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RAILROAD MANAGEMENT AND ENGINEERING: EDUCATIONAL NEEDS AND RECOMMENDED PROGRAMS



MARCH 1980

FINAL REPORT

**Prepared for
U.S. DEPARTMENT OF TRANSPORTATION**

**FEDERAL RAILROAD ADMINISTRATION
Washington, D.C. 20590**



DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

Railroad engineering, economics, regulation, labor relations, and management have received little attention at the college and university level over the past 20 years. This study, Railroad Management and Engineering: Educational Needs and Recommended Programs, conducted by the University of Tennessee Transportation Center and sponsored by the Federal Railroad Administration, considers the engineering and management skills needed by the railroad industry--and related manufacturers, consultants, and Government agencies. The report includes an assessment of existing university programs, and its recommendations reflect the results of discussions with more than 90 senior-level individuals associated with universities, Government agencies, and various aspects of the railroad industry.

The report recommends specific programs to strengthen railroad education, in the interest of a revitalized, efficient, and well-managed railroad industry able to meet the challenges of the next decade and beyond.

I commend the report to your attention and solicit your comments on its conclusions and recommendations.

Sincerely,

A handwritten signature in cursive script that reads "John M. Sullivan".

JOHN M. SULLIVAN
Administrator

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16. Abstract <p>The modern educational needs of the rail industry can best be met by a combination of focused and practical seminars and short courses for present and prospective professional employees, support for enrichment of the railroad content of university transportation offerings, a university railroad research program, and fellowship support. This is the consensus of more than 90 senior-level individuals interviewed, representing all segments of the industry, including railroads, Government agencies, suppliers, consultants, associations, and universities. The railroads state that they are having little difficulty in attracting talented people, but new employees typically, have no specialized railroad knowledge, which adversely impacts job expectations, career motivation, and employee retention. Railroads actively recruit the small number of new graduates with rail training. Suppliers, Government agencies, and consultants have greater recruiting problems and correspondingly have greater needs for improved educational programs. The recommended university programs will have an immediate and positive impact on railroad recruiting and will help to strengthen innovation in the railroad industry.</p>					
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FOREWORD

This research was performed for the U.S. Department of Transportation, Federal Railroad Administration under contract number DOT-FR-9037. The contract monitor was Marilyn W. Klein of the Office of Policy and Program Development. She was assisted by Donald L. Spanton, Office of Research and Development, and Theodore Vass, Office of Federal Assistance. The authors gratefully acknowledge their assistance. Special thanks are due to the members of a review panel who promptly and candidly reviewed the draft final report. The panel members were: Frederick J. Beier, University of Minnesota; Ronald A. Bowes, Consolidated Rail Corporation; Francis J. Coyne, Burlington Northern, Inc.; Jack R. Martin, Southern Railway System; Gilbert T. Satterly, Purdue University; and Edward J. Ward, Transportation Research Board. Similar thanks are due to Arnold D. Kerr, University of Delaware, and to several other reviewers in Government and academia who generously provided their comments and suggestions. Transportation Research Board Committee A0004, Transportation Education and Training, chaired by Dr. Lester Hoel, provided a forum for the preliminary study findings at the committee's 1979 mid-year meeting. The researchers extend their thanks and appreciation to all the above.

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EXECUTIVE SUMMARY

Sources for the development of future railroad managers and engineers have attracted the attention of those concerned about the industry. The question is asked: Are currently utilized personnel sources adequate for the coming decade? In response to this inquiry, The University of Tennessee, under a contract with the Federal Railroad Administration (FRA), conducted the Railroad Educational Needs Study with the following objectives: (1) to determine the extent of the needs for future qualified managers and engineers in this country's railroad industry; (2) to determine whether existing educational programs can meet this need; and (3) to the extent that deficiencies are noted, to recommend means by which such may be overcome.

The greatest emphasis in the research was placed on personal interviews with members of the railroad industry, State Governments, colleges and universities, industry associations, consulting firms, and various other agencies, both public and private. Another valuable source of information was a program conducted to solicit materials on railroad in-house and external educational programs offered or supported by railroad carriers.

It was noted from the interviews that from two-thirds to three-fourths of top and middle management will be replaced in the coming decade. As a result, the study concludes that a definite need exists and will continue to exist in the next 5 to 10 years for replacement railroad management; however, an exact number is subject to considerable qualification. The number could vary from 1,000 to 3,000 per year. The industry expects to be able to find these replacements without any special assistance, despite the acknowledged lack of railroad education programs.

The railroads are necessarily satisfied currently with hiring generalists rather than individuals trained specifically for railroad careers. This is predominantly because of a decided lack of the latter candidates rather than any inherent aversion to hiring railroad and transportation majors; in fact, the handful of railroad-oriented engineers currently graduating are avidly recruited by the railroads.

The majority of the railroads strongly favor in-house teaching of advanced railroad subjects and, in fact, are suspicious of external training in all but the basics. A significant minority of the managers and engineers interviewed, however, emphatically support the concept of external teaching as a vehicle for promoting change in the industry.

Rail planning agencies in State and Federal Government and railroad consulting firms need graduates, at all degree levels, with railroad training. The difficulties experienced in obtaining personnel from the railroads make university programs the only realistic long-term source for such individuals.

There are few programs designed specifically to the needs of the railroads. Those few that do exist are of relatively high quality and enjoy the continuing support of the industry. Rather than increasing the number of programs, however, resources should be directed to strengthening existing programs and to fostering the introduction of rail-oriented materials into existing engineering and management curricula.

Evaluation of the study findings leads to the following conclusions concerning the future educational needs of the railroad industry:

1. University railroad education programs will quite likely never again be large enough to completely fill the demand for new managers and engineers, thus forcing the railroads to continue hiring graduates with diverse backgrounds and training them in railroading.
2. The railroads' practice of actively recruiting the few graduates with rail transportation course work suggests that such individuals

are perceived to be potentially valuable and highly motivated additions to their professional staffs.

3. A mixture of academic programs and continuing education opportunities will be needed to respond to the broad array of railroad educational needs.
4. External teaching of railroad and rail-related subjects is a means of strengthening the industry's ability to innovate in response to a rapidly changing technological and business environment.
5. The expressed opinions of railroad management concerning the need for railroad specialists must be balanced against the fact that engineering and managerial philosophies which guided operations successfully years ago may no longer be valid.
6. Railroads actively utilize and support external educational programs, particularly those which complement their in-house programs, those which promise to enhance managerial effectiveness, and those disseminating new technological developments.
7. Some form of introduction to the railroad industry--its characteristics, uniqueness, demanding nature, problems--should be available to individuals considering it as a career.
8. Cross-pollination of disciplines, whereby engineers comprehend and, therefore, can deal with the realities of economics and business, and vice versa, is desirable for decisionmakers at all levels of railroad management.

In view of these conclusions, 4 possible forms of Federal assistance which will materially aid railroad education are recommended: (1) short courses; (2) curriculum enrichment; (3) university research; and (4) fellowships.

Short courses would take 1 week in duration and would encompass between a university quarter's and semester's work. Four specific short courses not presently available are recommended: (1) basic transportation; (2) surface transportation; (3) railroad transportation; and (4) railroad engineering. In addition to these, advanced courses of shorter duration focusing on specific technical and managerial subjects should be developed.

The recommended courses would be taught at a junior-senior university level. They would be designed for two groups: (1) recent graduates or those entering their senior year who are interested in entering the railroad industry but who

have not been able to learn much about it either through college courses or work experience; and (2) individuals already in the railroad industry who management feels should broaden their knowledge and outlook as a basis for future promotion (for example, orienting a union member with management potential to management's approach to problem solving and decisionmaking). Ideally, the courses would alleviate the potential shortage of railroad managers for the coming years, by making college graduates more attractive to rail recruiters for hiring into entry-level management positions and by retraining promising personnel already on the rail property for promotion into management positions.

The researchers recognize the need for a certain degree of professional uniformity in the presentation of the short courses. This requirement is one reason for the direct involvement of the Federal Government in putting on the programs. For example, they could be offered by the FRA or under a program similar to the National Highway Institute. In view of the rail industry's attitude toward Government involvement in activities directly or indirectly related to it, however, the programs should be organized and presented under the auspices of one or more properly accredited colleges or universities. The Department of Transportation (DOT) would establish uniform minimum standards to be met and would arrange whole or partial funding of the courses until such time as they become self-supporting, or until a decision is made that FRA will sponsor a continuing rail education program, similar to the transit and highway offerings of the Urban Mass Transportation Administration (UMTA) and Federal Highway Administration (FHWA), respectively.

Depending upon which specific expense categories are included, the cost to present a 5-day course involving 30 participants will vary from \$10,000 to \$40,000; the latter figure includes course development costs. This estimate excludes the cost of participant travel and per diem, which would average about

\$500 per participant. Most railroads are willing to underwrite these costs for worthwhile programs. The FRA might want to consider funding this for Government employees.

These estimated cost levels are the principal argument for initial Federal support. Some of the desirable and recommended courses are experimental in nature, and most universities or other offerors would be reluctant to commit significant development resources to them. Federal funding would thus accelerate the course development process and would keep attendance costs low enough to encourage participation by a wide range of people, including personnel of marginal and bankrupt railroad companies, rail planners employed by Federal, State, and local Government agencies, and individuals interested in entering the railroad field. The railroads themselves do not fund external course development efforts but rather support them by sending paying participants. Hence once the courses are operating, they could be supported by attendance fees. In this instance, FRA should consider continued funding of attendance costs for public employees and other eligible individuals.

The rail industry strongly favors assistance to existing university programs for maintaining and enhancing their coverage of the rail mode. This would have the benefits of keeping the university community involved in the future of the railroads and of maintaining the relevance and technical accuracy of university rail-related education and research programs. Funds channeled to university faculty members to improve the railroad content of transportation course offerings would be used for salary support, student assistants, support staff, travel to various railroads and to rail-related conferences, materials, and small exploratory research efforts. In essence, this program would establish one or more "minichairs" in rail (or perhaps surface) transportation. The trucking and package express industries and a few other segments of the transportation industry,

currently support university professorships. The FRA should explore developing similar programs for the railroad industry, perhaps in cooperation with the Association of American Railroads (AAR).

Curriculum enrichment funding will be attractive to universities if there are some assurances of continuity. Universities are somewhat reluctant to accept program specialization in the face of possible funding curtailment each year. This is less of a problem if established programs with existing rail coverage are selected for support. Funding needs vary directly with faculty salaries and with the percentage of program commitment that the FRA is willing to invest. Typical annual funding for an enrichment program large enough to have an impact will cost approximately \$40,000 per recipient per year. The railroads have indicated their willingness to make available data, case studies, guest speakers, and similar resources, but have not shown any interest in providing funding. Involvement of the AAR in program development could be instrumental in changing this.

All segments of the rail industry support the idea of a federally sponsored university railroad research program. There are precedents and guidelines for FRA to follow in establishing a university research program, including those of the Office of University Research (OUR) in the Research and Special Programs Administration. There is also considerable sentiment among the railroads for enlisting the aid of the AAR to help ensure the relevance of the research and to provide access to industry data. Railroad research projects at universities are most effective if funded for a period of 1 or 2 years and involve several faculty members and students. Annual funding requests in the range of \$60,000 to \$120,000 would be typical.

DOT already funds some university railroad research, under the auspices of the OUR program. However, rail research proposals must compete with projects in all

areas of transportation for the limited OUR funds. Further some meritorious rail research may be too specific to justify OUR support. Universities are sometimes successful in competing for FRA research contracts, but these often lack the long-term commitment and flexibility which are prized elements of university research. The research sponsored by the AAR is highly problem-oriented and often short-term, which is incompatible with most university programs. For these reasons, a special university railroad research program is necessary if this avenue for improving academic programs is pursued. It has been the experience in other transport specialties that this option is highly effective; research increases faculty involvement, interest, motivation, and competence, which, in turn, leads to improved undergraduate and graduate courses and to new short courses. In view of the benefits to the industry, a joint FRA-AAR university research program would be appropriate.

Grants for railroad education could be made directly also. A program of support to individual graduate fellows would require funding of \$7,000 to \$12,000 per year per fellow, depending upon the level of tuition and fees. Again, there are existing models for the FRA to follow. Both FHWA and UMTA sponsor fellowships. Their enabling legislation and program guidelines can be useful in structuring a similar program for the FRA. Railroad funding of graduate study is extremely rare, since individual railroads find it difficult to grant an employee a full year of leave and are concerned about losing the employee after they have paid for the employee's education. Yet the industry as a whole benefits from the advanced education of its professionals. This is a strong argument for Federal funding of railroad fellowships or, for that matter, for funding of the university programs described above.

In summary, a well-coordinated, Government-funded program consisting of (1) short courses targeted to entry-level professionals, (2) university curriculum

enrichment, (3) university railroad research, and (4) fellowships for studies in rail management and engineering will meet the educational needs of the railroad industry. Annual funding of \$1 million would support any one of the following (although combinations are obviously preferable): 40 1-week short courses; 25 rail transportation professorships; 15 university research projects; or 100 graduate fellows. Such a program would do much to provide railroads with the future talent needed to perform effectively.

I. INTRODUCTION AND RESEARCH PROCEDURE

INTRODUCTION

The railroad industry in the United States is confronted with serious challenges as it enters the decade of the 1980's. While several carrier components are financially stable and able to serve the shipping public effectively, the largest railroad, Consolidated Rail Corporation (Conrail) is dependent upon substantial Government assistance for continued survival. Several other major lines are either bankrupt or only marginally profitable. Overall, the industry earns less than 2 percent on its investment.

At the beginning of 1980, however, events occurring primarily outside the control of rail management will affect the industry significantly. One is deregulation in an economic sense, not only of the railroads but all surface transport involved in the movement of freight. The other is the energy shortage; the relatively fuel-efficient railroads may have the opportunity to regain former traffic and to attract new traffic if they can meet satisfactorily the service demands of shippers.

Despite what appears to be an improving financial climate for the industry, railroad observers have questioned the capability of railroad management to take advantage of the new opportunities. These doubts are shared by Government regulators and planners, shippers, academicians, consultants, and investors. The low rate of return generated over almost 3 decades and what to an outsider appear to be dated operational and marketing philosophies are two reasons for this doubt.

Looking ahead, sources for the development of future railroad managers and engineers have attracted the attention of those related, either directly or

indirectly, to the industry. Are current personnel sources adequate for the coming decade?

The Railroad Educational Needs Study deals with current and future industry managerial expertise. Specifically, its goals are: (1) to determine the extent of the need for future qualified managers and engineers in this country's railroad industry; (2) to determine whether existing educational programs, howsoever sponsored and in whatever form, can meet this need; and (3) assuming a shortfall, to recommend one or more means by which to resolve the deficiency.

The creation of an expert panel to review the work is included in the project.

The study was divided into six tasks, as follows:

- Task I: Determine needs in the railroad industry for specific educational background in management and engineering.
- Task II: Survey existing engineering, interdisciplinary and management educational programs relating to the railroad industry.
- Task III: Outline alternative engineering, interdisciplinary, management programs, short courses, seminars, at the undergraduate and graduate level, suitable to meet the identified needs of the railroad industry.
- Task IV: Develop an implementation plan.
- Task V: Project evaluation and review by railroad industry representatives.
- Task VI: Provide interim task reports and a final report.

In presenting the study results, the researchers have modified the order of the tasks in the following manner.

Part I introduces the study and outlines the research plan together with the researchers' reasoning in placing a heavy emphasis on the interview method of gathering data.

Part II presents and initially analyzes the results of the research. It presents measures of the demand for future railroad management both quantitatively, through the use of statistics, and qualitatively, through the interview process.

Part III describes and evaluates existing educational programs that directly affect railroad management. As such, it discusses the supply of education available to meet the demand covered in Part II. From Parts II and III discussion logically evolves Part IV, the researchers' recommendations for future Government participation in railroad education.

Part IV includes specific courses of action one or more Government agencies may take to strengthen railroad education in this country, together with the justification for these recommendations and a suggested plan for implementing them.

RESEARCH PROCEDURE

Primary research sources are: (1) interviews with members of the railroad industry, State Governments, colleges and universities, industry associations, consulting firms, and various other agencies; (2) solicited materials on railroad in-house and outside educational programs offered and/or supported by the carriers; (3) railroad statistics reported to Government agencies primarily the Interstate Commerce Commission, and compiled by the Association of American Railroads (AAR); and (4) a review panel charged with scrutinizing the study results, conclusions, and recommendations.

INTERVIEWS

Because of the exploratory, somewhat open-ended nature of the study, the researchers decided at the start that the interviews should constitute the primary study resource.

The interviews were held throughout the contract period, but primarily December 1978 through June 1979. In all, interviews were held with over 90 persons representing 35 companies, associations, and educational institutions, 15 of which were railroads. The complete list is shown in Appendix A.

Prior to the interviews, a series of probe areas appropriate to the study were formulated. These are shown in Appendix B. The possibility of inquiries being deficient in some way was recognized; consequently, an important part of the interviews involved asking the interviewees what they thought should be discussed in addition to the probe areas already included.

Interviews were held both privately and in groups, whichever the person interviewed believed would be most effective. Generally, the interviewer sought to determine what the individual or individuals perceived to be the rail industry's present and future management needs in operations, engineering, and marketing and the degree of difficulty that would be involved in successfully meeting these needs.

The researchers asked about exact qualifications sought by the carriers in hiring and promoting future and present managers, whether these requisites for entry-level management were being met adequately by the educational system (especially higher education), and what those interviewed believed would be the ideal educational background for future rail managers.

The selection of the railroads and personnel within the companies to interview was a function of budget constraint and the degree to which the researchers were acquainted with managers of the carriers. That is, there was no requirement or intent to obtain a random sample. Rather the relevant experience and expected candidness of the personnel interviewed were the primary selection criteria. References provided by the FRA monitor and her colleagues also were helpful.

In choosing individuals, a careful attempt was made to include managers who worked with and were responsible for recent employee training for future management responsibilities--not those persons who carried out the hiring per se. As a result, fewer than 15 percent of those interviewed were involved directly in personnel and related activities.

SOLICITED MATERIAL

Although, the interviews constitute the primary source of information in the study, a wealth of material regarding existing educational programs from the railroads and other private and public agencies connected with them was collected.

STATISTICS

Railroad statistics, as compiled and published by the AAR, primarily were used to determine, in as quantitative a method as possible, the managerial needs of the rail industry in the decade 1980-1990.

REVIEW PANEL

The draft final report was distributed for review to six representatives of three railroads, two universities, and one other agency. These reviewers were selected on the bases of their railroad experience, interest in the subject, and perceived potential for providing a candid and prompt review. Their comments and suggestions are incorporated in this document as are those of several other reviewers contacted directly by the FRA.

The researchers believe that the degree of emphasis on the potential study sources of information was basically correct and that their data collection procedure was successful. Further evaluation of this task is included throughout the report.

II. RESULTS AND ANALYSIS OF THE RESEARCH

THE NEED FOR FUTURE RAILROAD MANAGEMENT

Appendix C presents data on railroad employment, output, and productivity for the years 1971-1978. These data provided a basis for estimating future rail management needs. The data show that the total number of executives, officers, and staff varied between 16,000 and 17,000 for the study period. The ratio of general office executives to total management has been declining steadily, from 42.4 percent in 1968 to 35.7 percent in 1977.

Appendix C also displays total management-staff compensation as a percent of total freight revenues. For the period (1971-1978), this percent figure is surprisingly consistent--being 2.5 percent for 4 years, the figure for the remainder did not vary from this percentage by more than 0.2 percent.

ESTIMATING NEEDS

Interviews with railroad management brought forth agreement that from two-thirds to three-quarters of top and middle management would have to be replaced in the coming decade. If it is assumed that 16,500 is an average yearly number of managerial and staff people, then two-thirds replacement in 10 years means a total need for 10,720 people, or 1,072 yearly; a three-quarters replacement means a total of 12,375 individuals, or 1,238 yearly.

The yearly figures assume an even replacement rate over the decade. Persons interviewed indicated that such an assumption might be heroic. It is anticipated that a majority of the replacements could be required as early as

5 years down the road. Such a development obviously would increase the yearly replacement needs substantially.

Not surprisingly, the degree of replacement needs varied among the carriers; but only rarely were any actual figures quoted. What numbers were discussed were treated as confidential. It was agreed by virtually all rail people interviewed that a substantial number of individuals with managerial capability would be needed by the industry in the next decade.

MANAGERIAL PRODUCTIVITY

Appendix C indicates trends in managerial productivity for the period 1971-1978. It can be argued that changes in one or more trends reflect changes in the quality or capability of rail management.

The results indicated a slight increase in managerial productivity over the period 1971-1978. Increases in (1) revenue ton-miles, (2) freight-train miles, and (3) loaded car-miles generated per managerial-staff person are registered. Total labor productivity also increased in all cases for the period which also indicates an improvement in managerial capability in the last several years.

When output is compared with salaries of management people and total employees, as expressed in 1978 dollars, the changes in productivity reflect favorably upon management over the period. Productivity increases in every case, for both employment categories.

SUMMARY

A definite need exists and will continue to exist in the next 5 to 10 years for replacement railroad management; however, an exact determination is impossible. It could vary from over 1,000 to 3,000 per year. As for the need for increases in managerial and total employee productivity, in terms of both numbers

of people and compensation paid (in 1978 dollars), output per unit of input has increased encouragingly for the 1971-1978 period, indicating that the quality and capability of rail management has been maintained, perhaps improved, during the 1970's.

VIEWS OF THE RAILROAD INDUSTRY

The researchers interviewed 66 employees representing 15 carriers. The researchers believed that the views of these individuals regarding future Federal Government participation in railroad education constitutes the greatest contribution of this study to the literature. From all indications, those interviewed were candid regarding the questions asked, and all appeared interested in the study and sympathetic in terms of what it seeks to accomplish.

The researchers determined in their early planning sessions that their inquiries should attempt to answer such questions as:

1. The extent of current and future rail industry needs for engineering, operations, and marketing managers;
2. The degree of specialization in railroad subjects preferred by the industry when recruiting future managers and engineers;
3. The industry's preference for in-house training vis-a-vis externally operated training programs, possibly fostered by one or more Government agencies; and
4. The effect of the overall railroad image of decline and marginal financial status on hiring at the entry management level.

Every interview included these topics of inquiry, although not necessarily in the above order. The majority opinion (for on no one subject was there unanimous agreement) is presented below. This is followed by the researchers' evaluation and interpretation of the railroad opinions.

CURRENT AND FUTURE MANAGEMENT NEEDS

For the industry as a whole, 50 percent of the current work force is scheduled for retirement in 10 years (Modern Railroads, April 1978). The process has been accelerated for nonmanagement personnel in recent years through various early retirement programs established by the carriers. Similar programs for management will be instituted, thereby hurrying the day when replacements will be necessary. But while those interviewed agreed that there would be a substantial need for managers at all levels of the industry in the coming years, they also were in virtual agreement that the industry would be capable of providing its own replacements without any direct Government assistance. What forms of indirect assistance might be of value are covered in the next section.

SPECIALISTS OR GENERALISTS?

Railroads hire two types of college graduates on the bachelor's level--(1) engineers (primarily civil, but also mechanical and electrical), and (2) graduates with degrees in virtually every other field of study. In terms of engineers, only one carrier, Consolidated Rail Corporation (Conrail), had difficulty hiring all the civil engineers for which it had available positions, but this reflected its abnormally high requirements during the current period of widespread, substantial right-of-way rehabilitation. All carriers had difficulty hiring the required number of mechanical and electrical engineers, but this merely reflects a nationwide shortage of such individuals and was not limited to the railroad industry. No one had any recommendations for increasing the numbers of available engineers.

