on the other hand, might be adversely affected. The most likely transportation alternative for receiving feed and feed grains would be a combination of rail and truck. Simat, Helliesen, and Eichner (12) found three firms that reported increases in costs of \$0.80 and \$3.30/Mg (\$0.75 and \$3.00/short ton) that resulted from abandonment.

Most increased costs in these areas will be passed on to the firm's customers. In areas where competitors are unaffected by the loss of rail service and the increased cost of trucking cannot be passed along, firms

Table 5. Estimated agricultural shipments received on PULD lines.

Commodity	Rail Receipts[a] (Mg 000 000s) National Total	31-State Total[b]	On PULD Lines	Percentage of 31-State Total on PULD Lines	Percentage of National Consumption Received on PULD Lines
Phosphate fertilizers	9.6	6.1	0.8	13.1	2.0
All other fertilizers	6.0	4.6	0.3	6.5	0.7
Grain feeds	83.1	68.7	0.7[c]	1.0	–
Oil kernel, nut, and seed feeds	9.3	6.6	0.1[c]	1.5	–
All feeds	10.1	6.4	0.2	3.1	0.8
Farm machinery and equipment	0.8	0.6	0.1	16.7	–

Note: 1 Mg = 1.1 short ton.

[a] All consumption figures are national estimates; figures given for rail receipts on PULD lines are restricted to lines in the 31 southern and western states.

[b] Derived from FRA waybill files for 1972-1974.

[c] A significant portion of these commodities are made into feed for local agricultural use.

may be forced to close their feed operations. One study disclosed that of ten feed distributors who lost direct rail service, four closed, and a fifth reported a substantial decline in feed sales (12).

Fertilizer Distributors

Loss of rail service is likely to result in rail and truck transshipment of virtually all potash and most phosphate fertilizer destined for stations on the line. A nitrogen fertilizer producer is likely to be close enough to make direct shipment by truck feasible.

Estimates obtained by Bunker and Hill (13) of increased costs resulting from transshipment by rail and truck were approximately $1.65/Mg ($1.50/short ton) for transloading and 2 to 6 cents/Mg/km (4 to 8 cents/short ton-mile) for trucking. Compare these increases in costs to retail prices of $110 to $220/Mg ($100 to $200/short ton) for common forms of concentrated fertilizers and $9/Mg ($8/short ton) for agricultural limestone. This increase will probably make retailing agricultural limestone impractical. It could also cause a loss of sales of other types of fertilizers to nearby distributors who do not lose rail service.

Farmers

Only a relatively small number of farmers will encounter major increases in production and marketing costs for most crops, if local direct rail service is lost.

Data on feed and fertilizer presented previously indicate that the cost increase for these two commodities would generally be less than 2 percent and somewhat more for the cheaper fertilizers. Fertilizers account for only a small portion of the costs of growing crops, so the overall effect on crop production costs should be quite small. The effect of increased feed costs on livestock production costs will be relatively larger but still generally no greater than 0.5 percent of total costs.

The effect on farm incomes of increased shipping costs for grain could be significant. As discussed previously, a system of grain subterminals might allow many light density lines to be abandoned without any effect on shipping costs and perhaps even a reduction in costs. Otherwise, increased shipping costs of $1.50 to $3.00/m^3 (5 to 10 cents/bushel) might result. Such increased costs would be absorbed by farmers as lower net on grain sales, although in some cases some portion could be passed on to the consumer. Subterminals, therefore, might play an important role in minimizing or avoiding the adverse effects that the loss of rail service could have on the farmers served by light density lines.

ENERGY, ENVIRONMENTAL, AND OTHER COMMUNITY EFFECTS

Highway Effects

Freight now moving on unprofitable light density lines could be moved by other modes, chiefly motor freight. On-going research sponsored by DOT is focusing on developing reliable estimates of the extent of the modal shifts and the impact on the highway system. One preliminary examination suggests that the worst possible result would be 6 to 7 billion Mg/km (4 to 5 billion short ton-miles) of additional truck traffic on the highway systems of the 31 states, and between 650 and 800 million truck km (55 billion truck miles) of travel by combination trucks (14, Table VM-1). Thus, the shift from 41 000 km (25 500 miles) of light density railroad lines, assuming diversion to truck, would result in an increase in truck traffic of less than 1 percent.