In the second category, which includes business, liberal arts, and all remaining majors, the carriers were confident that they could hire the needed number of graduates. In fact, in many instances the graduates contacted the

railroads for employment and not vice versa, as might have been expected. This was particularly true in the case of marginal or money-losing carriers where the evident challenge or cause of providing rail service under difficult circumstances attracted employment candidates.

Particularly surprising was the carriers' stated preference for hiring generalists as opposed to specialists. This preference was extended to both engineers and all other graduates. Thus, a civil engineer did not require courses in railroad engineering and a business graduate would not need railroad or transportation courses as a prerequisite for employment.

This is not to say that some specialized rail course work is not helpful as a means of informing candidates of the background and nature of the railroad business, especially in the case of liberal arts and other graduates without business backgrounds. Some amount of rail orientation can accelerate job training and can reduce employee dropouts, but any advantage of a specially trained individual over a generally trained person would disappear within a year's time or less on the job in the opinion of the managers. The carriers indicated a preference for teaching their new employees the railroad business by their own methods and with their own peculiar biases rather than having one or more outside educational agencies do it.

Some of the engineers interviewed also indicated a need for specialists in some areas. The prototypical civil engineering trainee for maintenance-of-way assignments would hold a bachelors degree with extra work in materials, soils, and management, and a preference for hands-on outdoor work. This is much the same type of person who is recruited by the construction industry. Several persons interviewed agreed that construction engineering or construction management graduates would be ideal candidates. However, in more specialized areas such as track structure, track-train dynamics, and equipment engineering, the benefits

of advanced education were recognized. In fact, one person interviewed pointed out his personal (successful) efforts to hire and retain engineers with master and doctoral degrees for certain positions.

Graduates with special rail training or experience are not generally available, a situation which causes some interesting substitutions. For example, one department supervisor hires marine engineers for locomotive work, because both areas include the principles of mobile diesel power.

The managers were concerned about the inability of college graduates to communicate effectively or to approach problem solving with a realistic, logical attitude and procedure. Ability to deal with people was another missing ingredient, but most of those interviewed admitted that this capability had to be learned primarily through on-the-job experience. One type of individual cited as coming equipped with management experience is the military officer electing to leave the military after 4 years.

With 1 or 2 outspoken exceptions, the managers felt that engineers should have a semester or quarter of business and economics instruction.

In summary, those interviewed were virtually unanimous, with important exceptions, in calling for a general rather than a specialized education on the part of their employment applicants. The process of special learning could be handled elsewhere, as is discussed in the next section.

IN-HOUSE VERSUS EXTERNAL RAILROAD TRAINING AND ORIENTATION

Of some surprise to the researchers was the extent to which the managers opposed the teaching of practical railroad material to new employees by any agency other than the rail industry itself. With the usual exceptions, the industry regarded external educational influences with suspicion, evidently fearing that

such teaching might vary from the policies and practices regarded as sacred by the individual firms involved.

In the exceptions to the prevailing opinion, some managers and engineers emphatically supported the concept of external teaching, primarily as a vehicle for promoting change in the industry. In one particularly informative session, a young operations manager compared the way in which rail freight classification procedures would be taught by a railroad and the way they should be taught. In the former case, the process would simply be described, accompanied by a visit to a classification facility. In the latter, the description and visit would be included; however, the procedure's effect on overall rail operations then would be analyzed, underscoring the implications of classification on each road's ability or inability to compete with other transport modes in terms of price and service. The fact that the procedure is extremely costly and causes delays and often unreliable delivery times should be acknowledged, yet traditional management probably would regard such an orientation as "rocking the boat" and, consequently, undesirable.

Few supported, and most opposed, an independent Government institution, whether established, operated, or supported by either private or public agencies. In the latter case particularly, the managers feared the inevitable politicizing of the agency, especially in view of capricious treatment by Government of the industry to date.

The alternative favored by several persons interviewed involved Government aid to colleges and universities to establish orientation courses in railroading or to integrated surface transportation topics. A major study area in railroading or transportation was not recommended. Again, the majority's preference for in-house intermediate and advanced training was reflected when dealing with teaching beyond the basic stages. One alternative consisted of financial support

for respected individual professors of general engineering or economics and business courses. These people would not teach railroad courses per se but would inject railroading into their offerings in the form of examples, their knowledge of and enthusiasm for the mode subsequently bringing about interest in it on the part of the students. The names of several professors were mentioned during the discussions.

Most railroad managers believe that the success of a Government-supported railroad educational institution of some type is doubtful. Unless backed by the industry, which might hinge on the school's willingness to teach only current practice, graduates would likely be spurned by the carriers. Consequently, only indirect assistance (such as support for basic rail courses or rail-knowledgeable professors) would be regarded favorably by the industry.

THE RAILROAD IMAGE AND ITS EFFECT ON HIRING AND RETRAINING EFFECTIVE MANAGEMENT

The importance of the railroad industry's public image in the hiring of future management was raised in virtually all interviews. Not surprisingly, the profitable carriers said the overall image was no problem. Interested students knew which companies were financially stable and so were not affected by the often accepted public view that all the roads were bankrupt. The marginal carriers did feel the image was a problem in hiring, but once that individual was employed, the problem disappeared. Of some surprise was the experience of the bankrupt and money-losing companies. The applicants sought those carriers. The challenge of what is considered a valid method of transport that currently finds itself in precarious financial straits attracts those individuals who seek responsibility early in their careers while simultaneously supporting a worthy cause. The sources of these applicants, on both bachelors and masters levels,

were impressive--the Ivy League and the Big Ten schools, as well as the top independent institutions.

At least a majority of those interviewed recognized the need to change traditional railroad policies in handling entry-level management. Long hours without overtime pay, 24-hour responsibility, assigned responsibility often without equivalent authority, stifling bureaucracies that discourage innovation, and forced moves around the system one or more times a year all contribute to a relatively high turnover rate among young managers and engineers. Furthermore, not only do the carriers have to satisfy the new employee, they also have to win the support of the spouse and the family. A few disagree--railroading would not change, the conditions would not be altered significantly. The problem merely consisted of finding the right people.

SUMMARY OF RAILROAD INTERVIEWS

Conclusions after interviewing 66 individuals employed by the railroad industry are:

1. The rail industry knows there will be a significant need for future management but believes it can resolve the problem itself.
2. Individual railroads are wary of extensive, external rail-oriented training programs, preferring to train in their own way so as to minimize the introduction of undesirable material, however defined, to new workers with management potential.
3. The rail industry's public image is not a problem when hiring by profitable carriers, can be a problem for marginal carriers, and, surprisingly, constitutes the least problem for bankrupt and money-losing firms due at least in part to the attractiveness of early managerial responsibility or the support of a worthy cause.
4. For all railroads, retaining worthwhile people will involve revising the traditional rail policies of exceptionally demanding work conditions, assignment of responsibility without commensurate authority, and stifling of innovation by top management.

THE SIGNIFICANCE OF RAILROAD OPINION

At this point in the report, the researchers offer the following conclusions regarding the opinions of rail management.

First, management's reluctance to accept managerial changes in operating and marketing policies and practices, particularly as advanced by relatively inexperienced employees, is very real. Any change is regarded with suspicion, much less that advocated by the newcomer to the industry.

Second, and this applies particularly to the relatively profitable carriers, the industry is suspicious of Government intervention in its affairs. While most companies welcomed the researchers, a few either failed to respond to the request for information or refused assistance outright.

Regardless of the companies' reasons for deciding to help or hinder the research, their attitude must be considered when evaluating various methods through which one or more Government agencies can aid future rail education. That is, the form of assistance should be accepted and actively supported by the industry if it is to be successful.

The railroad industry is still primarily privately owned and operated. The financial success of most of its member firms, at least to date, is not a function of Government subsidy. Thus, its management, traditionally independent and conservative, does not have to embrace governmental programs or the products of those programs, for example, graduates of a Government-operated educational institution.

Because rail rights-of-way remain privately owned for the most part, there is no opportunity for training individuals to build, maintain, and operate the rail infrastructure such as exists in highway, water, and air transport unless the industry wants to turn this responsibility over to Government. To date, it has shown little inclination to do so.

Thus, the opportunities for direct Government assistance to rail education are restricted, when compared to the other transport modes, and may be virtually nonexistent if the railroads choose. This is all the more reason that any proposed programs to enhance rail education must be acceptable to the industry.

The minority view is that external education and advanced training can contribute to solving current railroad engineering, operations, and management problems. This minority view should not be ignored when considering possible educational programs. Meeting this need while simultaneously generating industry support is the dilemma to be faced and resolved.

It is also important to realize that a strong reason for the railroads' stated preference for hiring generalists is likely to be the general lack of candidates with a railroad-oriented education rather than any inherent aversion to hiring specialists. The railroads realize that university programs for railroad professionals will quite likely never again be large enough to completely fill their demand for new managers and engineers, hence their recruiting and other personnel practices are designed to obtain qualified candidates with diverse backgrounds and train them in the railroad business.

Finally, it is important to recognize that most of present rail management, particularly at the middle levels where personnel decisions are made, are the products of an educational system with little opportunity for studying railroad or other transportation subjects. Hence they may not be able to fully appreciate the advantages to be gained from studies which will prepare a graduate to deal effectively with the emerging technical, economic, and regulatory changes which promise to radically alter the railroad business in the medium to long-term future.

The manifestations of changing circumstances for the railroad industry are numerous. The industry is being required on a daily basis to become more

responsive to the dynamic nature of the business of providing transportation service. Market conditions in the railroad industry and factors related to competition are undergoing a continual process of change, and the response of the industry to such change must be managed effectively by those having decisionmaking responsibility. In addition, the outlook for Government regulatory policy suggests that the economic structure of the railroad industry may be subject to change, again emphasizing the need to be able to react to change as it occurs. Another example is the area of technology, where new developments in signaling and communications, railroad power systems, traffic control systems, data processing, automation of rail yards, rail line electrification, intermodal equipment and services, and the performance of track systems under heavier loads require the attention of engineers and managers who are able to foster innovation. Hence the expressed opinions of railroad management concerning the need for railroad specialists must be balanced against the fact that engineering and managerial philosophies which guided operations successfully years ago may no longer be valid.

VIEWS OF RAIL PLANNERS

Rail planners in State Government, Federal agencies, and consulting firms have educational needs that differ from those perceived by the railroads. In general, these segments of the railroad industry have a greater need for university graduates with specialized training in rail transportation and in other surface transportation subjects.

STATE RAIL PLANNERS

State Government agencies involved in rail freight planning have a great need for experienced and skilled personnel. Unfortunately, there is a marked

paucity of such individuals within State transportation organizations. This problem is compounded because States generally cannot readily hire recent graduates with the requisite skills. Frequent personnel freezes and increasing resistance to establishing new programs are major factors. The inability of States to offer competitive salaries to new graduates, particularly those with masters and doctoral degrees, also contributes to the problem.

Those States in a position to hire rail specialists are interested in hiring people who have taken courses in rail transportation and in supporting subjects such as public policy, public administration, and operations research. Some State agencies have succeeded in attracting such people despite relatively low salaries because the individuals in question desire to acquire some experience in State Government. These people often advance rapidly or are lost to other segments of the transportation industry after a short time.

Because of the problem of attracting qualified personnel from universities and from the railroads, most State rail personnel enter the field from other areas. Typically, people who have been engaged in transit or highway planning, engineering, or administration are recruited to fill positions in rail planning. Because these individuals have little, if any, rail experience, there is a great need in the States for specialized short courses. Almost any aspect of railroading that could be covered by this means would find support among the States. For example, courses in railroad operations, railroad engineering, rail cost-accounting procedures, finance, rail regulation, and benefit-cost analysis were frequently mentioned.

Some States have filled rail positions by recruiting rail planners from other States. This is possible because the rail operation in most State transportation agencies is small. When an individual becomes experienced (the supervisors typically have not been on the job very long), there is little opportunity

for advancement within the rail portion of the organization. Such individuals, therefore, become prime candidates for open positions in other States. This mode of operation is clearly a short-term solution and results in a situation where those States which are able to hire new graduates become the training centers for the entire State rail planning community.

It was implicit and sometimes stated in the interviews conducted with railroad managers that they would favor a program to provide for the education of State rail planners. The railroads must interact with the States in implementation of the Railroad Revitalization and Regulatory Reform Act, and railroad representatives alluded several times to the needs of State personnel for greater railroad experience and education.

FEDERAL AGENCIES

Federal transportation agencies have less problems in hiring new employees than do State agencies. Federal salaries are competitive with those available in the private sector. The relatively small size of the rail agencies and their newness create opportunities for the rapid advancement and large responsibility that many new graduates seek. The Federal agencies are particularly active in recruiting recent graduates with masters or doctoral degrees with a specialty in transportation. Civil engineering and business school graduates most often are recruited for these positions. As one Federal representative stated, they are recruiting an "industrial civil engineer," that is, someone with an engineering education but with additional course work in transportation, operations research, economics, and policy analysis.

Federal agencies will recruit heavily from any advanced transportation studies program they find to be of high quality. Federal agencies also will be active in supporting continuing education efforts and will send large numbers of

their staff to such educational offerings. This is an excellent way for Federal personnel to interact with State planners, railroad company employees, and the academic community.

CONSULTING FIRMS

Consulting firms are the least constrained of any segment of the industry in terms of their ability to attract and hire qualified personnel in the rail area. Because of the diverse nature of consulting practice, these firms are active in recruiting people from transportation and operations research programs in the universities. Consulting firms basically want well-rounded individuals with superior analytical and communication skills. They recruit from the same programs as those described for the Federal agencies. In fact, it is not uncommon to encounter rail specialists who have worked for both consulting firms and the Federal Government.

A consulting firm would be most interested in hiring someone with a general transportation background and some rail course work or research experience, particularly if that consulting firm has a modest-to-large railroad practice. If the railroad practice becomes large enough, the firm will find it advantageous to hire an individual with a more extensive rail background, but such an individual usually must be lured away from a railroad.

Consulting firms, generally, have not been able to attract the type of people they want from railroad companies. They do not want to hire a person retiring from the rail industry. Qualified junior railroad personnel are difficult to hire because those who are highly talented are recognized by the railroads and are compensated well enough and promoted fast enough that they are not interested in leaving the railroad. Those who do want to leave the railroad are often "rail fans" who are disenchanted with the industry after a short time of

employment there. This is not universal, but these are the facts as commonly perceived by consulting firms that work in the rail area.

In summary, consulting firms would be expected to be heavy recruiters of college graduates at all levels who have had specialized education in the railroad industry.

III. SURVEY OF EXISTING ENGINEERING, INTERDISCIPLINARY, AND MANAGEMENT EDUCATION PROGRAMS RELATING TO THE RAILROAD INDUSTRY

This portion of the report focuses attention on the identification of educational programs, courses, or seminars that pertain directly or are applicable in a broad sense to the area of railroad transportation. Included are programs offered by universities, railroads, equipment suppliers, and consulting firms or associations. The purpose is to develop an understanding of the extent to which rail-oriented educational programs are in evidence, thus providing a firm basis for recommending the types of programs that should be developed or reinforced to meet the projected needs described previously.

RESEARCH METHODOLOGY

Primary information sources for this phase of the project were published articles and other references, knowledgeable persons interviewed, and responses to a number of letters requesting recommendations for programs to include in the study. Additionally, two education-related surveys conducted previously by others provided insight into the issues being considered.

Although there is no overabundance of literature pertaining to railroad education in general or to rail-oriented educational programs specifically, several references were found to be quite useful. They include the following, all of which have been reproduced in Appendix D:

Bartley, Robert D., "The Training Scene: Busy and Getting Busier," Railway Age, February 25, 1974, pp. 18-21.

Ichniowski, Tom, "Southern Harvests the Colleges," Railway Age, March 27, 1978, pp. 41-42, 44.

Shaffer, Frank E. "Who Will Run the Railroads?" Modern Railroads, April 1978, pp. 36-39.

Of related interest are an editorial and a number of letters regarding railway education published in the December 1977 and April 1978 issues of Railway Track and Structures. Included among the authors are several well-known academicians and industry personnel with an interest in rail education.

Also relevant are the minutes of two meetings held at the Transportation Research Board (TRB) on June 5 and August 16, 1978, respectively, which pertained to the topic of railroad educational needs. Representatives from 5 universities, 3 Class I railroads, the American Railway Engineering Association (AREA), the Association of American Railroads (AAR), the Federal Railroad Administration (FRA), and TRB attended these meetings. Appendix E includes copies of the minutes of those meetings. Finally, the Department of Transportation in 1976 published a volume titled Directory of Transportation Education, which, although generally considered to be incomplete is of some value in identifying transportation programs.

As indicated previously, personal interviews were used to gather a variety of information and ideas regarding railroad educational needs. Included among the various persons interviewed (see Appendix A) were a number of university faculty members and others engaged directly in the provision of relevant educational programs. Many of those with whom discussions were held were able to supply sample course outlines and other related materials, as well as recommendations of what other programs should be surveyed. It was interesting to note also that many valuable suggestions and references were made available as a result of interviews with representatives of nonacademic groups. Personal interviews were a useful component of the study methodology.

Letters formally requesting project-related information were sent to a large number of representatives of academia (119), railroads (39), equipment suppliers (50), and a lesser number of consultants and other interested individuals.

Appendix F contains sample copies of the respective personal letters and listings of the particular persons to whom such requests were sent. The information which was gathered proved to be a valuable complement to that made available previously.

Three comprehensive survey-oriented studies were of interest. The first was a series of questionnaires sent by AREA Committee 24. Included was a survey titled "Undergraduate Curriculum Related to Railway Engineering" which was sent to 99 schools and a survey titled "Evaluation of Recently Graduated Civil Engineers" which was sent to 22 railroads and 23 consulting firms. Second was a study titled "Industry Evaluation of a Transportation/Logistics Curriculum" which appeared in the Fall 1977 issue of Transportation Journal. While the major focus of the research effort was on obtaining corporate evaluations of Transportation and Logistics curriculum offerings at The University of Tennessee, a number of rail-oriented courses were considered by the respondents. Copies of the AREA studies and The University of Tennessee study have been placed in Appendixes G and H, respectively.

Another source of program information was a reference guide published recently by the National Council of Physical Distribution Management, in which 450 schools responded to a survey regarding their respective curriculum offerings in the area of transportation and physical distribution. (This source of information is covered in greater detail in a subsequent section of this report.)

ORGANIZATIONAL FORMAT

To provide structure to the discussions of the programs, courses, and seminars which are currently offered, the following basic outline was developed:

1. Degree Programs--Engineering
2. Degree Programs--Management
3. Degree Programs--Interdisciplinary
4. Company Programs--Railroad In-house
5. Company Programs--Equipment Supplier
6. Seminar Programs--General
7. Seminar Programs--Specific

The degree programs noted in this study will be limited to those offered by colleges and universities throughout the United States. Both regular and cooperative educational programs will be considered. Alternatively, company programs include both those offered internally by domestic railroads and any which have been developed by suppliers of equipment to the rail industry. Finally, seminar or workshop programs may be offered by any of the groups under study. Included as possible sources of such programs are educational institutions, equipment suppliers, railroads, consulting firms, and various associations.

RESEARCH FINDINGS

Prior to a discussion of available programs on a categorical basis, there are several findings which deserve attention:

1. There is no currently existing authoritative source of information regarding educational programs related to the railroad industry.
2. Except for a number of highly regarded and visible programs, to be mentioned subsequently, the process of identifying lesser known educational programs is a hit-and-miss task at best.
3. While there are a great number of educational programs that deal with the topic of transportation in general, few are tailored specifically to the needs of the railroad industry. As a substitute, the claim is made frequently by program offerors that certain portions of subject content are applicable to the railroad industry or perhaps that the value to the railroad industry is implicit in the structure of the program.

4. The number of programs to receive consideration is diminished substantially by restricting attention to those engineering, interdisciplinary, or management programs, short courses, and seminars which are at the undergraduate and graduate levels. This is not a limitation of this study, but it does emphasize that a significant portion of those programs reported to be offered are not for managers but focus on providing tools and techniques for skilled and semi-skilled railroad employees.
5. There is no general consensus among rail industry executives as to what are the educational needs of the industry. For this reason, it is difficult to claim that any of the courses or programs to be discussed are of such overriding importance that the industry could not continue to function effectively in their absence.

The specific topical discussions that follow will indicate the importance of these various points as appropriate.

DEGREE PROGRAMS--ENGINEERING

The extent to which most colleges of engineering can devote specific attention to engineering aspects of railroad operations is somewhat limited. For example, the AREA Committee 24 survey of 99 schools regarding undergraduate curricula related to railway engineering (see Appendix G) found that even at the small percentage of schools covering the subject only an average of 4.43 semester-hours of elective courses are offered. No required course work pertained to the topic of railway transportation engineering. Part of such diffusion is due to the fact that, while the most appropriate discipline for coverage of railway engineering topics is civil engineering, most schools also offer programs in industrial, mechanical, electrical, and aerospace engineering. The area of civil engineering frequently is segmented into structural, environmental, water resources, geotechnical, and transportation engineering. Finally, the latter area is subdivided into planning and traffic engineering, leaving little flexibility to accommodate formal offerings in railway engineering. It is possible, however, that the national attention given to the generally deteriorated condition of the track and roadbed of many railroad physical facilities will

encourage a greater relative academic interest in railway engineering at the expense of the current attention directed toward topics related to highway construction.

There are a number of schools offering formally developed courses in railway engineering. Included are the following:

Bucknell University
Carnegie-Mellon University
Delaware, University of
Kentucky, University of
Maryland, University of
Massachusetts Institute of Technology
Pennsylvania, University of
Pennsylvania State University
Purdue University
Texas A&M University
Virginia, University of
West Virginia University

Principal texts suggested for use in railway engineering courses include the following:

Hay, William W., Railroad Engineering, Volume 1, John Wiley and Son, Inc., New York, New York, 1953.

Raymond, William G., Henry E. Riggs, and Walter C. Sadler, Elements of Railroad Engineering, John Wiley and Sons, Inc., New York, New York, 1947.

Armstrong, John H., "The Railroad, What It Is, What It Does," Simmons-Boardman Publishing Company, Omaha, Nebraska, 1977.

A number of persons contacted cited the lack of current textbooks in the "hard" areas of railway engineering as a serious problem. Professor Hay is revising his text, but others are unlikely to appear without the impetus of new railroad education programs.

A reference from the Illinois Institute of Technology indicated that, while no courses currently are offered which are devoted exclusively to railway engineering, a number of research projects are available for graduate and undergraduate students in mechanical engineering. Specific topical areas include:

wheel-rail interaction, friction, wear, creep, noise; wheel stress analysis, fatigue, and fracture; railroad car dynamics, computer analysis, and physical models; and experimental stress analysis.

Although the University of Illinois did offer a degree program in railway engineering, the program was discontinued upon the retirement of Professor William Hay, and for a time, there was no program available anywhere in the United States leading to a degree in that area. For the purpose of providing examples of railway engineering course descriptions, Figure III-1 shows the catalog description of the courses formerly offered at the University of Illinois.

It has been announced recently that the University of Delaware is offering a new program in Railroad Engineering leading toward the degree of Master of Civil Engineering. Program participants are expected to take courses in: Design, Analysis, and Maintenance of Railroad Tracks; Analysis of Continuously Supported Structures; Vehicle Dynamics; Soil Mechanics; Metallurgy; Economics; and Management. The new program is under the direction of Professor Arnold D. Kerr of the University's Department of Civil Engineering.

Professor A. J. Reinschmidt of the Department of Civil Engineering at The Pennsylvania State University (a former student of Professor Hay) offers a comprehensive 2-course sequence in Railway Engineering, with topical coverage devoted to Track Structures and Terminal Systems in the first and Railway Operating Systems in the second. Subject matter coverage of each sequence is provided in Figures III-2 and III-3, respectively. The content is representative of the coverage which industry representatives would expect in such a course or courses. Additional topics suggested for inclusion were: overview of the domestic transportation system; historical development of rail transportation; an analysis of the existing regulatory framework within which the railroads

335. Railway Construction and Maintenance. Loads and load distribution on track and subgrade; roadbed construction and stabilization; track stresses, design and materials; turnouts and crossings; and maintenance programs. Prerequisite: Senior standing or consent of instructor; credit or concurrent registration in Civil Engineering 230 for those with a minor in railroad or transportation engineering. 3 hours, or $\frac{1}{2}$ or 1 unit.
336. Railway Location and Operation. Influences of traffic, alignment, distance, gradients, and motive power upon operating expenses; mechanics of train operation; and economic design of location. Prerequisite: Senior standing or consent of instructor; credit or concurrent registration in Civil Engineering 230 for those with a minor in railroad or transportation engineering. 3 hours, or $\frac{1}{2}$ or 1 unit.
337. Signals. Train movements; systems of signals; track circuits; track capacity; interlockings; and economics of signaling. Prerequisite: Senior standing or consent of instructor; credit or concurrent registration in Civil Engineering 230 for those with a minor in railroad or transportation engineering. 2 hours, or $\frac{1}{2}$ or 1 unit.
338. Terminals. Design, location and operation of freight terminal facilities for rail, highway, air and water carriers; passenger terminals; special terminal requirements for specific commodity categories; and coordination with and relation to land use and urban planning. Prerequisite: Senior standing or consent of instructor; credit or concurrent registration in Civil Engineering 230 for those with a minor in railroad or transportation engineering. 3 hours, or $\frac{1}{2}$ or 1 unit.
435. Railway Construction and Maintenance. Roadbed load capacity; economic design of track; advanced geometric design; economics of maintenance; grade crossing separations; and review of specific projects. Prerequisite: Civil Engineering 335. 1 unit.
436. Railway Location and Operation. Track and traffic capacity; optimum train size, performance and scheduling; validity and accuracy of current practices; regional operating factors; and optimum size of plant and modern location. Prerequisite: Civil Engineering 336 or consent of instructor. 1 unit.

Source: University of Illinois

FIGURE III-1. RAILWAY ENGINEERING COURSE DESCRIPTIONS
FORMERLY USED AT THE UNIVERSITY OF ILLINOIS

Introduction to Course, Track Analysis: nature of track structure, origin, development, stresses in track. Talbot's Approach, track as continuous, elastically supported beam

Track Analysis Cont'd., subgrade stability: design and construction requirements for a stable track and subgrade structure

Subgrade Construction and Soil Selection: methods of subgrade construction, desirable characteristics of soils, also undesirable characteristics and what to do

Roadbed Stabilization: problems; theories of stabilization; methods of stabilization

Surface Drainage: need for,
Ballast: types, uses, specifications

Ballast: transmission of pressures; depth of ballast under tie; pressure at any point, stability, ultimate strength; cleaning

Cross Ties: design, bending moments allowable loads; stability; installation and handling; renewals

Cross Ties: life; cost; economics; other material

Rail: manufacture; design stress

Rail: design stress cont'd.; defects therefrom; shelly rail, corrugated rail, rail crushing and flow, transverse defects

Rail: defects cont'd.; rail life and economics

Rail: welded rail and rail joints

Rail: installation and relay procedures; rail maintenance

Track: standards and classification to tolerances, stability, FRA requirements

Track: maintaining line and surface; requirements and procedures

Track: tie plates, spikes, anchors

Turnouts: design theory, problems in application

Crossings:

FIGURE III-2. TOPICAL COVERAGE OF CIVIL ENGINEERING 427
TAUGHT AT THE PENNSYLVANIA STATE UNIVERSITY
(Track Structure and Terminal Systems)

Work Planning and Control:

Costs and Cost Control:

Costs and Cost Control: accounting requirements, cost items, RFE request, etc.

Right of Way Problems: land requirements, fencing, weed control

Terminals: introduction

Terminals: freight movement

Terminals: arrangements for service, types and elements of yards

Terminals: types of classification yards, typical configurations.

Classification Yards: throughput volume design considerations

Passenger Terminals, Engine Terminals:

FIGURE III-2 (Continued)

Introduction to Course: Basic Location Formula Economic Location Planning Procedures

Economic Evaluation: Traffic flow, Sources of Revenue

Costs: Capital vs. Operating Costs, Depreciable Property

Costs: Fixed vs. Variable, Direct and Indirect, Joint, Incremental Marginal and Avoidable Costs, Cost vs. Expenditures

Resistance: Types and Measures of Resistance

Resistance: Types and Measures of Resistance

Resistance: Roller Bearings, Davis Equation Revisions, etc.

Distance: Units and Measure of Cost, Short, Medium and Long Distance Effects

Gradient: Grade Resistance, Tonnage Ratings

Curvature: Review of Curve Geometrics, Superelevation, Length of Spiral

Curvature Cont'd. Sources of Curve Resistance

Motive Power: Concepts and Computation of Horsepower and Tractive Effort, Adhesion, Drawbar Pull

Motive Power: Gearing Coupling, Electrification

Motive Power: Economics of Motive Power, Tonnage Ratings

Economics of Ruling Grades: Ruling Grades, Variations in Cost with Traffic, Significance of Ruling Grades on Costs

Mechanics of Acceleration and Decelerations: Speed-Distance Equations, Computation of Speed-Pull-Distance-Time Curves

Mechanics of Deceleration: Stopping Distance Equations, Breaking

Deceleration Cont'd:

Problems in Gradients: Momentum Grades, Balanced Profiles

Problems in Gradients Cont'd: Velocity Head and Velocity Profiles

Velocity Profiles Cont'd:

Train Performance Calculators:

FIGURE III-3. TOPICAL COVERAGE OF CIVIL ENGINEERING 428
TAUGHT AT THE PENNSYLVANIA STATE UNIVERSITY
(Railway Operating Systems and Analysis)

Rise and Fall:

Sidings Stations and Branches:

Urban Area Problems:

Railroad Mergers: Types of Mergers, Their Effect on Operation

Operational Control: Time Interval Systems

Space Interval Systems:

Systems of Fixed Signals:

Track Circuits:

Automatic Signals: Track Circuit Control, Two and Three Block Systems

Automatic Signals: Signal and Double Track Systems, CTC, Cabsignals

Interlocking:

FIGURE III-3 (Continued)

operate; and emphasis on managerial, economic, and operating problems and opportunities in the industry.

Current development of an engineering-oriented railroad program at Bucknell University is being pursued by Professors Richard G. McGinnis, C. H. Coder, Sid Miller, and Dean Glenn Keitel. Besides a course offering in Railroad Civil Engineering, Bucknell currently offers a course in Railroad Mechanical Engineering, an outline of which appears in Figure III-4. Two additional courses, Special Topics in Civil Engineering and Civil Engineering Design, allow students to specialize in topics related to railroads.

Figure III-5 is a list of a number of suggested courses in railroad subjects which was prepared by a representative of the TRB. Included are two civil engineering courses, one each of mechanical, electrical, and industrial engineering, and three courses in transportation and railroad management.

It is interesting to note that the College of Engineering of The Pennsylvania State University is planning to offer an Associate Degree program in Railway Engineering Technology. The program is scheduled to be offered at one or more of the University's commonwealth campuses. Specific railroad-related courses to be included are titled Economic Railway Location and Geometric Design, Railway Track Maintenance and Operation, and Railway Track Structure Design and Construction.

Although there are no specific course offerings in the area of railroad engineering at Washington University (St. Louis), degree candidates in 2 particular areas of study have found employment generally in the railroad industry. The programs cited are the M.S. and D.Sc. degree offerings in the areas of fracture mechanics and computational mechanics. Another highly accepted program is the M.S. degree program in Transportation Safety offered at Central Missouri State University in Warrensburg, Missouri. Course offerings in Transportation

- I. The Train as an Energy System. (half of the course)
 - A. The Hirst papers on transportation efficiency.
 - B. Power required:
 - 1. Tractive forces considering rolling resistance and air drag as a function of size, weight, shape and velocity.
 - 2. Steady state power required.
 - 3. Power required on grades and curves.
 - C. Diesel and gas turbine powerplant performance:
 - 1. Full throttle power available versus drive shaft speed.
 - 2. Constant brake specific fuel consumption (brake thermal efficiency) as a parameter on power versus shaft speed plots.
 - 3. Performance of propulsion systems considering the best engine and electrical machinery transmission efficiencies.
 - D. Matching power required with power available.
 - 1. Freight car and passenger car payloads.
 - 2. BTU per ton mile and BTU per passenger mile estimates versus train velocity.
 - a. Steady state running
 - b. Grades
 - c. Curves
 - d. Accelerating
- II. Freight Car and Passenger Car Force Analysis. (one-fourth of the course)
 - A. The car in equilibrium considering various conditions.
 - 1. Empty weight and fully loaded.
 - 2. Steady state running.
 - 3. Grades and curves.
 - 4. Accelerating.
 - B. Component force analysis
 - 1. Wheels
 - 2. Bearings

FIGURE III-4. TOPICAL COVERAGE OF MECHANICAL ENGINEERING 337K
TAUGHT AT BUCKNELL UNIVERSITY
(Railroad Mechanical Engineering)

3. Couplers
4. Car structure
5. Cycling load histories

III. Component Design. (one-fourth of the course)

- A. Material strength properties. Safety factors.
- B. Stress concentration factors. Fatigue strengths.
- C. Member sizing considering fatigue.
 1. The car structure.
 2. Couplers.
- D. Bearing selection.
 1. Journal bearings.
 2. Roller bearings.

IV. Laboratory Projects. (scheduled throughout the semester)

- A. Diesel engine performance map with constant brake specific fuel consumption curves. Dynamometer testing.
- B. Diesel-electric performance testing using a dynamometer to simulate road loads.
- C. Fatigue strength reduction factors for component models.

V. Guest Lecturers. (scheduled throughout the semester)

- A. A chief railroad mechanical engineer.
- B. A locomotive engineer/designer.
- C. An operating railroad engineer.
- D. A design engineer from a car building firm.

VI. Field Trips. (scheduled throughout the semester)

- A. ACF, Milton, PA
- B. GE, Erie, PA
- C. Train operating experience. (a local railroad)

FIGURE III-4 (Continued)

These courses are new and are to be added to the presently available courses in the basic engineering disciplines and in business.

CE xxx Railway Civil Engineering, route location and economics, train resistance, tonnage ratings, gradients, earthwork, stabilization, drainage, ballast, rail, ties, track fastenings, turnouts, maintenance problems and procedures, environmental problems, safety, research problems

ME xxx Railway Mechanical Engineering, locomotive design, car design, couplers and draft gear, trucks, stability, power braking systems, track-train dynamics, environmental factors, safety, energy, research problems

EE xxx Railway Electrical Engineering, railway signaling systems, railway telecommunications systems, railway data and information systems, railway control systems, railway applications of electronics, electrification, electromagnetic interference, research problems

IE xxx Railway Operations and Planning, yard operations, train blocking and scheduling, power assignment, railway traffic control systems, railway supervision, the Power Brake Law and other laws, special services, unit train operations, bulk materials handling, logistics and physical distribution, research problems

xx xxx Principles of Transportation, (the basic course as taught in business schools, emphasizes the transport aspect of transportation)

xx xxx Economics of Transportation, (the basic course as taught in business schools, emphasizes the economic aspect of transportation)

xx xxx Railroad Business Practices, railroad freight rate structure, railroad accounting practices, purchasing and materials management, the Interstate Commerce Act and other laws affecting railroads, management information systems for railroads, interline shipments, labor agreements

CE xxx Urban Rail Transit Systems, system route layout, stations, scheduling, support facilities, electrification, fare collection systems, functional design of transit cars, signaling and control systems, safety, ventilation, interfaces, capacity planning, light rail transit, commuter rail service

The idea is that the student will graduate with a degree in basic engineering discipline and will have a railroad orientation due to having completed several of the above courses.

Source: TRB Representative

FIGURE III-5. SUGGESTED COURSES IN RAILROAD SUBJECTS

Safety include Transportation and Storage of Hazardous Materials, Management of Safe Transportation Systems, Transportation Laws and Regulations, and Innovations in Transportation Safety. Although awareness of the program at Central Missouri State University is more regional than national, it is representative of a number of highly specialized programs offered at colleges and universities throughout the country. Unfortunately, it is difficult to learn of the existence of such programs.

Prior to concluding the discussion of degree programs and courses in engineering aspects of railroading, it is interesting to note several observations made at the May 16, 1978, Railroad Educational Needs Meeting held in Washington, D.C., which dealt with the reluctance of many universities to expand or introduce course offerings in the area of railroading. Specific "obstacles" which were credited with preventing the proliferation of such courses are the following (see Appendix E for more detail):

1. Lack of funds to pay faculty for the time to develop course content (including the preparation of text and reference materials);
2. Lack of National Science Foundation support for curriculum development (cited by one university representative in attendance);
3. Limitations on faculty positions; and
4. Lack of external impetus.

Before moving to the topic of degree programs in Business Administration, it is appropriate to make a few comments regarding the value of cooperative programs as related to the educational needs of the railroad industry. An excellent method of education and recruitment is available to the railroad industry through the cooperative education program. Cooperative education may be defined as the integration of classroom theory with practical experience under which students have specific periods of attendance at the college and specific periods of employment. Cooperative education has existed for many years, and although the

railroad industry has participated in the program, it has not made full use of its opportunities.

The popularity of the cooperative education program is seen by its phenomenal growth during the past 2 decades. In 1950, fewer than 50 colleges participated in the program, but today there are over 400 colleges participating. This growth has occurred because the program benefits both the school and the participating industrial concern.

While the colleges implement the program in different ways, the most popular implementation is to send a student to a company after the completion of the freshman year. The student alternates semesters or quarters between work in the industry and study at the school for a period of 3 years while completing the sophomore and junior years. The senior year is completed with no interruptions at the educational institution. Upon graduation, the student becomes a candidate for employment and usually is offered a position by the cooperating company. This program gives the industry a chance to evaluate an employee in a working situation; therefore, the choice to retain the new graduate is based on a 3-year period of work performance.

The past year (1979) was one of the most competitive years for new engineering, business administration, and accounting graduates. The graduates received 40 percent more offers for placement than they did in 1978. The competition for graduates has become intense. The cooperative program tends to iron out the peaks and valleys in recruitment, because there is a 3-year period for the student to learn about the company and to develop a loyalty. There have been some complaints from industry that, after investing 3 years of training in a student, the student does not select that company for employment. There is attrition, but under the program, many loyal employees are developed, and those who do choose their cooperating industry make excellent lifetime employees.

The Cooperative Education Association has compiled a list of advantages for the cooperating organization, educational advantages to the student, and advantages to the school. Advantages for the cooperating organization are:

1. The student can learn established employer practices and organization while still at the formative level.
2. The program is an excellent source of temporary and potentially permanent manpower.
3. The infusion of bright young people coming from an educational environment into an organization can provide new ideas and viewpoints which can be refreshing and stimulating.
4. Most cooperative programs are developed to allow continuous job coverage so the employer usually does not have to be concerned about job continuity.
5. The cooperative student serves as a "goodwill ambassador" for the cooperating organization with faculty and other students upon returning to the campus.
6. A mutually important industry-college relationship is enhanced.
7. The cooperative program provides the company with a low-cost training program, because the cooperative students generally earn salaries below the average salaries paid to graduates; they more nearly "earn" their salaries at the beginning stages of professional employment.

The educational advantages to the student are:

1. By coordinating work experience with the campus education program, theory and practice are more closely integrated; students find greater meaning in their studies.
2. This coordination of work and study increases student motivation. As students see connections between the jobs they hold and the subjects they are learning on the campus, greater interest in academic work develops.
3. For many students, work experience contributes to a greater sense of responsibility for their own efforts, greater dependence on their own judgments, and a corresponding development of maturity.
4. Because the work experience involves the student in relations with co-workers who come from a variety of backgrounds, and because success in these jobs requires constructive relationships with colleagues, most students in cooperative education develop greater understanding of other people and greater skills in human relations. (In interviews with the railroads, several expressed a clear desire that their employees be especially skilled in human relations.)

5. Cooperative education helps markedly to orient college students to the world of work.

The advantages to the school are:

1. The establishment of a relationship with the cooperating organization can reduce the "isolation" of the college and can result in a better rapport with the commercial community.
2. The faculty of the institution can be kept up-to-date and stimulated by the events that transpire in the daily life of the cooperative student and that can be brought to the classroom by the student.
3. In certain instances, the student in industry has the advantage of using the most modern facilities and equipment. It is sometimes too costly for the college to supply equipment of either a specialized nature or of a recent vintage.
4. The placement of graduates of a cooperative program is much easier for the college because of the graduates' background experience.
5. Because cooperative students can alternate on a year-round basis, the college physical plant can be used more efficiently with the attendant advantage that more students can be accommodated within existing facilities.

The railroad industry is ideally suited to the cooperative education program.

There are literally hundreds of jobs in which a student can be placed to learn the industry from the ground up. At the same time, the students will be furnishing a useful service. This method of recruitment should not be overlooked. It can supply a steady source of well-trained employees to the railroad industry.

Nevertheless, some railroads are hiring industrial engineers and perceive no need for specialized training. This results from a belief that industrial engineering principles apply to almost any industry, and, therefore, the need for specific courses in railway engineering is negated. This opinion is not representative of a majority of railroads surveyed, and hence the contributions made by existing educational programs are recognized in most cases.

DEGREE PROGRAMS--MANAGEMENT

This category includes those degree programs that are directed more toward the management of railroads and of rail operations rather than toward the technical aspects of such operations. Typically found as curriculum offerings in Colleges of Business Administration, Colleges of Management or Administrative Science, and Schools of Management Studies, such programs tend to emphasize the economics of transportation and transportation systems in general. That is, although the principles of rail management receive attention in many such programs, frequently such coverage is in the context of the larger transportation perspective. This is not necessarily a deficiency, because a sound understanding of a general set of business management principles serves to provide a suitable background for those aspiring to careers in railroad management. The degree to which candidates become familiar with managerial and operating components of competitor industries should be considered a positive aspect of the student's academic preparation.

In conjunction with the National Council of Physical Distribution Management, Professor Edward J. Marien recently conducted a study to determine the extent to which colleges and universities offer courses and programs in physical distribution management. Titled College and University Courses in Physical Distribution, the reference guide also includes related course offerings in traffic, transportation, materials management, and business logistics. Appendix I shows the specific schools responding to the survey and stating that their programs included an emphasis on Transportation Management and Economics. The respondent schools included 18 offering doctorate degrees, 32 offering masters degrees, 48 offering bachelors degrees and 54 offering associate and(or) certificate programs. This relatively large market has generated a number of excellent

and current textbooks on Transportation Management, including one devoted specifically to railroad management.

Although a large number of academic programs are cited in the study, only a subset of those listed were indicated by railroad industry representatives to be both highly regarded and highly visible. The following list includes those universities offering Transportation Management courses or programs and which were recommended specifically by industry personnel or which were identified by means of the survey included in this study.

Alabama, University of
Arkansas, University of
Auburn University
Case Western Reserve University
Colorado, University of
Columbia University
Georgia, University of
Golden Gate University
Harvard University
Illinois at Urbana-Champaign,
University of
Indiana University
Iowa, University of
Iowa State University
Maryland, University of
Memphis State University
Michigan State University

Minnesota, University of
Missouri-Columbia, University of
North Florida, University of
Northeastern University
Northwestern University
Ohio State University
Oklahoma, University of
Oregon, University of
Pennsylvania State University
Pennsylvania, University of
Syracuse University
Temple University
Tennessee at Knoxville, University of
Texas at Austin, University of
Texas A&M University
Toledo, University of
Washington State University
Wisconsin-Madison, University of

Few business schools offer a course devoted specifically to railroad management or operations. As an example of a course description and topical coverage for a course in railroad management, a current offering at The University of Tennessee is presented in Figure III-6.

In summary, while there are no academic programs that lead to degrees in railroad management, several programs include railroad content in the curriculum offerings. It is valuable to consider, once again, that some of the railroads interviewed prefer entry-level employees with general management skills rather than with any abundance of discipline-specific knowledge.

Statement of Course Objective:

Although the railroad industry's market share of intercity freight transportation has declined in the last three decades, the mode (in terms of ton-miles) continues to carry more freight than any other single type of transport. Despite its relative importance, particularly in the carriage of bulk commodities, the industry is considered a sick one by the financial world and several government agencies, and many predict its takeover by government in the next decade. This course is designed to introduce the student to the mode and its technical advantages and disadvantages, the structure of the U.S. rail industry, together with an analysis of the industry's problem areas and possible methods of revitalizing it in the future. It is anticipated that upon completion of the course, the student will have at least an appreciation of the rail mode of transport and, if the industry is being considered as a career, will know in what area and/or capacity he/she would want to contribute to it upon graduation from the University.

Introduction and orientation.

Development of rail industry. The major carriers; industry structure.

The mechanics of railroading.

Rail problems/current topics: Government relations.

Rail problems/current topics: Labor, management development finances.

Railroad organization; pricing/marketing; recommendations for change in current railroad policies/practices.

Intercity rail passenger service; Amtrak.

Commuter rail passenger service.

The short line railroad industry.

FIGURE III-6. RAILROAD MANAGEMENT COURSE DESCRIPTION AND TOPICAL COVERAGE AS TAUGHT AT THE UNIVERSITY OF TENNESSEE

DEGREE PROGRAMS--INTERDISCIPLINARY

Interdisciplinary programs are defined as those that integrate rail operations, marketing and management on the one hand and railroad and transportation engineering on the other. Since few schools offer relevant interdisciplinary programs, those available at the Massachusetts Institute of Technology, the University of Pennsylvania, and The Pennsylvania State University are notable.

Massachusetts Institute of Technology emphasizes an intermodal and interdisciplinary approach to transportation education. There is a broad spectrum of transportation subjects throughout the School of Engineering, plus additional subjects in the Departments of Urban Studies, Economics, Management, and Political Science. Of particular interest is the recent introduction by Massachusetts Institute of Technology of an M.S. program in Transportation through the Center for Transportation Studies. The Center was established in 1973 to increase cooperation in interdisciplinary and intermodal matters in transportation, to facilitate innovative research, and to provide a focal point for educational programs at the Massachusetts Institute of Technology.