Energy Consumption

On the basis of estimates of fuel use for the alternate transport modes and preliminary estimates of the use of these modes, the potential effect of abandonment on fuel consumption should be between 75 and 150 million L (20 to 40 million gallons) annually; compare this with the 413 billion L (109 billion gallons) of fuel consumed annually by railroads and highway vehicles (15, pp. 194-197). Thus, it can be seen that even under the worst circumstances abandonment will result in less than a 0.04 percent increase in rail and highway fuel consumption.

Air Pollution

Air pollution emission factors have been developed by the Environmental Protection Agency for trucks, locomotives, and riverboats (16). However, although trucks and railroads are both usually diesel powered, trains frequently use a lower grade of diesel fuel, which generates higher emissions. This is particularly true for the four-stroke switch engines commonly used for branch-line operations. As a result, a change in mode would increase emissions of carbon monoxide and nitrogen oxides. Even for these two pollutants, preliminary estimates indicate that the increases would be only about 0.004 percent and 0.04 percent respectively, of the estimated national total emissions for all transportation sources.

Local railroad operations are particularly energy intensive, and the locomotives used in these operations have generally high emission levels, so the individual communities most affected by abandonment would see a small overall improvement in air quality.

Water Pollution

In general, abandoning a light density rail line can produce some minute improvements in local water quality by eliminating herbicide leaching and runoff, oil and lubricating fluid leakage, and the possibility of accidental spills. However, any overall improvement in water quality will probably be negligible.

Noise

A shift from rail to truck for part or all of a haul will have some effect on noise generated and perceived. Railroads normally generate somewhat more noise than trucks do, and railroad train noise levels also decline less with increasing distance. On the other hand, since two to four trucks are normally required to transport the contents of a single freight car, more trucks will produce more noise events.

Noise, and particularly the impact of noise on the population, is a very involved phenomenon, meaningful only at a particular locale under particular conditions, and cannot be judged overall. A review of various retrospective studies of railroad abandonments did not reveal complaints of increased noise levels, but generally speaking the effects of abandonment will be minor.

Other Effects

Other effects of abandonment, including those on safety, land use, and aesthetics, were also seen as being minor overall. At the local level there can be expected economic adjustments. Of particular concern to local interests is the effect of abandonment on population. Therefore, the demographic histories of a number of communities included in retrospective abandonment studies were tabulated. It was found that after abandonment almost as many communities gained population as lost.

ALTERNATIVES FOR FREIGHT TRANSPORTATION NOW PROVIDED BY LIGHT DENSITY LINES

Rail users and communities who face the possible loss of railroad service have a number of possible responses. The alternatives fall under the following:

1. Subsidization of railroad service,
2. Alternatives for cost reduction,
3. Alternatives for increased revenue,
4. Substitution of alternate freight transportation service,
5. Nontransportation alternatives, and
6. Combinations of the above alternatives.

These alternatives are discussed in some depth in another report (2). Rail users and government officials charged with the responsibility of dealing with rail line abandonment are encouraged to consider the full range of alternatives in their planning. The state railroad planning procedure established by Section 803 of the 4R Act is very appropriate to dealing with the analysis of alternatives throughout the transition period and to achieving stabilized local freight services in areas apt to experience abandonment.

CONCLUSIONS

The research reported here indicates that the matter of uneconomic light density railroad lines, when scaled to the perspective of the total railroad freight system, is of relatively little consequence. The agricultural sector merits special attention insofar as significant portions of the nation's agricultural traffic originate on uneconomic lines. However, there are a number of indications that the effects on agriculture can be satisfactorily diminished by minor adjustments in the logistics of transporting those products affected, particularly grain.