The transportation program of the University of Pennsylvania is unusual because it includes all the major disciplines involved in the study or practice of transportation activity. The program encompasses graduate and undergraduate degree programs concentrating on transportation planning, transportation engineering, transportation management, and transportation economics. Of particular interest is the formal offering by Professor Edward K. Morlok of a course in Railroad Engineering and Planning (Civil and Urban Engineering 581) that appears to be one of the few interdisciplinary course approaches to rail education. According to the transportation program brochure published by the University of Pennsylvania, this course:

. . . treats railroads in the context of the entire intercity transportation system. Rail technology is described--including way facilities, terminals, train operating characteristics, and routing and blocking of traffic--forming a basis for discussion as roles of government, multimodal services, and the need for technological development, are discussed. The course is designed for engineering and non-engineering students.

The Pennsylvania Transportation Institute of The Pennsylvania State University offers a yearly interdisciplinary Rail Transport Seminar Series. The series provides the opportunity for students to listen to and interact with some of the most accomplished people in the railroad industry, Government, education, and consulting and research. A copy of a recent Rail Transport Seminar Series outline appears in Figure III-7.

Finally, an interdisciplinary approach to rail education is evident in the organizational format and research programs of the transportation research centers at a number of leading colleges and universities.

COMPANY PROGRAMS--RAILROAD IN-HOUSE

As indicated previously, letters were sent to a number of railroads in an attempt to learn more about railroad educational programs, particularly those offered internally. Although the response rate of 26 percent (10 replies from letters sent to 39 Class I railroads) was less than anticipated, the material received was useful. As a supplement to the responses, materials received directly from certain railroads during the personal interviews proved to be of value.

Figure III-8 provides examples of different methods used by railroads to categorize educational programs. Although some obvious diversity can be noted, it will be assumed for purposes of this study that the grouping by railroads of educational programs include (1) college-university degree programs, (2) management-training (orientation) programs, (3) general and(or) specialized management

RAIL TRANSPORT SEMINAR SERIES
sponsored by
The Pennsylvania Transportation Institute
of
The Pennsylvania State University
Spring 1978

Place and Time: 62 Willard Building, Thursdays, 6th Period (3:55-5:10)
(Except as otherwise noted)*

<u>Date</u>	<u>Lecturer</u>	<u>Topic</u>
March 16	A. J. Reinschmidt and J. C. Spsychalski, The Pennsylvania State University	Introduction
March 23	E. P. Patton, Department of Marketing and Transportation, College of Business Administration, The University of Tennessee	Problems and Opportunities in Preserving Local Rail Line Service
March 30	Dr. Frederick J. Beier, Transportation Systems Center, U. S. Department of Transportation Cambridge, Massachusetts	Railway Manage- ment and Its Relationship with Government Research
April 6	A. Scheffer Lang, Assistant to President-- Staff Studies, Association of American Railroads	The Railroad Profit Problem
April 12*	Dr. L. K. Sillcox, Honorary Vice Chariman of the Board, New York Air Brake Company	Troubled Trains
April 20	M. Rougas, Chief Engineer, Bessemer and Lake Erie Railroad Company	Railroading: An Attraction for Young Engineers
April 27	Dr. Michael R. Bonavia, Chief Officer (retired) British Railways Board	Railway National- ization--The British Experi- ence
May 4	Dr. Lloyd McSparran, Locomotive Products Division, General Electric Company	Factors Influ- encing the Design of Modern Railroad Motive Power
May 11	A. L. Sams, Vice President, DeLeuw Cather/ Parsons, Washington D. C.	North East Cor- ridor Improve- ment Project
May 18	Dr. James W. Boone, Director, Office of Rail Economics and Operations, Federal Railroad Administration, U. S. Department of Transpor- tation	Intermodal Com- petition and Economic Dis- crimination: A Reassessment

*Please note that this session will meet on Wednesday, April 12, at
8:00-9:10 a.m. in 71 Willard Building.

For more information please contact:

A. J. Reinschmidt	or	J. C. Spsychalski
225-B Sackett Building		508-R Business Administration
865-4544		865-2872

The seminar series may be taken for academic credit (1 cr.) under CE 400,
CE 500.2 or B. Log. 597.2. Please contact A. J. Reinschmidt or J. C. Spsychalski
for details.

FIGURE III-7. RAIL TRANSPORT SEMINAR SERIES

Railroad	Educational Program Categories	Comments
Burlington Northern	Specialized Management Skills Adult Evening Classes Outside Educational Seminars and Conferences Team Building and Organizational Development Lunch Bag Courses	Description of courses and of Burlington Northern's Tuition Refund Plan are published in the <u>Educational Resource Catalog</u> , prepared by the Personnel Development Department
Canadian National	"Standard" Management Courses, Seminars and Workshops Special Skill Development	Details provided in <u>The Selection and Development Process for Supervisors and Managers</u> , published by the Industrial Relations and Organization Department
Chicago and North Western	General Management and Supervisory Skills Programs Operating Department Officer Programs Special Purpose Programs Technical Training Programs	Details prepared and published by the Training and Development Department in the <u>Catalogue of Programs</u>
Union Pacific	Technical Training General Management Development Programs Outside Programs	Details provided in a document prepared by the Department of Labor Relations and Personnel

FIGURE III-8. REPRESENTATIVE METHODS FOR CATEGORIZING RAILROAD EDUCATIONAL PROGRAMS

development programs, (4) specialized skills development programs, and (5) technical education programs. The approach adopted here will be to discuss successively each of the groupings and to indicate the extent to which such programs are available on both an internal and an external level. The overall conclusion to be drawn is that while there are some differences among railroads, the industry recognizes a wide variety of educational needs and relies on both internal and external sources for the preparation and execution of many programs. Although the following discussions include specific information from certain programs, they are merely meant to be representative of various offerings and should not be interpreted as encompassing all offerings.

College-university degree programs have been already discussed and are offered exclusively by institutions external to the railroad industry. Individual railroads tend to be knowledgeable of and recruit from specific programs offered at institutions within their respective operating regions. There is considerable disagreement among industry representatives as to the value of degree programs designed specifically to meet railroad industry needs as opposed to more general approaches to the education of potential employees.

Although most railroads offer some form of management training and orientation for new employees, such efforts are aimed largely at the development of familiarity with the operating practices and procedures of individual companies. For example, Southern Pacific gives a 3-week management orientation program, which is offered principally in San Francisco but includes portions in Sacramento or Los Angeles. Specific topics include (1) introduction to Southern Pacific, (2) Southern Pacific's railroad operations, (3) Southern Pacific's customer services, (4) Southern Pacific's support services, (5) Southern Pacific's non-railroad businesses, (6) beginning a management career, and (7) Southern Pacific's environment. Other railroads place emphasis in some cases on a

loop-type management training course where the trainee works in several different departments over a period of 6 to 18 months. While the importance of such programs to the industry is obvious, the development and presentation of them is predominantly an internal responsibility. The use of outside consultants and specialists, although minimal, can sometimes contribute to the inclusion of more general topical matter of such programs.

Railroads generally have a high regard for the need to send middle- and upper-level management personnel to management development programs of both a general and special nature. Such programs, are offered by colleges and universities as well as a variety of professional and consulting firms. There are offerings by some railroads of programs of this type, as exemplified by Canadian National, Chicago and North Western, and Union Pacific. Figure III-9 provides more detail concerning the respective content of selected offerings of those railroads.

Specialized skills development programs address specific staff-management skills which may need to be developed or sharpened. A number of railroads indicated in-house offerings of such programs. Typical examples include Salesmanship, Freight Rates Study Course, Business Writing, Rapid Reading, Report Writing and Presentation, Time Management, Work Study, Coaching and Developing People, Effective Listening, Interpersonal Communications, and Managing the Human Resource.

All railroads that participated in the personal interviews or responded to the written request for information indicated that they offered at least some formal internal technical education programs. The main focus of this study, however, excludes technical offerings from principal consideration.

Railroad	Courses and/or Programs
Canadian National (many of which are attended by employees of Grand Trunk Western)	<p>"Standard" Development Courses, Seminars, and Workshops Include the following:</p> <ol style="list-style-type: none"> 1. Productive Supervision 2. Labor Relations 3. Collective Agreement Problem Causes 4. Effective Management 5. Business Values 6. Management Values 7. Motivation and Job Enrichment 8. Consulting Skills 9. Introduction to Behavioral Science
Chicago and North Western	<p>General Management and Supervisory Skills Programs Include the following:</p> <ol style="list-style-type: none"> 1. Management Techniques I 2. Management Techniques II 3. Supervisory Development I 4. Supervisory Development II 5. Supervisory Development III 6. Executive Problem Solving/Decision Making 7. Problem Solving/Decision Making Review 8. Assistant Trainmaster School 9. Traveling Engineer School
Union Pacific	<p>General Management Development Programs Include the following:</p> <ol style="list-style-type: none"> 1. Executive Development Seminar 2. Advanced Management Workshop 3. Advanced Management Practices Seminar 4. Management Practices II 5. Management Practices I 6. Supervisory Development Seminar II 7. Supervisory Development Seminar I

FIGURE III-9. SELECTED RAILROAD IN-HOUSE OFFERINGS OF
MANAGEMENT DEVELOPMENT COURSES AND PROGRAMS

COMPANY PROGRAMS--EQUIPMENT SUPPLIERS

A letter was sent to 50 railroad equipment manufacturers and vendors requesting information on educational programs or courses related to the railroad industry which they provided. Twelve replies were received and are tabulated in Figure III-10. Because equipment suppliers focused on technical aspects of railroading, their educational offerings do not assist to any great extent the provision of management or engineering educational programs.

SEMINAR PROGRAMS--GENERAL

This category of offerings includes a very wide range of seminar, workshop, or short-course programs which are of general interest to those engaged in the professions of business management or engineering. Although such programs are not designed specifically to meet needs of the railroad industry, railroad personnel can benefit from participation in high-quality offerings of a general (as opposed to disciplinary-specific) nature.

Professional groups such as the American Management Association and Penton, Inc. also sponsor a broad number of offerings in the general management area. While it would be illustrative to identify specific programs which qualify for inclusion in this category, there are too many to enumerate here. Another consideration to be made is that, while some programs are perceived to be more prestigious than others, there are a substantial number of programs believed by rail industry personnel to be of high quality. Therefore, the reader desiring more specific recommendations should consult a guide such as Bricker's Directory (of University-Sponsored Executive Development Programs), Tenth (1979) Edition, South Chatham, Massachusetts: Bricker Publications, 1978.

General Railway Signal

Courses on product application, circuits, railway signaling, main control using SEPTA, MBTA, NYCTA, CTA; maintenance.

Safety Electrical Equipment Corp.

Sent to Carbuilders - Air conditioning and aux. electronic. Training sessions only.

G.E.

Locomotive schools - 1 week courses at technical level.

WABCO

Air brakes - training programs - technical level for trainmen, maintenance carbuilders and purchasing agents.

Bombardier, Inc.

1 week course for customers on Alco Engine at assembly plant.

Bethlehem Steel

1 day in sales loop course on railroad products.

Purdy Co.

None

Morrison Railway Supply

None
ref. Western Nebraska Technical College
Vocational Technical Course

Vapor Corp.

None

Anbel Corp

None

Garrett Corp

None

Automatic Equipment Co.

None

ASEA Inc.

Individually adapted courses only.

FIGURE III-10. SUMMARY OF EQUIPMENT SUPPLIER RESPONSES

SEMINAR PROGRAMS--SPECIFIC

There are a number of management development and engineering programs structured to meet railroad industry needs. The following list is representative of those currently being offered:

- "Railroad Profit Strategy"
 - offered by: The Transportation Center
Northwestern University
 - dates: Fall of each year
one week in length
 - topics: Use of Control Budgets
Sources of Capital
Profit Maximizing
Profit Evaluation
Planning

- "Railway Engineering Short Course"
 - offered by: University of Illinois
 - dates: Summer of each year
two weeks in length
 - topics: Track Structures
Track Geometry
Railway Structures (Bridges, Tunnels)
Tractive Effort and Horsepower
Acceleration and Deceleration
Velocity Head and Momentum
 - note: Primary speakers include Professors Hay (re
tired, University of Illinois), Reinschmidt
(Penn State), and three others from the Univer-
sity of Illinois

- "Railway Engineering Short Course"
 - offered by: The Pennsylvania State University
 - dates: Summer of each year
two weeks in length
 - topics: Track and Foundations
Track Geometry
Train Operation

- "Rail Transport Seminar Series"
 - offered by: The Pennsylvania Transportation Institute
The Pennsylvania State University
 - dates: Spring quarter
 - topics: varied (see outline, Figure III-7)

- "Railroad Tracks: Design, Analysis and Maintenance"
 - offered by: The Technological Institute
Northwestern University
 - dates: Spring of each year
one week in length

topics: Evolution of Railroad Track Designs
Track Response when Subjected to Thermal
and Mechanical Loads
Installation and Maintenance of Continuously
Welded Rails
Track Specifications and Maintenance
Practices
note: Primary speakers include:
Professor Kerr (University of Delaware)

- "Railroad Costing and Analysis"
offered by: Distribution Planning Specialists
Warren Ross and Associates
Boca Raton, Florida
dates: several times per year
two days in length
various locations
topics: Rail Costing and Transportation Pricing
ICC Rail Form A Costing
Rate Making and Rate Structuring
Rate Investigations and Negotiations
- "Rail Institute"
offered by: Transportation Center
The University of Tennessee
dates: periodically
variable length format
topics: The Rail Institute is a continuing program
of short courses, seminars and workshops devoted
to rail management, operations, and economics.
Recent offerings include a two-week seminar
dealing with contemporary rail issues, and a
three-day workshop on benefit/cost analysis in
State rail planning.
- "Analytical Techniques for Railroad Strategic Planning and Market
Analysis"
offered by: Princeton University
dates: twice yearly
one week in length
topics: Perspectives: Planning, Marketing, Policy,
Regulatory, Users
Characteristics of Railroad Markets
Data Bases
Base Models
Concepts
Integrated Models
Workshops

Although somewhat more general in nature, the following transportation management programs were cited by industry representatives as being responsive to the educational needs of the rail industry:

- "Advanced Transportation Management Program"
offered by: The Transportation Center
Northwestern University
dates: late Spring of each year
four weeks in length
topics: Financial Management
Marketing Management
Management Science
Distribution Management and Logistics

- "The Transportation Management Program"
offered by: Graduate School of Business
Columbia University
dates: Winter of each year
one week in length
topics: Transportation and Distribution in
a Changing Economy
Economics of Competitive Transportation
Developments in Regulation of Transportation
Developments for Improved Management of
Transportation
International Operations

- "Transportation Systems Management and Analysis"
offered by: Massachusetts Institute of Technology
dates: Summer of each year
two weeks in length
topics: Basic Concepts and Techniques of Management and
Analysis of Transportation Systems
International Aspects
Case Studies; Applications of Basic Concepts

Finally, there are a number of seminars and programs that concentrate on the topics of business logistics and physical distribution management, as viewed by the user of rail services. While participation in such programs is reputed to be of significant value for rail industry executives and managers, they will be categorized for purposes of this study as general offerings rather than railroad-specific. Bricker's Directory is a good reference document for a listing of such programs.

IV. CONCLUSIONS AND RECOMMENDATIONS

Part IV has two purposes. The first is to discuss, in a conceptual fashion, the effectiveness of current educational programs to meet present and future managerial needs of the rail industry. The second is to build upon the first. Taking into consideration the pros and cons of currently available programs, together with industry needs as determined in Part II, specific recommendations for introducing new and reinforcing existing programs are presented together with estimated costs and suggested implementation procedures for carrying out these proposals.

COLLEGE AND UNIVERSITY DEGREE PROGRAMS

This category includes all 4-year degree programs available beyond the high school level.

ENGINEERING

American railroads are no longer in the mainstream of professional engineering education. This is evident from such factors as the number of engineers employed, the number of research grants sponsored by the railroads, the number of papers and textbooks concerning railroad problems, and all aspects of railroad engineering.

This situation has forced railroads to hire engineering generalists and engineers from other fields--not any real aversion to hiring railroad engineers. Although modest attempts to revive railroad engineering education are underway, it will take considerable industry support and involvement to sustain

this effort. Simply accepting the status quo and adopting it as the preferred course, as implied in the interviews, will not suffice.

There is essentially one source of new professional engineering talent in this country--the several hundred universities with accredited engineering programs. Engineering education remains organized around the traditional disciplines of Civil Engineering, Electrical Engineering, and Mechanical Engineering and strongly resists change through reorganization as new departments. Professional railroad engineers most often have come from a background of Civil Engineering, which is natural because of the predominance of work in that area. In response to this need, railroad specialty courses have been more common in Civil Engineering Departments of universities. It is also important to note that graduate engineers are organized in professional societies which are predominately structured exactly like the educational departments, into Civil Engineering, Mechanical Engineering, and others.

This means that if the railroads want to attract engineers they must get back into the mainstream of engineering education.

OPERATIONS

Apparently no college or university offers a degree program in railroad operations; in fact, study efforts failed to uncover even a course on the subject. Segments of railroad or general transportation courses may include railroad operations text material or case studies, but extensive coverage of this vital subject simply is not available. Most transportation courses, regardless of mode or modes emphasized, deal primarily with modal development, theoretical principles, and Government policy; they do not provide a practical "hands on" approach to operational practices and policies.

The closest subject area provided on the college level is management, including production, industrial, and personnel management, which is offered in virtually every business school curriculum. While a background in business and management is good training for an individual interested in a railroad career, it obviously does not provide an insight into the peculiarities of the rail industry.

As indicated in Part II, railroad management is ambivalent on the subject of how much specialized background an individual should have to become a proficient operations manager. Roughly half those interviewed felt no training was necessary; the other half thought some business background-experience, especially in transportation per se, would provide the individual with an edge over others without this background.

The researchers agree with those who believe some familiarization with railroad operating policies and practices on the part of new employees is desirable. Knowledge of the uniqueness of the industry, especially in terms of the demands made of a person in entry-level and middle management, should reduce training time and costs and long-run managerial turnover. The strategy to employ and encourage the development of courses concerning railroad operations is another matter.

For several reasons, the most effective methods of filling the void in teaching railroad operations are not clear cut. These reasons include, but are not limited necessarily to: (1) faculty acceptance of such subject matter; (2) availability of professorial expertise; and (3) the potential restrictive nature of the material.

Thirty-four schools offering extensive programs in transportation management, including rail-oriented material, were listed in Part III. In view of this relatively low number, at least when compared to this country's total number of

colleges and universities, it is easy to consider suggesting Department of Transportation (DOT) support for new rail-oriented programs at additional institutions. Yet establishment of new transportation programs is not recommended. Rather, the researchers call for support, by various means, of existing programs.

An important reason for this recommendation is existing faculties' attitudes toward the field known as transportation. Many faculty people simply do not accept transportation as a discipline worthy of separate treatment from traditional business and economics programs. Theoretically oriented individuals oppose the practical, "hands on" approach to transportation subjects taught at some schools.

The researchers are familiar with case histories where attempts have been made or are being made currently to downgrade or eliminate transportation courses and programs. Fortunately, they also know of cases where the transportation curriculum has been expanded in recent years. Certainly the attempt to expend funds where transportation is only accepted begrudgingly or is outright opposed by segments of a faculty would be in error. These comments apply to the whole academic area known as transportation; thus, they would be underscored more sharply when restricted to railroad transportation.

A potential second problem to be encountered, were a series of new programs to be established, involves the availability of qualified faculty to teach in the area. On the basis of interviews with transportation professors, the number of individuals presently in transportation teaching or in the terminal degree pipeline to be graduated in the next few years is considered to be adequate to meet current and future demands provided there is no unexpected expansion in transportation education.

These comments apply to transportation teaching in an overall sense. The problem of adequate professorial expertise potentially is more acute in the teaching of rail transportation. The greater private and public interest in

highway and air transport understandably has led to greater educational emphasis on these modes relative to the rail industry.

The final consideration relative to implementation of railroad courses and programs concerns the restrictive nature of such material. Rather than recommend strictly a railroad-oriented curriculum, the researchers would prefer railroad subjects integrated with similar material covering those modes that compete in some way with the rail mode. Thus, the motor, barge, and pipeline methods of transport would be discussed as to how they interact with the rail mode. Individuals planning to enter the rail industry thus would receive a broader perspective and understanding regarding what they will face if railroad-ing is selected as a career.

Railroad personnel firmly supported the concept of what could be termed surface transportation, as opposed to rail, truck, or barge transportation. The University of Tennessee recently combined three quarter-length courses (one each in rail, truck, and barge) into two integrated courses, Surface Transportation I and II. Transportation courses now will be taught by function (for example, finance, labor, operations) instead of by mode. The integrative procedure also promotes logically the teaching of intermodal transportation (for example, TOFC/COFC) whereas the modal approach can mean course overlap in subject matter or, equally undesirable, insufficient coverage of important material.

For these reasons, railroad operations should be included in general, over-all courses in transportation operations or transportation management. This format already has been adopted by several schools. The concerns of the team are that (1) rail operations are not overlooked relative to the other modes, and that (2) adequately trained faculty people are in charge of the courses.

MARKETING

The discipline of marketing is included in virtually every college and university business program in the country, on both the undergraduate and graduate levels. As in the relationship between rail operations management and production management generally, a similar situation exists between railroad and transportation marketing and general business marketing in that, with one exception, no specialized marketing courses are offered in the transportation field.

The single exception is in the area of transportation pricing where the industry's rigid economic regulatory controls place unusual responsibilities on carrier management. Thus, several separate courses on transportation pricing continue to exist in many of the programs described in Part III. (This may change, of course, if substantial deregulation of the industry occurs.) The topic of transportation pricing also is covered indirectly in regulatory course topics, for example, discriminatory price setting and intramodal and intermodal competitive ratemaking.

Otherwise, the areas of merchandising, marketing strategies, and research are included in curricula as part of general survey or case study courses in transportation.

As in the case of rail operations, differences exist in transportation marketing versus general business marketing. These differences include: (1) differences in the demand for a service versus the demand for a product; and (2) differences in pricing in a regulated environment. Conclusions as to the need to introduce new courses in railroad and transportation marketing on the university level are the same as those pertaining to the needs for operations courses on the same level. In brief, railroad and transportation marketing should be

included in transportation management survey and case study courses, being sure to encourage adequate coverage of the rail mode's problems, practices, and policies.

INTERDISCIPLINARY

As indicated in Part III, few colleges or universities offer interdisciplinary programs. At best, courses in transportation planning and engineering as part of an engineering degree typically are all that are available. At The University of Tennessee, for example, the following seven courses are available through the Department of Civil Engineering:

<u>Course Number</u>	<u>Course Title</u>
3600	Transportation Planning
3610	Transportation Engineering
4600	Highway Engineering I
4620	Airport Planning and Design I
4640	Traffic Engineering
4650	Highway Engineering II
4660	Airport Planning and Design II

Despite this array of courses, it cannot be said that a truly interdisciplinary transportation program is offered by the university. The taking of engineering courses by transportation majors and vice versa, while not discouraged, is not encouraged. This is despite the finding that, with only one exception, all those interviewed felt college-trained, entry-level management people would contribute more effectively to and advance faster in their companies if they were to participate in interdisciplinary programs.

Consequently, it is in the interdisciplinary area that Government-sponsored programs could have a significant impact in meeting present and future educational needs of the rail industry. Government-sponsored seminars, short courses, and possibly quarter- or semester-length courses provided by a potential variety of agencies and stressing the integration of the engineering and transportation

economics disciplines could help overcome the traditional resistance to interdisciplinary study by higher education faculties.

SUMMARY

Despite the vast educational opportunities available in the country's colleges and universities, rail-oriented courses or programs in engineering, operations, marketing, or an integrated mix of two or all of these disciplines is virtually nonexistent. While specialized transportation degree programs exist at a limited number of schools, the best background a future aspiring railroad manager can obtain from U.S. higher education is a general education in the basic disciplines studied with little or no chance of interdisciplinary study.

CONTINUING EDUCATION

The term "continuing" education is used in this study to describe an education process that comes after the granting of the first professional degree. The railroads recognize the importance of continuing education, and all support the concept enthusiastically. Examples of this form of education are university divisions of continuing education and professional society and industrial firm programs, including vendor promotional material.

The professional competence and personal satisfaction of engineers or business-oriented persons working for a railroad will be correlated highly with their interests in and the ability to obtain continuing education. The Federal Highway Administration (FHWA) uses the resources of universities to design courses that constitute continuing education for State highway employees. The rail industry could follow this model to make sure that the continuing education needs of its employees are met fully.

GOVERNMENT-SPONSORED PROGRAMS

In this section the various types of Federal Government programs and forms of assistance to railroad education are defined and evaluated briefly in a general sense. Four types of Government programs or assistance are:

1. A Government-owned and operated transportation academy;
2. A Government-owned and operated institute;
3. A series of seminars and short courses offered by a single or a number of Government agencies; and
4. Government support to private and public agencies, primarily colleges and universities, to aid in the establishment of new and operation of ongoing fellowship and research programs, transportation centers, endowed chairs, and the like.

A distinction is made between an academy and an institute. Dr. Harvey Heiges in his draft report, "A DOT Surface Transportation Academy or Professional Institute: Questions and Issues" differentiates the two as follows:

"Academy" and "Professional Institute" have differing connotations. Academies usually conjure an image of a permanent institution of higher education offering baccalaureate degrees and possibly advanced degrees, such as the U.S. Military Academies. (There are at the present time seven Federal academies operated by the Army, Navy, Air Force, Coast Guard, FBI, Interior and Merchant Marine.) Institutes, on the other hand, generally connote educational institutions offering professional programs other than regular four year degree programs in the accepted fields. An institute may consist of a staff and facility designed specifically to prepare and implement programs for managers, specialists and planners. An institute generally has a permanent core faculty augmented by specialists and consultants who serve as advisors and lecturers.

TRANSPORTATION ACADEMY FOR RAILROAD EDUCATION

As indicated in Part II, there was very little support by those interviewed, including both railroaders and academicians, for a transportation academy to help meet future rail engineering and management needs. In fact, in many cases there was outright opposition to such a suggestion.

The researchers recognize that establishment of a Government transportation academy threatens both railroad management and the academic community. On the one hand, the academy would be teaching what up until now has been strictly rail management's prerogative--how to manage the property. Whether justified or not, management wants to retain this responsibility and feels threatened with loss of control if any part of this task is absorbed even partially by an outside agency.

In short, an academy could "rock the boat." When academy graduates were introduced to a carrier's own operational policies and practices, they might question or oppose the policies based upon the academy's teachings. Most present rail management would not accept such behavior on the part of new employees.

Colleges and universities, on the other hand, would be threatened by an academy because it represents a form of direct competition for students, particularly for those schools offering transportation-oriented programs.

For the above reasons, the researchers will not devote additional space to the establishment of an academy to teach railroad management. In view of the limited funds available to meet the rail industry's educational needs, to consider sacrificing them on a program that is unacceptable to that industry is unacceptable itself.

Removal from consideration of a transportation academy does not necessarily eliminate a Government-operated training facility from the railroad educational field. In almost all cases, railroad management supported the concept of Government-sponsored vocational training for present and potential skilled workers. One manager estimated that up to 20 percent of management came from the ranks or were promoted in-house; therefore, support directly or indirectly of technical programs would aid the development of future rail management personnel.

THE TRANSPORTATION INSTITUTE AND SEMINAR-SHORT COURSE EDUCATION METHODS

The interviews indicated that the railroad industry supports the concept of short courses, seminars, and the like where, of course, top management feels that its middle and entry-level management will gain from such programs. While underwriting the cost to attend university-sponsored seminars was mentioned as a consideration by money-losing or marginal carriers, the real problem for all the roads is management's time away from the job to attend the programs. This problem is particularly acute for the poorer companies with reduced management and engineering personnel that, consequently, cannot spare them even though, in the long run, a better manager could be the result.

GOVERNMENT SUPPORT FOR EXISTING COLLEGE AND UNIVERSITY PROGRAMS

This concept received the greatest support by those interviewed and holds the greatest appeal for the researchers. The support can come in many forms-- establishment of centers of excellence in transportation education, partial funding of professional teaching and research positions, and establishment of loan programs and scholarships and fellowships at selected colleges and universities. The major problem in this method of Government support is determining which schools will receive the assistance.

An example of an endowment that could deserve the support of a Federal transportation agency is the proposed Martin F. Schmidt Endowment for Transportation and Distribution, described in Appendix I. As indicated in the brochure designed to raise funds, the endowment's purposes include:

1. A fully funded professorship of transportation and distribution;
2. A perpetual scholarship and research fund to aid undergraduate and graduate students of transportation and distribution; and

3. Provision of funds for conferences and seminars to promote and further the study of transportation and distribution for both students and faculty.

STUDY RECOMMENDATIONS

Evaluation of the study findings leads to the following conclusions concerning the future educational needs of the railroad industry:

1. University railroad education programs will quite likely never again be large enough to completely fill the demand for new managers and engineers, thus forcing the railroads to continue hiring graduates with diverse backgrounds and training them in railroading.
2. The railroads' practice of actively recruiting the few graduates with rail transportation course work suggests that such individuals are perceived to be potentially valuable and highly motivated additions to their professional staffs.
3. A mixture of academic programs and continuing education opportunities will be needed to respond to the broad array of railroad educational needs.
4. External teaching of railroad and rail-related subjects is a means of strengthening the industry's ability to innovate in response to a rapidly changing technological and business environment.
5. The expressed opinions of railroad management concerning the need for railroad specialists must be balanced against the fact that engineering and managerial philosophies which guided operations successfully years ago may no longer be valid.
6. The railroads actively utilize and support external educational programs, particularly those which complement their in-house programs, those which promise to enhance managerial effectiveness, and those disseminating new technological developments.
7. Some form of introduction to the railroad industry--its characteristics, uniqueness, demanding nature, problems--should be available to individuals considering it as a career.
8. Cross-pollination of disciplines, whereby engineers comprehend and, therefore, can deal with the realities of economics and business, and vice versa, is desirable for decisionmakers at all levels of railroad management.

Within the study environment as developed to this point, the researchers present their recommendations for possible Government assistance to railroad education in the coming decade. These proposals, in the order in which each one will be described and evaluated, are: (1) short courses; (2) curriculum enrichment; (3) university research; and (4) fellowships.

SHORT COURSES

Short courses would be one week in duration, from Sunday evening through noon Friday, and would encompass between a university quarter's and semester's work--27 meetings at 1.25 hours each, plus 4 optional 2-hour evening sessions (Monday through Thursday) and a 2-hour Introduction and Orientation meeting Sunday night. Inclusion of the weekday evening sessions would exceed a university semester in terms of student-teacher contact hours at most schools. Four specific short courses not presently available are recommended: (1) basic transportation; (2) surface transportation; (3) railroad transportation; and (4) railroad engineering. In addition to these, advanced courses of shorter duration focusing on specific technical and managerial subjects should also be developed.

The recommended courses would be taught on a junior-senior university level. They would be designed for two groups of individuals. First would be recent graduates or those entering their senior year who are interested in entering the railroad industry but who have not been able to learn much about it, either through college courses or work experience. Second would be individuals already in the railroad industry whom management feels should broaden their knowledge base and outlook as a basis for future promotion (for example, orienting a union member with management potential to management's approach to problem solving and decisionmaking). Ideally the courses would alleviate the potential shortfall problem of training sufficient railroad managers for the coming years by:

(1) making college graduates more attractive to rail recruiters for hiring into entry-level management positions; and (2) retraining promising personnel already on the rail property for promotion into management positions.

Outlines of the proposed courses are shown in Figures IV-1 through IV-6. The first four emphasize the contents of the courses for each day of the week and recommend textbooks to be used. Figure IV-5 gives a breakdown of subjects included in the broad categories suggested for the basic, surface, and railroad transportation courses shown in Figures IV-1 through IV-3. Finally, Figure IV-6 contains a suggested class schedule, with 1.25 hour class sessions, breaks, and meals.

The first 3 courses offer two sections each, depending upon the background of the students. One section is designed for students without any business or economics courses. The other assumes a business or economics major or at least extensive background in these areas. All three nonbusiness courses devote Monday to an introduction to these areas and build upon the basic knowledge on Tuesday. Topics for each course otherwise are the same, with only the time devoted to each area varying because of introductory material included in courses designed for nonbusiness-oriented students.

The nonbusiness background course is designed for a wide variety of students: liberal arts, education, or engineering seniors, or graduates. It is intended to introduce in an intensive, realistic fashion the transportation and railroad industry and to aid such individuals, in a short time span, in deciding whether or not to pursue further a career in this field.

The basic course would be taught primarily from what might be called a social or general viewpoint; that is, the overall importance of transport, reasons for Government participation, and a review of the modes. The surface and railroad courses would be taught primarily from a management viewpoint. How

Nonbusiness		Business	
Sun	Orientation/Objectives	Sun	Orientation/Objectives
M-1	Basic business	M-1	Modal structure/development
2	Basic business	2	Modal structure/development
3	Basic business	3	Modal structure/development
4	Basic economics	4	Modal nomenclature
5	Basic economics	5	Modal costs
6	Basic economics	6	Modal costs
T-1	Modal structure/development	T-1	Marketing
2	Modal structure/development	2	Marketing
3	Modal structure/development	3	Marketing
4	Modal nomenclature	4	Marketing
5	Modal costs	5	Operations: line-haul
6	Modal costs	6	Operations: line-haul
W-1	Marketing	W-1	Operations: terminal
2	Marketing	2	Operations: terminal
3	Marketing	3	Operations: terminal
4	Operations: line-haul/term.	4	Maintenance
5	Operations: line-haul/term.	5	Maintenance
6	Operations: line-haul/term.	6	Maintenance
R-1	Maintenance	R-1	Government relations
2	Maintenance	2	Government relations
3	Government relations	3	Government relations
4	Government relations	4	Labor relations
5	Labor relations	5	Labor relations
6	Labor relations	6	Labor relations
F-1	Finance	F-1	Finance
2	Finance	2	Finance
3	Wrapup	3	Wrapup
Suggested texts:			
Hazard: <u>Transportation; Management/Economics/Policy.</u>			
Davis/Farris/Holder: <u>Management of Transportation Carriers.</u>			

FIGURE IV-1. PROPOSED COURSE IN SURFACE TRANSPORTATION

Nonbusiness		Business	
Sun	Orientation/Objectives	Sun	Orientation/Objectives
M-1	Basic business	M-1	RR structure/development
2	Basic business	2	RR structure/development
3	Basic business	3	RR structure/development
4	Basic economics	4	RR functions/organization
5	Basic economics	5	RR economics
6	Basic economics	6	RR economics
T-1	RR structure/development	T-1	Marketing
2	RR structure/development	2	Marketing
3	RR functions/organization	3	Marketing
4	RR economics	4	Maintenance of way
5	Marketing	5	Maintenance of way
6	Marketing	6	Maintenance of way
W-1	Operations: line-haul/term.	W-1	Operations: line-haul
2	Operations: line-haul/term.	2	Operations: line-haul
3	Operations: line-haul/term.	3	Operations: terminal
4	Maintenance of way	4	Operations: terminal
5	Maintenance of way	5	Maintenance of equipment
6	Maintenance of equipment	6	Maintenance of equipment
R-1	Labor relations	R-1	Labor relations
2	Labor relations	2	Labor relations
3	Finance	3	Finance
4	Finance	4	Finance
5	Government relations	5	Government relations
6	Government relations	6	Government relations
F-1	Passenger business	F-1	Passenger business
2	Passenger business	2	Passenger business
3	Wrapup	3	Wrapup
Suggested texts:			
Armstrong: <u>The Railroad--What It Is, What It Does.</u>			
Wyckoff: <u>Railroad Management.</u>			

FIGURE IV-2. PROPOSED COURSE IN RAILROAD TRANSPORTATION

Nonbusiness		Business	
Sun	Orientation/Objectives	Sun	Orientation/Objectives
M-1	Basic business	M-1	Significance of transport
2	Basic business	2	Transport structure and
3	Basic business	3	development of modes
4	Basic economics	4	(3 periods)
5	Basic economics	5	Introduction to government
6	Basic economics	6	participation in transport
T-1	Transport economics	T-1	Government policy
2	Transport economics	2	Government policy
3	Significance of transport	3	Government policy
4	Transport structure and	4	Government policy
5	development of modes	5	Government policy
6	Intro to government policy	6	Government policy
W-1	Government policy	W-1	Carrier management
2	Government policy	2	Carrier management
3	Government policy	3	Carrier management
4	Government policy	4	Carrier management
5	Government policy	5	Carrier management
6	Government policy	6	Carrier management
R-1	Carrier management	R-1	Transport economics
2	Carrier management	2	Transport economics
3	Carrier management	3	Transport economics
4	Carrier management	4	Transport economics
5	Special topics	5	Special topics
6	Special topics	6	Special topics
F-1	Intro to business logistics	F-1	Intro to business logistics
2	Intro to business logistics	2	Intro to business logistics
3	Wrapup	3	Wrapup
Suggested texts:			
Harper: <u>Transportation in America: Users/Carriers/Government.</u>			
Lieb: <u>Transportation: The Domestic System.</u>			
Fair/Williams: <u>Economics of Transportation & Logistics.</u>			
Sampson/Farris: <u>Domestic Transportation: Practice, Theory & Policy.</u>			

FIGURE IV-3. PROPOSED COURSE IN BASIC TRANSPORTATION

Description

Planning, design, construction, operation, and maintenance of railroad facilities and equipment including track, structures, yards and terminals, rolling stock, and signaling and communications systems. The technological elements and relationships governing railroad operations and underlying railway engineering practice. The role of engineering within the railroad enterprise. Current developments in materials, equipment, and maintenance and their impacts on future operations.

Texts

1. Armstrong, John H., The Railroad--What It Is, What It Does, Simmons-Boardman, Omaha, 1978.
2. Hay, William W., Railroad Engineering, Wiley, New York, 1953.

Sun	Orientation/Objectives
M-1	What do engineers do?
2	Track structure
3	Subgrade construction
4	Drainage; ballast
5	Cross ties
6	Rail design and construction
T-1	Rail defects
2	Track standards; safety, tolerances
3	Track construction; turnouts and crossings
4	Miscellaneous right-of-way features
5	Terminals
6	Classification yards
W-1	Bridges and buildings
2	Locomotives
3	Rail cars
4	Train assembly and operation
5	Resistance, motive power, speed
6	Curvature and grade effects
R-1	Train performance
2	Sidings, branch lines
3	Control systems
4	Signals, track circuits, communications
5	ABS, CTC; double track systems
6	Rail-highway grade crossings
F-1	Current developments
2	Current developments
3	Engineering for profit: the engineer's impact on the bottom line

FIGURE IV-4. RAILROAD ENGINEERING: AN OVERVIEW FOR RAILROAD MANAGEMENT AND OPERATIONS PERSONNEL

Basic Business

- * Analysis of balance sheet, income statements.
- * Types of business organizations-importance of each.
- * Functions of business: marketing, production, finance, etc.
- * Elements of business law.

Basic Economics

- * Micro vs. macro economics; emphasis on microeconomics.
- * Demand and supply; definitions and determining factors.
- * Price and its significance; normal vs. exploitive profits.
- * Costs: definitions, long(short) runs, fixed(variable), opportunity.
- * Components of economics.

Transport Economics: basic economics applied to the transportation industry and its component parts and activities.

Government Relations/Policy

- * Justification for Government participation in transportation.
Social, political, economic significance of low cost transportation.
- * Types of participation.
 - Promotion; direct and indirect.
 - Regulation:
 - Economic: types and philosophy.
 - Safety and police.
 - Environmental.
 - Other.
- * Future of Government promotion/regulatory policies.

Note: Relations to be regarded/considered from a management viewpoint;
Policy considered from a social viewpoint.

Structure/Development

- * Development of Modes:
 - Current market share/competitive status of each mode.
 - Competitive interaction among modes; present and future.
 - intramodal and intermodal.
- * Modal Structure:
 - Number of competitors; degree of concentration.
 - By regulatory types,
 - Common, contract, exempt.
 - Potential Future Development
 - Regulated versus deregulated scenarios.

FIGURE IV-5. OUTLINE OF TOPIC AREAS OF SURFACE, RAIL, AND BASIC PROGRAMS

Marketing

* Pricing

- Maximum/minimum limits and factors affecting these limits.
 - Value of service versus cost of service.
- Strategies.
 - Intramodal versus intermodal.

* Merchandising

- Traditional policies and practices
- Recent innovations

* Market Research

Carrier Management

- * Problems and policies in marketing, operations, and maintenance; introduction to labor relations and finance. Covers surface and air modes.

Note: All subject matter for managers (marketing, operations, labor, finance, etc.) should be covered from the point of view of both general principles and case study examples of individual carrier policies and/or practices.

FIGURE IV-5 (Continued)

P R O G R A M

Sunday Evening Through Noon Friday

		Surface Transp.		Railroad Transp.		Basic Transp.	
Period		No Bus.	Gen. Bus.	No Bus.	Gen Bus.	No Bus.	Gen Bus.
S U N	1800- 2100	Introduction and Orientation		Introduction and Orientation		Introduction and Orientation	
M O N D A Y	0800- 0915	Classes	Classes	Classes	Classes	Classes	Classes
	0915- 1030						
	1030- 1045	Break		Break		Break	
	1045- Noon	Class	Class	Class	Class	Class	Class
T H	Noon- 1330	Lunch		Lunch		Lunch	
R U	1330- 1445	Class	Class	Class	Class	Class	Class
	1445- 1500	Break		Break		Break	
T H U R	1500- 1615	Classes	Classes	Classes	Classes	Classes	Classes
	1615- 1730						
S D	1730- 2000	Dinner		Dinner		Dinner	
A Y	2000- 2200-	(Optional) Discussion Case Studies		(Optional) Discussion Case Studies		(Optional) Discus- sion, Case Studies	
F R I D A Y	0800- 0915	Classes	Classes	Classes	Classes	Classes	Classes
	0915- 1030						
	1030- 1045	Break		Break		Break	
	1045- Noon	Class	Class	Class	Class	Class	Class

FIGURE IV-6. PROGRAM SCHEDULE

does management deal with pricing, merchandising, operations, maintenance, and financing?

Taking the basic course before either the surface or railroad course (although not required) would be beneficial to the student with 2 weeks available and an interest in this work.

The engineering course would be designed for any graduate without engineering training; but the student should have an appreciation of the function as a significant part of the railroad industry. Engineering graduates with no railroad training or experience also could attend.

It is suggested that students be recruited for the short courses much the way they are for positions with industry. Fliers describing the courses should be sent to college and university placement offices and to engineering, business, and economics departments of schools where majors in these fields are offered. Fliers also should be sent to railroad personnel officers, department heads, division superintendents, and similar level management to make them aware of the courses.

Transport associations such as Delta Nu Alpha fraternity, the American Society of Traffic and Transportation, the Transportation Research Board, and the National Council of Physical Distribution Management can promote the courses once they learn of them. Publications such as The Alphan, Transportation Journal, Transportation Research News, Traffic World, Railway Age, and Modern Railroads are logical candidates for disseminating information on the programs.

Since the proposed program is novel and is targeted to a nontraditional audience, initial classes may be difficult to fill; however, enthusiasm of program graduates should ease the job of obtaining full enrollments as word of the opportunity spreads throughout the rail industry and the academic community.

The researchers have considered several forms of acknowledgement for graduates but continue to consider the matter open. The one point they unanimously agree upon is that the courses should not be offered for credit toward a degree. Some form of certificate verifying successful completion of each course or one or more continuing education units earned would appear to be satisfactory methods of handling the problem.

There is a need for a certain degree of professional uniformity in the presentation of the short courses. This requirement is one reason for the direct involvement of the Federal Government in the programs. For example, they could be offered by the Federal Railroad Administration (FRA) or under a program similar to the National Highway Institute (NHI).

In view of the rail industry's attitude toward Government activities directly or indirectly related to it, however, the programs should be organized and presented under the auspices of one or more colleges or universities properly accredited to carry out such functions. DOT would establish uniform minimum standards to be met and would arrange whole or partial funding of the courses. The programs could be offered in Washington, D.C., at the participating schools, or at other locations agreed upon by the participating agencies.

There would be three advantages to these arrangements. First, the rail industry would be more likely to accept a program that was minimally politicized. Second, agencies familiar with putting on such programs, namely colleges and universities, would have expertise that might not be available to a Government agency relatively inexperienced in such matters. Third, involving the schools of higher learning directly in the program should eliminate their objections to it.

Table IV-1 depicts estimated program costs for the proposed short courses. Depending upon which specific categories are included, the cost to present a

TABLE IV-1. ESTIMATED PROGRAM COSTS

I. SEMINARS/SHORT COURSES

Cost of presenting a 5-day course, 30 participants.

Assume two instructors, pay each for 8 days of effort.

Annual Salary = \$32,000

Assume use of hotel conference facilities.

Personnel

Instructors 16 days x 8 hr. x 17.85	\$ 2,285
Support Staff 80 hr. x 6.00	<u>480</u>
	2,765
Fringe Benefits, Overhead	<u>2,765</u>
Total Personnel	\$ 5,530

Other Direct Costs

Travel, instructors	1,100
Transportation 2 x \$250	500
Per diem 10 days @ \$60	600
Texts, course materials 30 x \$50	1,500
Brochures, slides, other graphics (pro rated)	300
Conference rooms, beverage service, etc.	500
Postage, telephone	<u>250</u>
Total ODC	\$ 3,650

Total	\$ 9,180
Use Estimate of	\$10,000

TABLE IV-1 (Continued)

This estimate excludes the cost of participant travel and per diem, which would average about \$500 per participant or, for 30 participants, \$15,000. Most railroads are willing to underwrite these costs for worthwhile programs. The FRA might consider funding this for Government employees.

The cost of course development is also excluded. A grant or contract to develop one seminar would require about 3 months and the following funding:

Professional Staff (50% time, one summer)	\$ 4,000
Support Staff 100 hr. x \$6.00	600
Fringe benefits, overhead	4,600
Travel	1,000
Supplies, publications	300
Communications	200
Graphics	<u>300</u>
Total	\$11,000

If additional professional hours, sponsor review meetings, and pilot presentations are required, development costs could reach to \$30,000.

5-day course involving 30 participants will vary from \$10,000 to \$40,000, the latter figure including course development costs.

These estimated cost levels are the main argument for initial Federal support. Most universities and other potential course sources would be reluctant to commit resources to course development in view of the present dismal state of railroad education. The experimental nature of some of the desirable courses accentuates this problem. Also, the projected cost of conducting the courses would necessitate a registration fee in the \$300 to \$400 range if to be self-supporting. This fee is beyond the means of a large segment of the target population. Hence Federal funding would accelerate the course development process and would help to keep attendance costs low enough to encourage participation by a wide range of people, including personnel of marginal and bankrupt railroad companies, rail planners employed by Federal, State, and local Government agencies, and individuals interested in entering the railroad field.