While the effects of light density line abandonments are small on a nationwide perspective, they may be important at the local level, where detailed analysis of various alternatives is needed to produce creative solutions and stabilized local freight services for the future. The state railroad planning established in Section 803 of the 4R Act provides the mechanism for such creative local planning and presents a challenge to state and local railroad planning officials.

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Analysis of Rail Line Abandonment Priorities

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Recent reorganization of railroads in the Northeast faced many kilometers of rail lines with service abandonment. The cost to the taxpayer of rail service continuation subsidies was judged to be "less than the cost of abandonment of rail service in terms of lost jobs, energy shortages, and degradation of the environment." Legislation provided federal funds and left the decision to individual states, who were required to submit state rail plans. This paper explains the process used by the New York State Department of Transportation to select analysis variables, importance weights, and impact indexes for establishing line abandonment priorities. Sensitivity testing and interpretations of the analysis are reported.

In 1970 the Penn Central Transportation Company declared bankruptcy. This failure, along with that of four other railroads in the Northeast and Midwest, created a unique and potentially dangerous economic situation, possibly affecting the entire country. To minimize the impact of these bankruptcies, Congress enacted the Regional Rail Reorganization (3R) Act of 1973. The act's major purpose was to reorganize the bankrupt railroads into one or more rail system(s) capable of meeting the rail service needs of the 17-state region at the lowest possible cost to the taxpayer.

Congress recognized from the outset that any attempt to reorganize existing railroads into a self-supporting system would mean large-scale abandonment of light density branch lines. To ease the impact of abandonment, Title IV of the 3R Act provided federal subsidies for a 2-year period to assist state and local governments either in financing the continuation of essential rail services for that period or in systematically phasing out services on lines not selected for reorganization.

Section 401 of the 3R Act emphasized that "under certain circumstances the cost to the taxpayer of rail service continuation subsidies would be less than the cost of abandonment of rail service in terms of lost jobs, energy shortages, and degradation of the environment." The act, however, left to the individual 17 states the decision of whether avoiding the negative social impacts of discontinuing rail service justified continuation subsidies. In December 1975 the New York State Department of Transportation's (NYSDOT) preliminary rail plan was presented, and, after a series of public hearings throughout the state, the final state rail plan was adopted.

As part of the planning process, it was essential that a procedure be developed for quantitatively comparing the potential social impacts—on lines, rail shippers, and communities—of lines threatened with discontinued rail service. Of the long list of variables suggested, five were ultimately selected—consumer costs, employment, tax effects, sales effects, and environmental effects—according to the variable's perceived importance by members of the rail planning staff and local officials, its ability to be quantified, and the availability of relevant data. Scaling and weighting techniques were then developed to pool the measures of satisfaction of the variables. Linear scaling was done by using statistical measures (mean and variance) of independent variables. A small sample survey was conducted to derive weights for pooling scaled values.

This paper briefly explains the process employed by the NYSDOT in selecting their variables, assigning the level of importance weights to them, computing a single "impact index" for each line, and ultimately ranking the lines by their respective impacts. Several hypothetical importance weights are then applied, and the resulting line priority implications are observed and discussed. Conclusions about this decision-assisting process, its sensitivity to values, and the proper interpretation of results are presented.

SOCIAL IMPACT ANALYSIS

When a rail line is abandoned, each of its users must choose one of three courses: using alternate means of transportation for commodities previously carried by the line, relocating to another site having rail service, or ceasing at least that portion of business involving use of rail service. Each user is influenced by many variables such as the availability and cost of the alternative compared to rail service at the user's original site, the availability of suitable alternate sites, the user's market area, the amount of investment required at a new site, and the profitability of the business (1).

Few commodities carried by rail could not in theory be transported by other modes. There are some notable exceptions, such as very large electric generators, transformers, and so forth, but movement of such commodities is relatively infrequent. Usually when a firm says they depend on rail for some portion of their transport needs, they really mean that the cost of using an alternative is prohibitively high.

In general, abandoning rail lines will leave former users with no direct transport facilities other than highways. In the past, some shippers faced with such a situation have elected to use trucks between the plant and an alternate rail station; others have diverted their traffic entirely to trucks for the full haul. In the former the