The railroads themselves do not fund external course development efforts, but rather support them by sending paying participants. Hence once the courses are operating, they could be supported by attendance fees, as are the handful of successful technical and specialized courses presently available, thus eliminating the need for continuing subsidy. In this instance, FRA should consider continued funding of attendance costs for public employees and other eligible individuals. Alternatively, FRA may elect to sponsor a continuing rail education program, similar to the mass transit and highway offerings of the Urban Mass Transportation Administration (UMTA) and FHWA, respectively.

Finally, it should be noted that there is precedent for FRA funding of railroad short courses. Research and development results are often the subject of FRA-sponsored seminars. Also, the Office of State Assistance Programs in FRA sponsors workshops for State rail planners.

CURRICULUM ENRICHMENT

In line with the virtual unanimous agreement with the concept of using existing university programs as the primary educational conduit, the rail industry strongly favors assistance to such programs for maintaining and enhancing their coverage of the rail mode. Funds channeled to university faculty members to improve the railroad content of transportation course offerings would be used for salary support, student assistants, support staff, travel to various railroads and to rail-related conferences, materials, and small exploratory research efforts. This would keep the university community involved in the future of the railroads and would help to maintain the relevance and technical accuracy of university rail-related education and research programs.

In essence, this program would provide for a federally supported "minichair" in rail (or, perhaps, surface) transportation. The main differences between this and a traditional chair or professorship are the dependence upon an annual or periodic funding rather than an endowment and the percentage of faculty time funded. Otherwise, the activities covered by the funds are virtually identical. The trucking and package express industries, and a few other segments of the transportation industry, currently support university professorships. The FRA, perhaps in conjunction with the Association of American Railroads (AAR), should explore developing similar rail programs.

A related concept involves a visiting faculty program, where individual faculty members spend time during the summer working with a railroad on problems of mutual interest. Some rail companies and other types of transportation companies already make use of this idea. Curriculum enrichment funds could be used to help support such faculty-on-leave activities.

Curriculum enrichment also can be a means of supporting seminar and short course development. Short courses often are a natural outgrowth of the teaching

and research activities of university faculty. If faculty members are teaching and researching railroad subjects, additional relevant short course offerings will likely evolve. This evolution greatly reduces the separate short course development costs cited previously.

The main questions to be resolved concern which programs would be eligible for funding and how they would be selected. The simplest procedure would be for the FRA to develop and announce program criteria and to invite interested institutions to apply for support. The Office of University Research (OUR) would be a logical choice as program administrator; this office likely will be administering the university "transportation centers of excellence" program authorized in the Surface Transportation Act of 1978.

Curriculum enrichment funding will be attractive to universities if there are some assurances of continuity. Universities are reluctant to commit to program specialization in the face of possible funding curtailment each year. This is less of a problem if established programs with existing rail coverage are selected for support.

Funding needs vary directly with faculty salaries and with the percentage of program commitment which the FRA is willing to fund. Typical annual funding requirements for an enrichment program large enough to have an impact are estimated below. The railroads have indicated their willingness to make available data, case studies, guest speakers, and similar resources, but have not shown any interest in providing funding. Involvement of the AAR in program development could be instrumental in changing this.

Personnel

Faculty 25% time, \$32,000/yr	\$ 8,000
Graduate Assistant, 50% time	6,000

Support Staff	<u>3,000</u>
	\$17,000
Fringe benefits, overhead	<u>17,000</u>
Total personnel	\$23,000
<u>Other Direct Costs</u>	
Travel	3,000
Supplies	500
Communications	<u>500</u>
Total Other Direct Costs	\$ 4,000
<u>Total Cost</u>	\$38,000
<u>Use Estimate Of</u>	\$40,000

UNIVERSITY RESEARCH

All segments of the rail industry support the idea of a federally sponsored university railroad research program. Several rail carriers suggested that the industry could make use of the research results and should be willing to provide financial support. (The latter idea, of course, is less attractive to marginal roads.) All those interviewed appreciated the educational value and curriculum enrichment aspects of such a program.

There are ample precedents and guidelines for the FRA to follow in establishing a university research program. Three existing programs in the transportation area are the DOT University Research Program, the UMTA University Research and Training Program (which has recently added a program support element), and the Maritime Administration University Research Program. Again, the DOT OUR might be a logical administrator. There is also considerable sentiment for enlisting the aid of AAR to help ensure the relevance of the research and to provide access to industry data.

Railroad research projects at universities are most effective if they are funded for a period of 1 or 2 years and if they involve several faculty members and students. Typical annual project funding requirements are estimated below:

Personnel

Faculty, 2 @ 33% time	\$22,000
Graduate Assistants, 2 @ 50% time	12,000
Support Staff	<u>5,000</u>
	\$39,000
Fringe benefits, overhead	<u>39,000</u>
Total personnel	\$78,000

Other Direct Costs

Travel	4,000
Equipment	4,000
Supplies	1,000
Communications	1,000
Computer support	<u>2,000</u>
Total Other Direct Costs	\$12,000

Total Cost \$90,000

Annual funding requests in the range of \$60,000 to \$120,000 would be typical. Certain types of research might have substantially higher equipment or computer costs. Annual total funding of \$1 million would provide for an average of 10 to 15 active projects. This number currently would cover most of the institutions with sufficient rail expertise to warrant support.

DOT already funds some university railroad research, under the auspices of the OUR program. However, rail research proposals must compete with projects in all areas of transportation for the limited OUR funds. Further, some meritorious rail research may be too specific to justify OUR support. Universities

are sometimes successful in competing for FRA research contracts, but these often lack the long-term commitment and flexibility which are prized elements of university research. The research sponsored by the AAR is highly problem-oriented and often short-term, which is incompatible with most university programs. For these reasons, a special university railroad research program is necessary if this avenue for improving academic programs is pursued. It has been the experience in other transport specialties that this option is highly effective; research increases faculty involvement, interest, motivation, and competence, which, in turn leads to improved undergraduate and graduate courses and to new short courses. In view of the benefits to the industry, a joint FRA-AAR university research program would be appropriate.

FELLOWSHIPS

A university research program would provide student funding in the form of graduate research assistantships or funding for undergraduate hourly employees. Alternatively (or additionally), grants for railroad education could be made directly. A program of support to individual graduate fellows would require funding of \$7,000 to \$12,000 per year per fellow, depending upon the level of tuition and fees. A \$1 million program would fund roughly 100 graduate fellows. In comparison, the FHWA currently offers 186 fellowships per year for studies in highway transportation.

Again, there are existing models for the FRA to follow. Both the FHWA and the UMTA sponsor fellowships. Their enabling legislation and program guidelines can be useful in structuring a similar program for the FRA.

The two programs are very similar. Enabling legislation in the Urban Mass Transportation Act of 1964 and subsequent revisions allow an employee training program for UMTA employees and for the employees of federally funded public

transportation systems to be created and maintained by the UMTA. The FHWA program is authorized by the biannual highway act. Eligibility is limited to persons employed by the FHWA or federally funded State agencies. Candidates must have a bachelors degree or equivalent.

The administration of the FHWA fellowship program is assigned to the NHI. The guidelines and policies for fellowship selection are detailed in the Federal-Aid Highway Program Manual (see Appendix K).

It is interesting to note that the UMTA is in the process of consolidating its education and training funding into a single program. It will solicit training proposals from transit properties annually. These proposals will identify individuals and specific training programs for which support is requested. All types of training, including technical workshops, short courses, university study, and degree programs, will be eligible. UMTA is currently funding these activities at a cost of about \$500,000 annually and would like to double this effort.

The FHWA program is well developed and runs smoothly, with minimal problems both for the fellows and the institutions. Extensive guidelines for eligibility, selection, and employment continuation are contained in the regulations. The NHI has the administrative machinery in place to administer such a program. The FHWA-NHI model, tailored to fit the railroad industry, is recommended for FRA emulation.

Railroad funding of graduate study is extremely rare, since individual railroads find it difficult to grant an employee a full year of leave and are concerned about losing the employee after they have paid for the employee's education. Yet the industry as a whole benefits from the advanced education of its professionals. This is a strong argument for Federal funding of railroad fellowships, or, for that matter, for funding any of the university programs described above.

HIGH SCHOOL ORIENTATION PROGRAM

A final idea is built upon a concept successfully used in many parts of the country--high school orientation programs to introduce and explain employment opportunities and minimal prerequisites to enter the many vocations available to the high school graduate. Such programs can be provided by the schools themselves using materials from both public and private agencies, by teams of university personnel explaining their own peculiar field(s), or by Government agency personnel doing the same for their particular organization.

An effective DOT sponsored orientation program for high school students could acquaint the students with the opportunities in the transportation field, including the railroad business. Although potentially more expensive than efforts by university personnel on relatively localized bases, this program could be uniform in format, material offered, and degree of professionalism.

SUMMARY

A well-coordinated and Government-aided program consisting of: (1) short courses targeted to entry-level professionals; (2) university curriculum enrichment; (3) university railroad research; and (4) fellowships for studies in rail management and engineering will meet the educational needs of the railroad industry. In terms of estimated financial requirements, annual funding of \$1 million would support any one of the following (although combinations are obviously preferable): 40 1-week short courses; 25 rail transportation professorships; 15 university research projects; or 100 graduate fellows. Such a program would do much to provide railroads with new and capable employees with strong career motivation and with the skills needed to respond to the emerging business and technological environment of the railroad industry.

A. INDIVIDUALS INTERVIEWED

1. ASSOCIATIONS, CONSULTANTS, GOVERNMENT AGENCIES, TRADE JOURNALS

Association of American Railroads, Washington, D.C.
George H. Way, Assistant Vice-President

ATE Rail Services, Inc., Cincinnati, Ohio
Peter E. Ward, Vice-President

CACI, Inc., Arlington, Virginia
Wm. Shepherd Moore, Group Manager
Wayne Baxter, Manager, Transportation Systems Department

California Department of Transportation
Division of Mass Transportation
Warren D. Weber, Chief, Office of Bus and Rail
Gerald J. Meis, Chief, Rail Freight Branch
Ed Boyle, Rail Freight Branch
N. F. McWilliam, Rail Freight Branch

Ernst and Ernst
Gerald S. Lutes, Supervisor

Florida Department of Transportation
David C. Blodgett, Public Transportation Operations Division

Maryland Department of Transportation
Robert T. Beard, Rail Freight Operations Specialist

Modern Railroads, Chicago, Illinois
Tom Shedd, Senior Editor
Frank Shaffer, Associate Editor

Railway Personnel Association
Steve Dewhurst

Transportation Research Board, Washington, D.C.
Edward J. Ward

U. S. Department of Transportation,
Transportation Systems Center, Cambridge, Massachusetts
Frank Baroni
Robert Smith
Gerhart Kaess (German Federal Railways)
Lothar Fendrich (German Federal Railways)
Thomas Harvey, Chief, National Transportation Research Division

U.S. Department of Transportation
George Schriever, National Highway Institute
Larry E. Jones, National Highway Institute
Harvey Heiges, Office of University Research
Jack Smith, Northeast Corridor Improvement Project

West Virginia Railroad Maintenance Authority
John P. Killoran, Executive Director

2. UNIVERSITIES, OTHER EDUCATIONAL INSTITUTIONS

Massachusetts Institute of Technology, Cambridge, Massachusetts
Carl Martland

Harvard University, Cambridge, Massachusetts
D. Daryl Wyckoff, Graduate School of Business Administration

Northwestern University, Evanston, Illinois
The Transportation Center
C. Page Townsley, Director-Management Programs

Pennsylvania State University, University Park, Pennsylvania
A. J. Reinschmidt, Professor of Engineering
John Spychalski, Professor of Business Logistics

University of Pennsylvania
Edward K. Morlok, UPS Foundation Professor of Transportation

Central Missouri State University, Warrensburg, Missouri
Robert L. Marshall, Dean, School of Public Services and Director,
Missouri Safety Center
Robert L. Baldwin, Professor of Safety and Assistant Director,
Missouri Safety Center
Robert A. Ulrich, Professor of Safety and Head, Safety Department

3. RAILROAD COMPANIES

Atchison, Topeka and Santa Fe Railway Company, Chicago, Illinois
Otto F. Sonefeld, Special Assistant-Staff Studies and Planning
Lance F. Garrels, Trainman, Emporia, Kansas

Boston and Maine Corporation, Boston, Massachusetts
Alan G. Dustin, President and Chief Executive Officer
William J. Rennie, Assistant to the President
Michael V. Smith, Vice-President Marketing and Sales

Burlington Northern, Inc., St. Paul, Minnesota
Francis J. Coyne, Director-Manpower Planning
Keith B. Sletten, Director-Personnel Development
Richard Hall, Recruiter
Thomas R. Hackney, Division Superintendent, Lincoln, Nebraska
William J. DeWitt III, Asst. Superintendent-Administration, Lincoln, Nebraska

Chicago, Milwaukee, St. Paul and Pacific Rail Company, Chicago, Illinois
Joseph Moomaw, Assistant Trainmaster

Chicago and North Western Transportation Company, Chicago, Illinois
Donald J. Bailey, Director-Sales and Marketing Training
Edwin E. Ellis, Assistant to the Vice-President-Sales and Marketing
Stephen Gregory, Rates Manager-Natural Resources and Chemicals
James A. Giblin, Transportation Quality Control Supervisor, Boone, Iowa
J. J. Johnson, Assistant Vice-President-Quality Control
A. H. Malecha, Assistant Vice-President-Transportation
J. A. McCarthy, Assistant Superintendent-Car Service
R. E. Snyder, Director Maintenance Operation

Consolidated Rail Corporation, Philadelphia, Pennsylvania
Ronald A. Bowes, Manager-Strategic Planning
Craig I. Coit, Research Analyst-Strategic Planning
George Estock, Research Analyst-Strategic Planning
David L. Glickstein, Assistant Director-Management Personnel
A. T. Lewis, Assistant Director-Transportation-Rehabilitation and
Capital Planning
William Mueller, Operations Improvement Analyst
C. T. Popma, Director-Quality Control Mechanical Engineering
Judith B. Rideout, Research Analyst-Strategic Planning

Illinois Central Gulf Railroad, Chicago, Illinois
W. F. Bolla, Manager of Planning-Mechanical
W. G. Bumpas, Assistant General Manager-Transportation
C. P. Davis, Engineering-Maintenance of Way
Kenneth Edwards, Director-Data Processing
Robert M. Grossbert, Manager of Professional Placement
D. D. Hagestad, Assistant Vice-President-Market Development
Richard Marzullo, Director of Selection and Development
Jens Notestein, Assistant Director-Programming
Keith White, Train Dispatcher, Memphis, Tennessee

Missouri Pacific Railroad Company, St. Louis, Missouri
J. E. Angst, Director-Management Development
Paul L. Morey, Director-Personnel

National Railroad Passenger Corporation (Amtrak), Washington, D.C.
D. A. Boehr, Manager-Operations Control
James A. Bryant, Director-Special Services
Jack Clifford, Management Development
David Ferguson, Management Development
Donald L. Larson, Vice-President-Computer Services
Robert F. Lawson, Vice-President-Chief Engineer
Alfred A. Michaud, Vice-President-Marketing
L. V. Shrbeny, Operations

Southern Pacific Transportation Company, San Francisco, California

H. B. Berkshire, Assistant Vice-President, Maintenance of Way and
Engineering

W. B. Cogswell, Special Assistant, Executive Department

David J. DeBoer, Manager, Market Planning

R. D. Krebs, General Manager

C. E. Lamb, Assistant Manager of Labor Relations

Philip D. Lively, Assistant Chief Mechanical Officer

Peter G. Vajta, Vice President-Marketing

Southern Railway System, Atlanta, Georgia, and Washington, D.C.

Dan Barker, Assistant General Superintendent-Operations, Communications
and Signals

Harvey Bradley, Assistant Vice-President-Transportation

R. D. Hedberg, Assistant Vice-President-Personnel Administration

Jack Martin, Assistant Vice-President-Transportation Planning

F. P. Weldon, Director of Training

Robert Wharton, Special Assistant to the Executive Vice-President-
Operations

Union Pacific Railroad, Omaha, Nebraska

J. R. Davis, Assistant Vice-President-Operations

Robert L. Godfrey, Assistant Vice-President Marketing

Western Pacific Railroad Company, San Francisco, California

Ashley P. Schuetz, Manager-Personnel

B. GENERAL QUESTION AREAS

1. What educational background do you look for? (level, discipline, specialty, etc.)
2. What work experience and other qualifications do you seek for hiring and promotion?
3. How do you fill open positions?
New hires
Promotions
4. Which specific educational programs do you recruit from? Why?
5. Do wage employees make the transition to salaried employees?
6. What form of in-service employee development do you use?
In-house programs (formal, with/without release time)
Apprenticeship system
External (degree support and/or seminars)
7. What education/training needs do you have?
8. What is the single greatest contribution that this study can make to the railroad industry?
9. What road blocks will we encounter in this study? How can we best overcome them?
10. Who else should we talk to
(a) in your company?
(b) in the railroad industry?

C. RAILROAD EMPLOYMENT DATA

Tables C-1 and C-2 present figures from which estimates of future rail management needs can be derived. The data are for the years 1971-1978, an 8-year period. Years before 1971 were not used in the interest of uniformity of management effort; specifically, pre-1971 data included both freight and passenger traffic officers, 1971 and later include freight traffic officers only, because of the absorption of most of this country's intercity passenger train service by Amtrak. The tables show that the total number of executives, officers, and staff vary between 16,000 (1976) and 17,000 (1974) for the study period.

Table C-1 gives a breakdown for selected years between general office/headquarters management personnel and "in the field" operating managers. The table reveals a steady decrease in headquarters personnel, from 6,700 in 1968 to 6,000 in 1977, offset by an overall increase in field personnel, from 9,100 to 10,800 for the same period. In the interest of extending the study period, data in Table C-1 include both pre- and post- Amtrak years.

As a result of the above trends, the ratio of general office managers to the total number of executives, general officers, and staff has declined steadily since 1968. In that year, it was 42.4 percent. By 1972, it was 38.9 percent; in 1974, it was 26 percent; in 1977, it was 35.7 percent.

Table C-2 also provides salary data for both management categories for the period. The significance of total management/staff compensation as a percent of total freight revenues is shown in line 17. For the period, this percent figure is surprisingly consistent, being 2.5 percent for 4 years with the figure for the remaining years not varying from this percentage by more than

TABLE C-1. RAILROAD MANAGEMENT EMPLOYMENT

	Executives Gen. Off's. Assistants (000)	Annual Salary (\$000)	Division Officers, Assistant Staff Asst's. (000)	Annual Salary (\$000)	All Officers Ann. Sal. (\$000)
1968	6.7	18.4	9.1	12.7	15.1
1969	6.6	20.4	9.9	14.1	16.6
1972	6.5	22.9	10.2	16.4	18.9
1973	6.4	24.3	10.6	17.6	20.0
1974	6.2	26.4	11.0	19.1	21.7
1975	6.1	28.7	10.9	21.0	23.8
1977	6.0	33.8	10.8	25.0	28.2

Source: Association of American Railroads.

TABLE C-2. TRENDS IN RAILROAD EMPLOYMENT, OUTPUT, AND PRODUCTIVITY

		1971	1972	1973	1974	1975	1976	1977	1978
(1) Executives Officers, Staff	(a) (thousand)	16.6	16.65	16.8	17.7	16.7	16.1	16.3	16.5
	(b) (million \$)*	586.0	562.9	536.0	536.5	525.9	494.1	501.7	509
(2) Total Employees	(a) (thousand)	544	526	520	525	488	483	483	472
	(b) (billion \$)*	11.8	11.5	11.2	10.9	9.96	9.8	9.7	9.6
(3) Carloadings	(millions)	25.3	26.1	27.3	26.2	23.2	23.5	23.2	23.4
(4) Tonnage	(billions)	1.4	1.5	1.5	1.5	1.4	1.4	1.4	1.4
(5) Revenue Ton-miles	(billions)	740	777	852	851	754	794	826	865
(6) Freight Train-miles	(millions)	430	451	469	469	403	425	428	433
(7) Freight Car-miles	(billions)	29.2	30.3	31.2	30.7	27.7	28.5	28.7	29.1
(8) Loaded Freight Car-miles	(billions)	16.5	17.1	18.0	17.6	15.2	15.8	16.3	16.8
(9) Mgmt./Total %	(a) number	3.1	3.2	3.2	3.2	3.4	3.3	3.4	3.5
	(b) compensation	4.75	4.9	4.8	4.9	5.3	5.0	5.2	5.3
(10) Carloadings †	1a	1524	1568	1625	1541	1389	1460	1423	1420
	2a	47	50	53	50	48	49	48	50
	1b	0.043	0.046	0.051	0.049	0.044	0.047	0.047	0.046
	2b	0.0021	0.0022	0.0024	0.0024	0.0023	0.0024	0.0024	0.0024
(11) Tons †	1a (thousand)	84.3	90.1	89.3	88.2	81.8	87.0	85.9	84.2
	2a	2574	2852	2885	2857	2869	2899	2899	2966
	1b	2.39	2.67	2.80	2.80	2.66	2.83	2.79	2.75
	2b	0.12	0.13	0.13	0.14	0.14	0.14	0.15	0.15
(12) Revenue ton-miles †	1a (million)	44.6	46.7	50.7	50.1	45.1	49.3	50.7	52.4
	2a (million)	1.4	1.5	1.6	1.6	1.5	1.6	1.7	1.8
	1b	1263	1381	1589.5	1586	1434	1607	1647	1700
	2b	62.3	67.5	75.9	77.7	76.05	81.0	85.1	90.0
(13) Freight Train-miles †	1a (thousand)	25.9	27.1	27.9	27.6	24.1	26.4	26.3	26.2
	2a	790	857	902	893	826	880	886	920
	1b	0.73	0.80	0.87	0.87	0.77	0.86	0.85	0.85
	2b	0.036	0.039	0.042	0.043	0.041	0.043	0.044	0.045
(14) Total Freight Car-miles †	1a (million)	1.76	1.82	1.86	1.81	1.66	1.77	1.76	1.76
	2a (thousand)	53.7	57.6	60.0	58.5	56.8	59.0	59.4	61.7
	1b (thousand)	49.8	53.85	58.2	57.2	52.6	57.6	57.2	57.2
	2b	2.47	2.64	2.78	2.81	2.78	2.89	2.95	3.03
(15) Loaded Freight Car-miles †	1a (million)	0.99	1.03	1.07	1.04	0.91	0.98	1.00	1.02
	2a (thousand)	30.3	32.5	34.6	33.5	31.1	32.7	33.7	35.6
	1b (thousand)	28.2	30.4	33.6	32.8	28.9	32.0	32.3	33.0
	2b	1.39	1.49	1.61	1.62	1.53	1.60	1.67	1.75
(16) Freight Revenue	(billion \$)	11.8	12.6	13.8	15.8	15.4	17.4	18.9	20.3
(17) 1b †	Inflated Freight Revenue %	2.5	2.5	2.5	2.3	2.6	2.4	2.4	2.5

* 1978 dollars

Source: Association of American Railroads

0.2 percent. Range for the 1971-1978 period is 0.3 percent (2.3 in 1974 to 2.6 in 1975).

Lines 10 through 15 of Table C-2 represent ratios that purport to indicate trends in managerial productivity for the period 1971-1978. It can be argued that changes in one or more trends reflect changes in the quality-capability of rail management. Equivalent ratios comparing output with total rail industry employment are included for comparison with the managerial employment data. Both numbers and inflated compensation data (1978 dollars) are used in compiling the table.

The results indicate a slight increase in managerial productivity over the period 1971-1978. Increases in (1) revenue ton-miles, (2) freight train-miles, and (3) loaded car-miles generated per managerial/staff person are registered, while, with one exception, other ratios remain basically the same.

The exception is in carloading per individual where the product decreases from 1,524 carloads (1971) to 1,420 (1978). The decrease may be in large part due to the increase in carload capacity during the period--68.4 to 76.7 tons (Association of American Railroads data).

Industry productivity increased in all cases for the period, which also indicates an improvement in managerial capability in the last several years.

When output is compared with dollars paid to management and to total employees, as expressed in 1978 dollars, the changes in productivity reflect favorably upon management over the period. Productivity increases in every case, for both employment categories. Figures C-1 and C-2, where Table C-2 data are plotted, show the trends in employment and output (C-1), then compares output by management and by all employees (C-2) for the years 1971-1978.

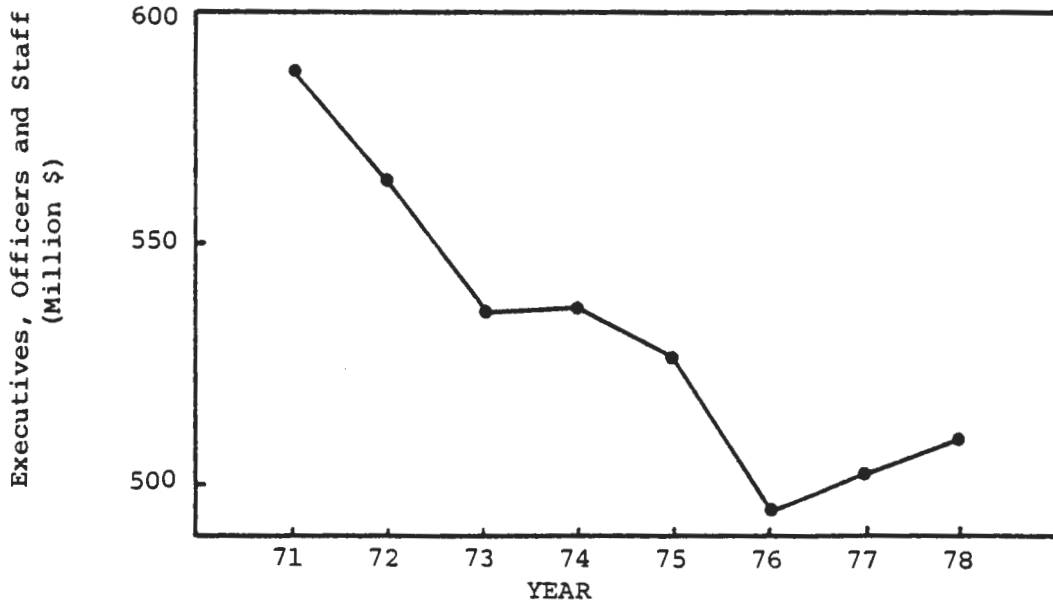
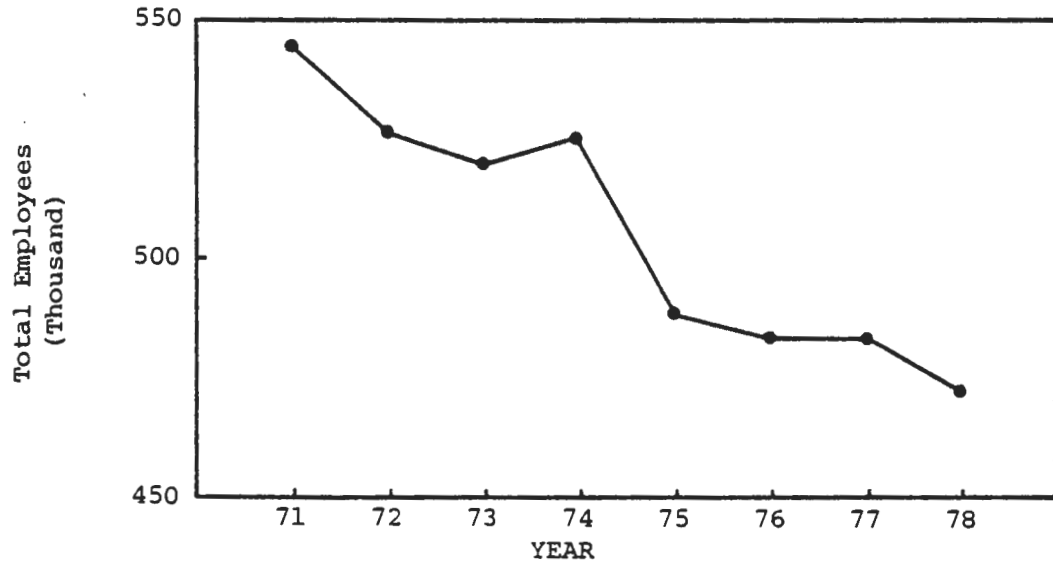
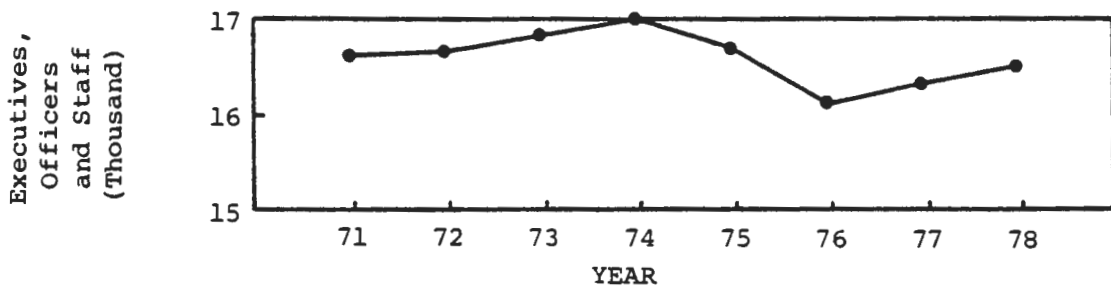


FIGURE C-1. TRENDS IN EMPLOYMENT AND OUTPUT

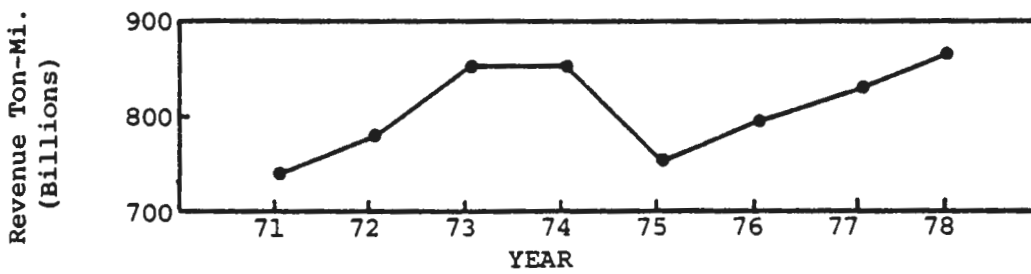
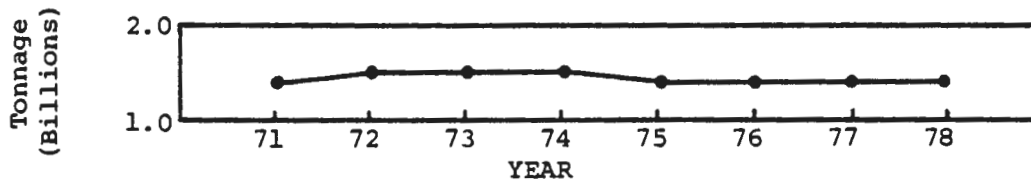
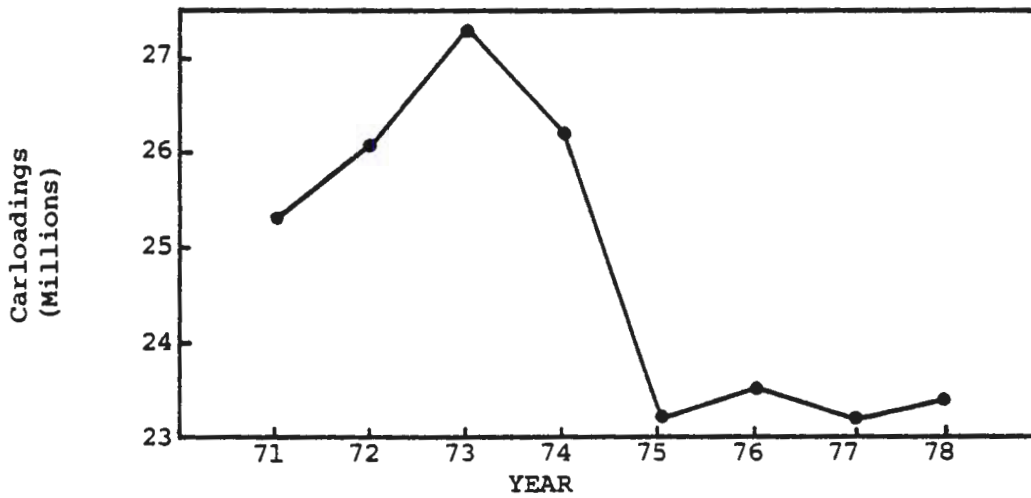
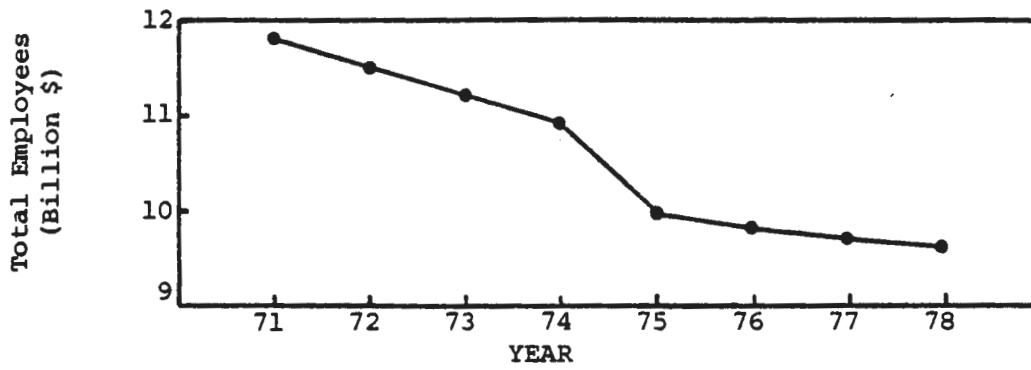
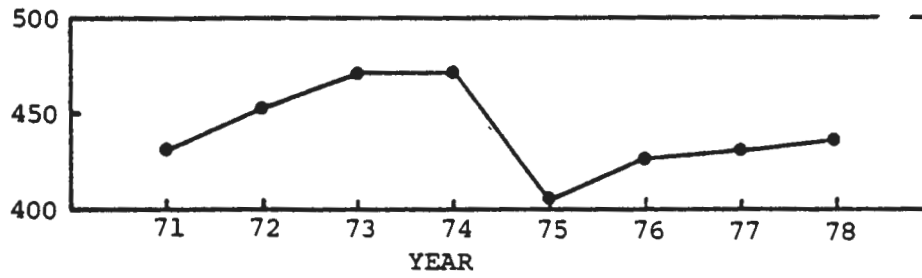
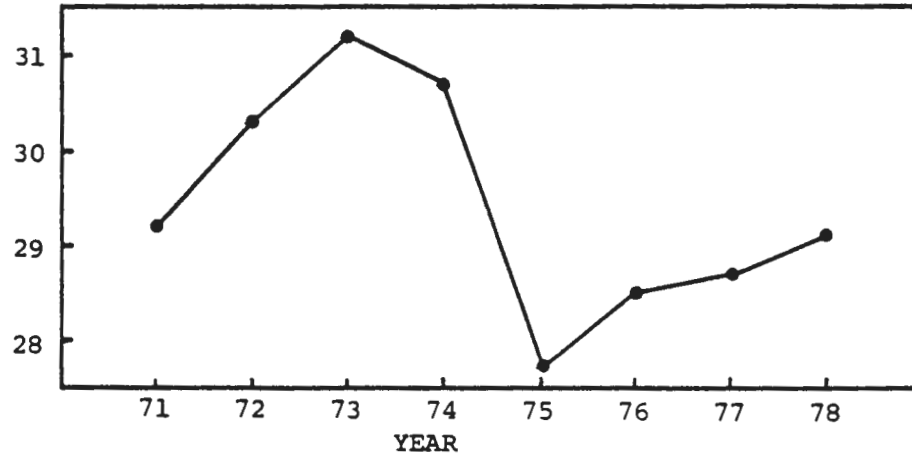


FIGURE C-1 (Continued)

Freight Train-Mi.
(Millions)



Freight Car-Mi.
(Billions)



Loaded
Freight Car-Mi.
(Billions)

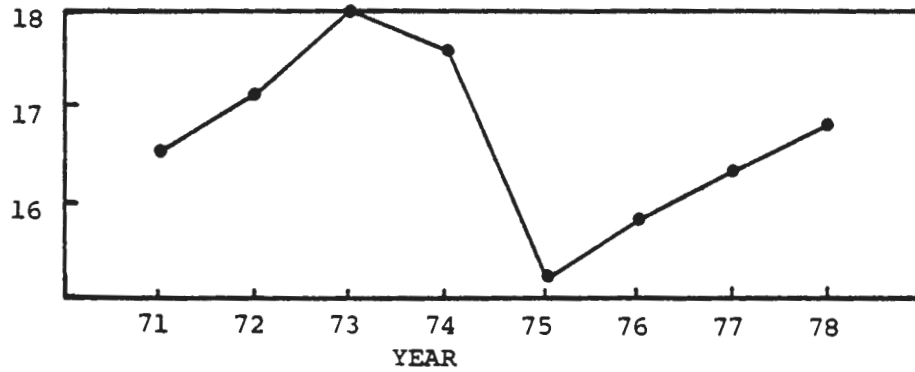


FIGURE C-1 (Continued)

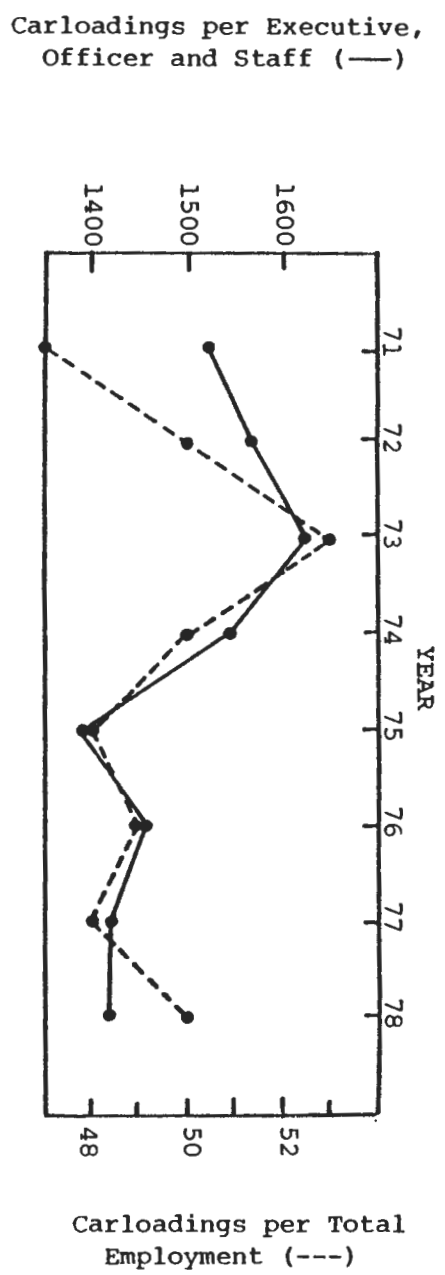
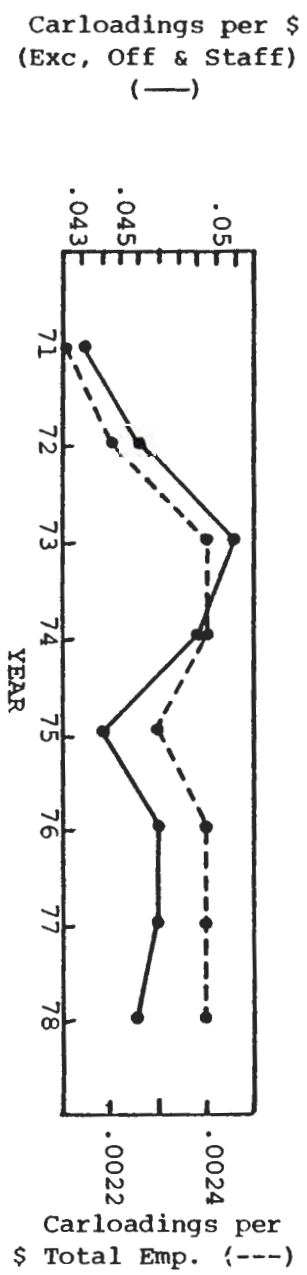
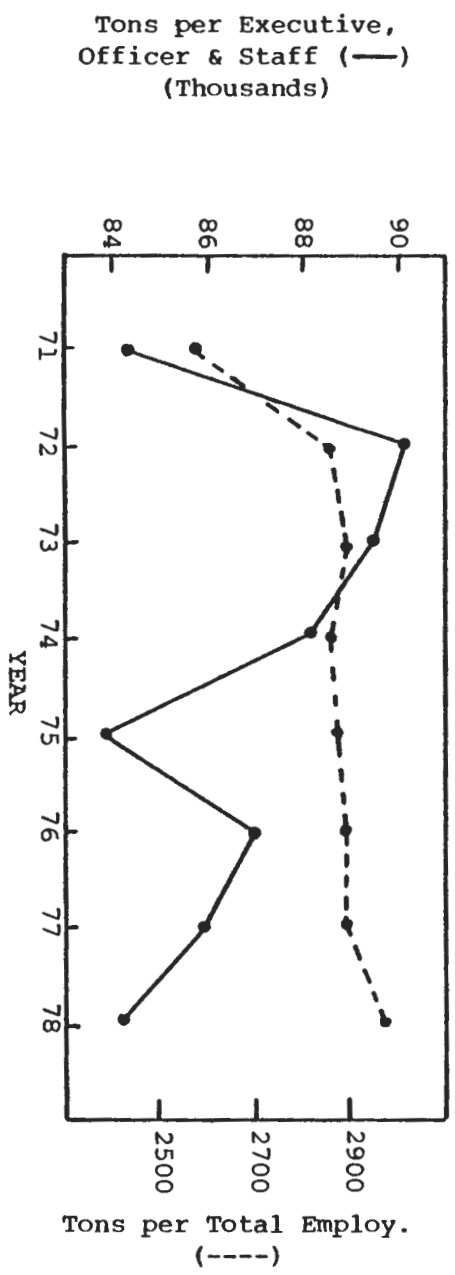
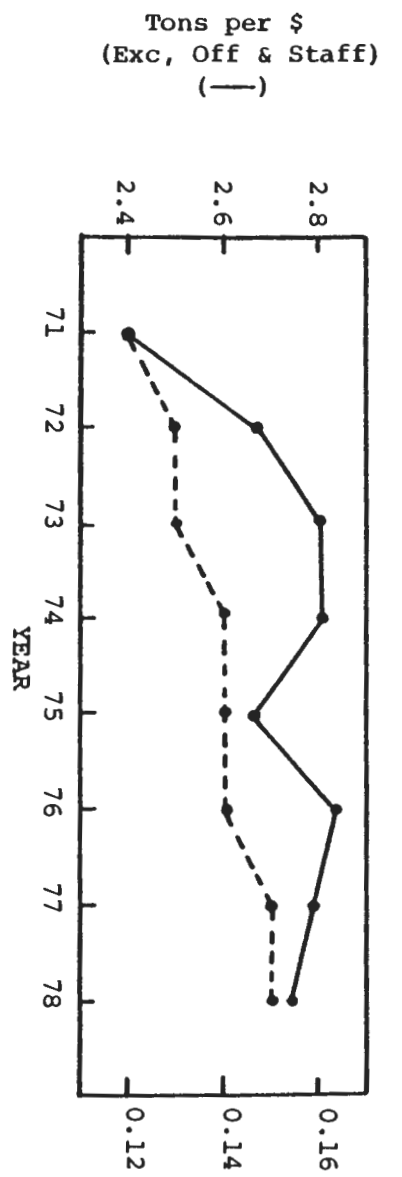
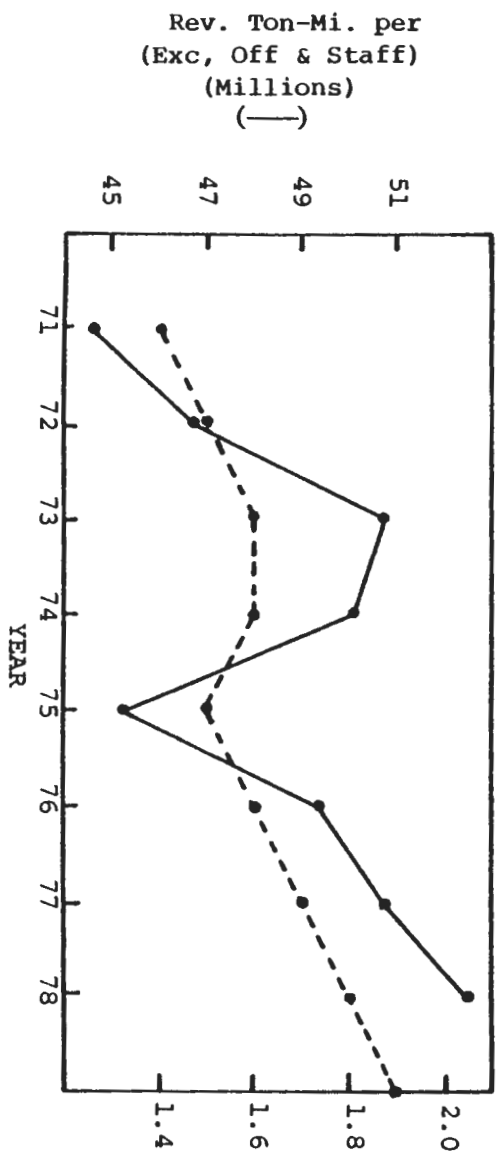
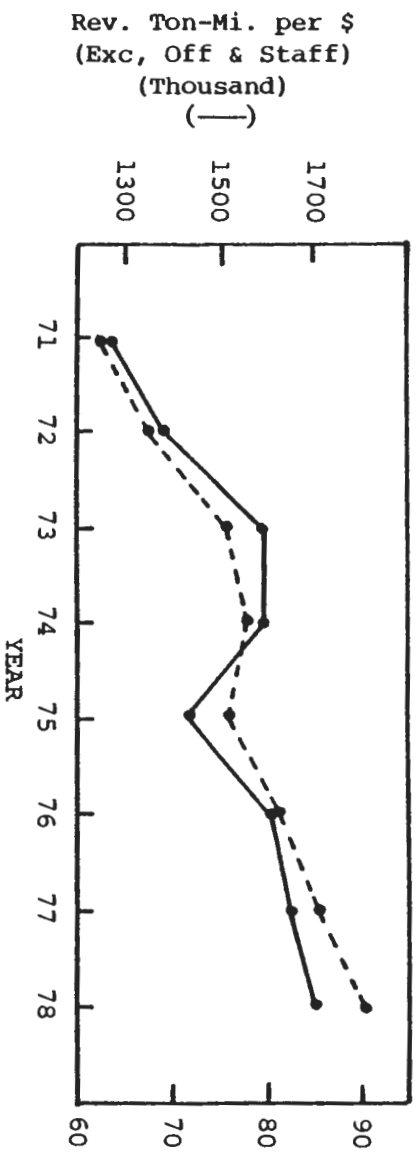


FIGURE C-2. OUTPUT BY MANAGEMENT AND BY ALL EMPLOYEES



Rev. Ton-Mi. per \$ (Tot. Emp.)
(---)

Rev. Ton-Mi. per Total Emp.
(Millions) (---)

Tons per \$ Tot. Empl.
(---)

FIGURE C-2 (Continued)

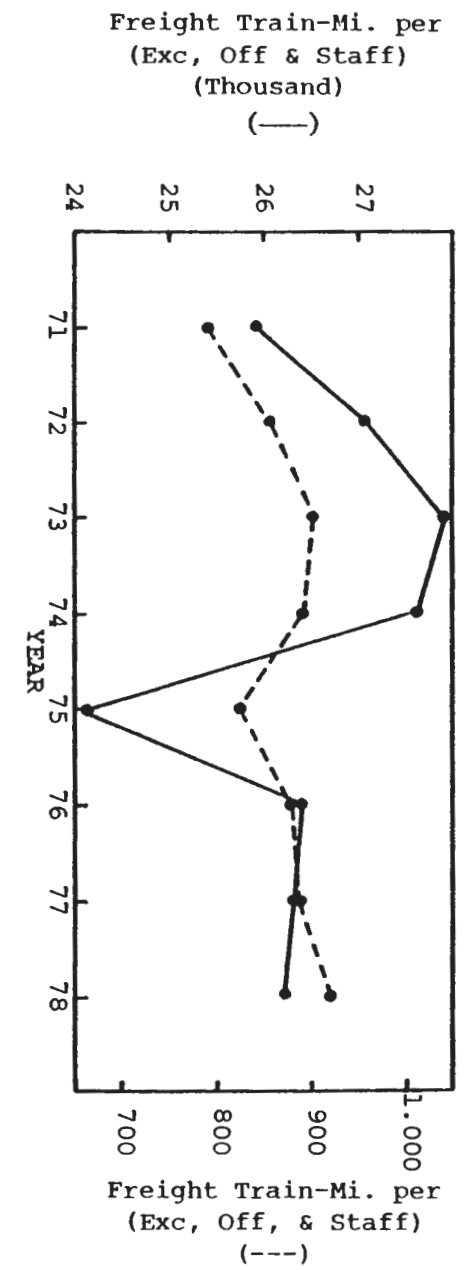
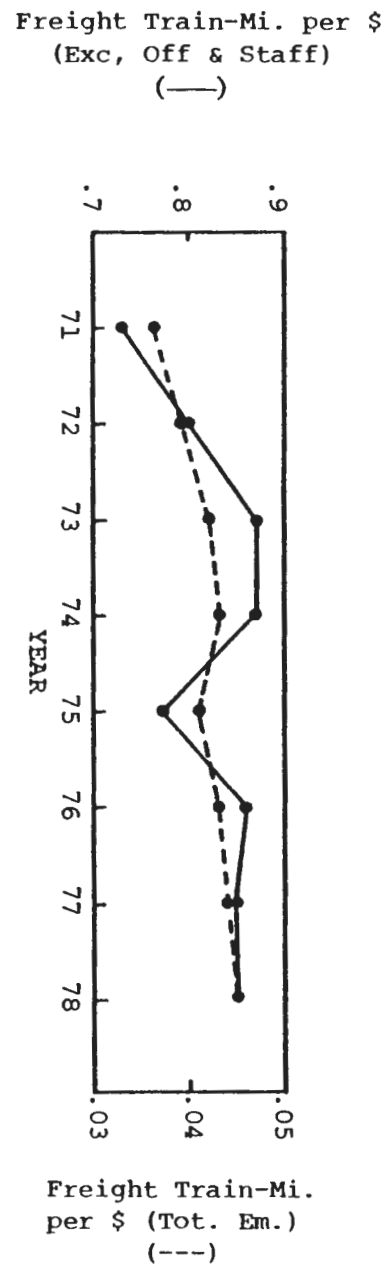
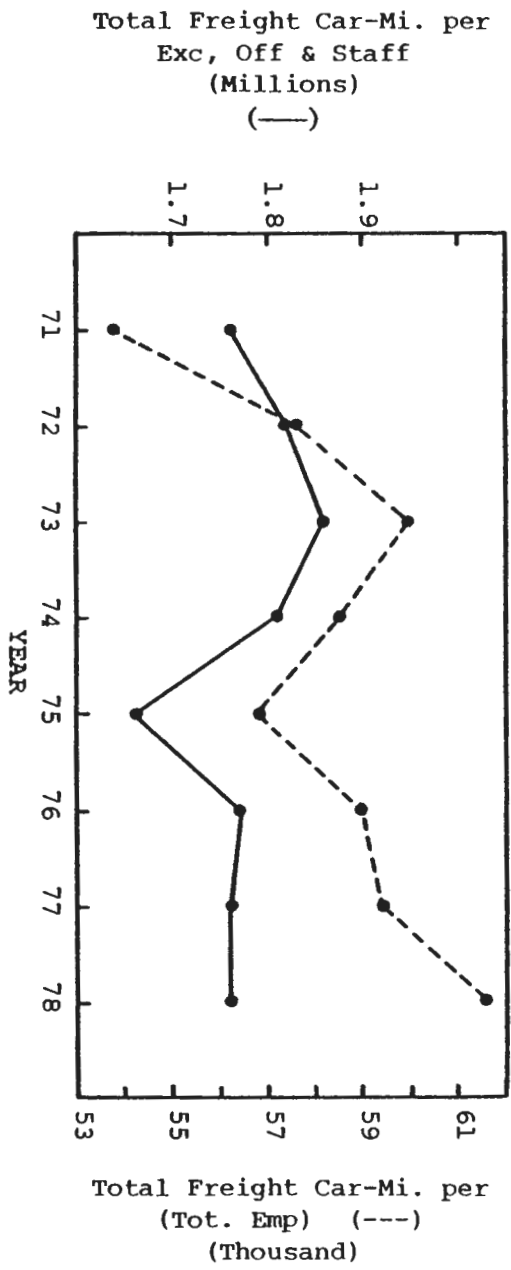
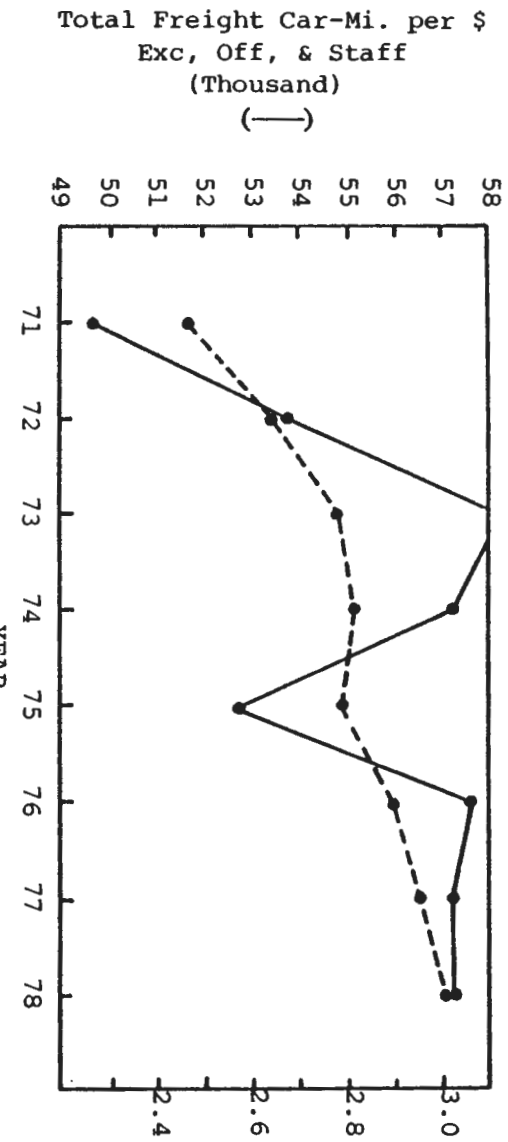
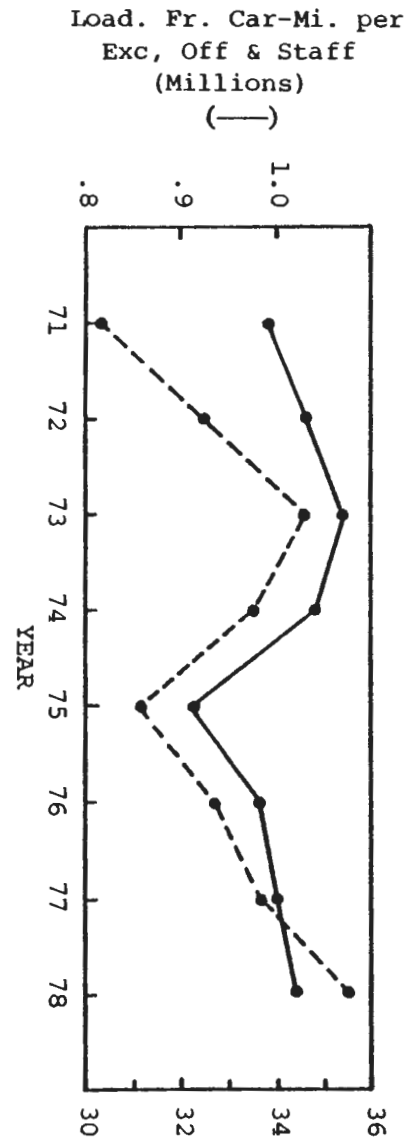


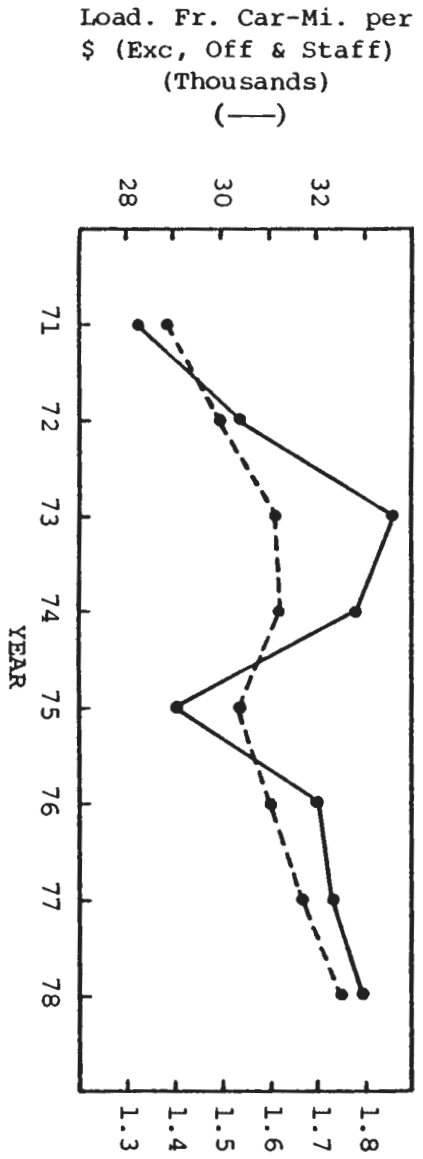
FIGURE C-2 (Continued)



Total Freight Car-Mi. per \$ (Tot. Employ) (---)

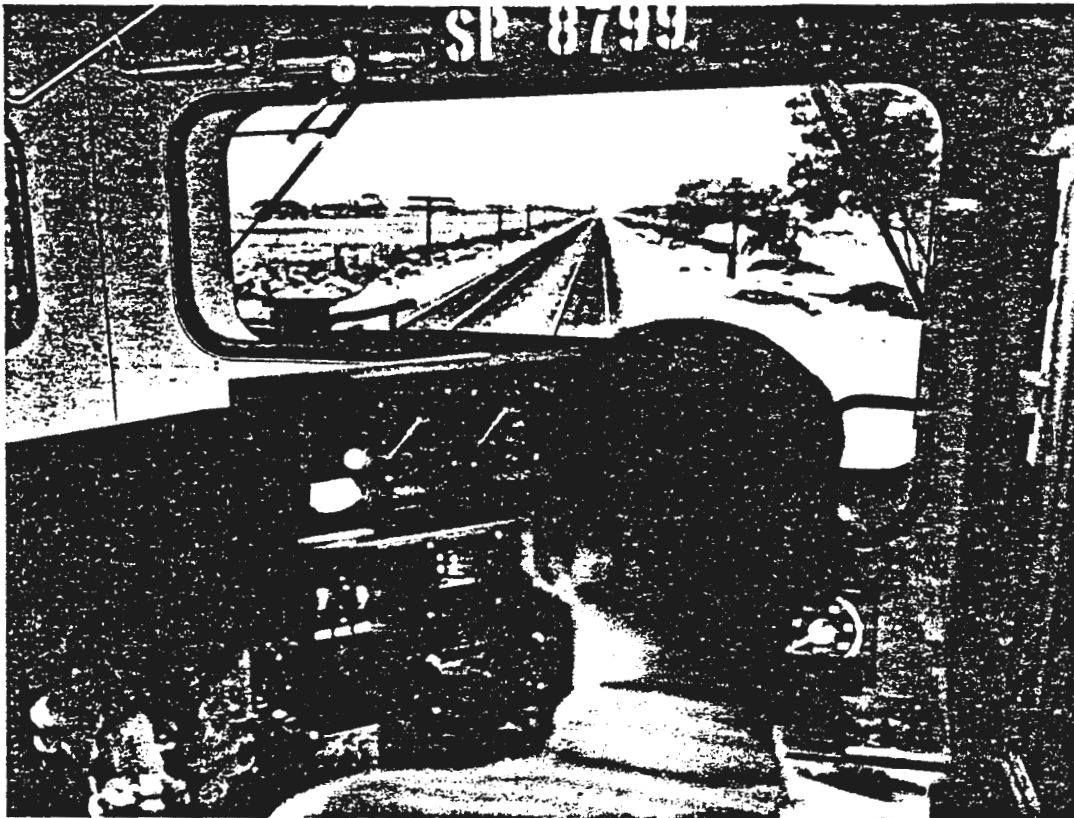


Load. Freight Car-Mi. per Tot. Emp. (Thousands) (---)

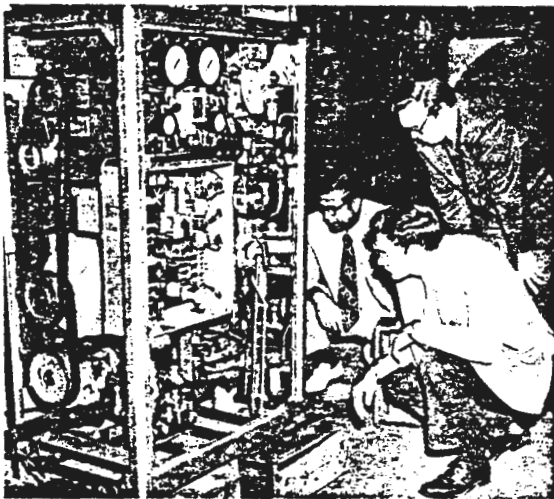


Load. Freight Car-Mi. per \$ (Tot. Emp) (---)

FIGURE C-2 (Continued)



ENGINE AND TRAIN SIMULATORS, introduced by Southern Pacific (above) and Santa Fe, have now been adopted by several other roads.



SUPPLIERS IN THE ACT: Vapor Corp. conducts classes in operation and maintenance of steam generators in its Chicago plant.

The training scene: Busy and getting busier

By ROBERT D. BARTLEY, Associate Editor

School bells are ringing loud and clear these days on railroad properties throughout the United States and Canada. On railroads large and small, there is a new emphasis on development of training programs that will enable employees—top management as well as new apprentices—to learn new skills or to discover how to do their jobs better.

Not too long ago, a noted labor leader described the railroads as "the nation's great untrained industry," where the lack of emphasis on training was stifling the development of new ideas that would help it reach its full potential. Is the railroad industry really the vast training wasteland that he described?

● Who, what, where. Here are some of the things going on in the industry today that say otherwise:

Source: Bartley, Robert D., "The Training Scene: Busy and Getting Busier," *Railway Age*, February 25, 1974, pp. 18-21. (Reprinted by permission of the publisher.)

—On an 18-acre site near McDonough, Ga., Southern has broken ground for a \$1-million training center where programs for locomotive engineers, communications, signal and shopcraft employees as well as management trainees will be conducted. The center will have a staff of 12-15 full-time instructors and will handle 50-60 students at a time.

—Employee-owned Chicago & North Western is mapping plans for a new technical training center west of Chicago where courses similar to those planned for the Southern's new training center will be conducted.

—Audio-visual training aids, including color tv, are being used extensively throughout the industry. Burlington Northern, for example, has full-color production capabilities for tv tapes and has produced 45 in-house training tapes, with more on the way. Twenty-three repair facilities, mostly locomotive shops, are fully-equipped with tv sets and cassette players for use in all types of training programs.

—Santa Fe and Southern Pacific introduced simulators for locomotive engineer training to the railroad industry in 1969. Since then, several roads have either built their own simulators or have had them commercially-designed. Canadian National expects to have a simulator in full operation at its Gimli, Man., training center in 1975. Meanwhile, BN has announced plans to install a locomotive and train simulator in a new \$2.25-million training center in St. Paul, Minn.

—The Railway Educational Bureau, which enrolls approximately 3,000 railroad employees a year—primarily shopcraft skills—in its correspondence school operating out of Omaha, Nebr., added 50 new lessons in 1973. The school offers 750 individual lesson units altogether, and is seeing strong emphasis being placed by the railroads on skill-upgrading in addition to apprentice training.

—Training on railroad property is not limited to workmen on first-line supervision. On the Union Pacific, for example, all levels of management engage in various types of training programs throughout the year. The road's top 44 officers attend a three-week seminar each year that is conducted by non-company leaders. Programs for other levels of management cover basic management and behavioral sciences.

—Since the railroads have become heavily dependent upon the computer for day-to-day operations as well as long-range planning, new emphasis has been placed on the training of personnel involved in data processing. MoPac, for example, has a video tape-assisted training program which is being used to teach personnel how to feed data into its complex Transportation Control System and how to cope with the many changes taking place in this computer-oriented freight car control system. And UP, which is just now introducing an improved version of its COIN (Complete Operation Information) computer-based information gathering and distribution network, is conducting training classes throughout the 9,500-mile rail system, using a highway van and a converted dining car as classrooms.

—Sales training on the railroads is getting a tremendous boost these days. For instance, on the MoPac, an in-house training program that extends from top to bottom in the Traffic Department, with strong emphasis on a Management-by-Objective approach to establishing individual sales goals, is reaping impressive benefits. TV playbacks are used extensively to allow salesmen to critique their own simulated "sales calls."

The list of subjects covered by training programs on the railroads goes on and on. There are switchman training programs, signal technician training courses, yard clerk programs, apprenticeship and craft upgrading sessions, rates and divisions training programs, track equipment maintenance seminars, training for special services personnel, air brake instruction, and there are even training programs for those who will be responsible for training others.

• DOT, suppliers pitch in. Railroads aren't going it alone in preparing and conducting training courses and classes relating to the rail industry. At the Department of Transportation's

February 25, 1974



METALLOGRAPH is one of training aids at DOT's Transportation Safety Institute, Oklahoma City.

Transportation Safety Institute, in Oklahoma City, six railroad-related training courses have been developed; two more courses are being prepared for introduction this year. These courses, most of which are of two weeks' duration, were developed under the direction of the Federal Railroad Administration's Office of Safety for training Federal railroad inspectors. But, as FRA is quick to point out, railroad and rail union representatives are more than welcome to participate. The emphasis in these courses is on accident prevention and achieving compliance with new Federal safety standards and environmental laws.

Industry suppliers are also pitching in with in-plant training programs and they also furnish the railroads with training films and tv tapes, plus brochures and other training aids. Electro-Motive Division of General Motors, for instance, conducts seminars periodically to instruct railroad personnel on a variety of subjects relating to motive power. In April, a session will be held for purchasing and material management people. And training sessions covering a host of technical subjects are conducted throughout the year at the locomotive builder's LaGrange, Ill., headquarters.

Other firms—General Electric, New York Air Brake, WABCO, Vapor Corp., and many, many more—also participate in training programs for railroad employees. Vapor, for example, has just completed making the rounds of key locomotive maintenance facilities throughout the country conducting training sessions on proper maintenance of boilers on Amtrak locomotives.

Seeking to avoid en route accidents caused by the failure of loading personnel to check hitches to see if trailers are secured firmly aboard piggyback flat cars, Trailer Train had six special hitch-instruction cars built a couple of years ago. Equipped with six different styles of hitches, each car can be taken around the country to piggyback loading sites where loading personnel can receive training in hitch operation. Since developing these cars, Trailer Train in cooperation with BN, IVC Corp., Minneapolis, and REB, has also produced a tv training tape on the hitch securement subject.

● **Craft programs** are lengthy. Not only does the training available to railroad employees cover a wide variety of subjects, but it also varies in length. The shopcraft apprentice programs on most roads extend over a three- or four-year period. En route to attaining a journeyman classification,

machinist or electrician apprentices will attend three, perhaps four, four-hour classes each month in the training period while also undergoing on-the-job training.

Many railroads use the lesson plans developed by the Railway Educational Bureau, which, like Railway Age, is part of Simmons-Boardman Publishing Corp. Other schools, such as DeVry Institute of Technology, Ohio Technical College and Central Technical Institute, offer courses on subjects which will help apprentices improve their knowledge and skills.

REB requires two lessons a month in its study program, although a railroad may, if it wishes, increase the number. Aside from providing the lesson books, REB also develops the tests and grades them. The cost of an REB study course extending over the full apprentice period is \$230 per student.

Surprisingly, the railroad industry itself does not have a central agency which oversees training developments. However, the Training and Development Section of the Railroad Personnel Association does an effective job of keeping member railroads informed of any new training techniques, methods or equipment which will enable training departments to keep abreast of new developments.

John Lines, assistant vice president-training and development at the Chicago & North Western, and chairman of the T&D section of RPA, reports that members are "constantly assisting each other in the development of modern, effective and practical training programs in all appropriate craft areas as well as in management and supervisory areas."

Training to improve safety is getting special emphasis these days. Lines adds, "Daily—even hourly sometimes—we're seeing new reasons for stressing safety training. With Federal agencies getting more involved in railroad accident prevention, we'll have to be more concerned with safety training."

● **Training is costly.** The cost to the railroads to train new people or to upgrade the skills of veteran employees is sizable. Conversely, the expenses which will surely be encountered due to the errors or inefficiencies of improperly trained employees would no doubt be even greater. Furthermore, studies of employee behavior have shown that the man who does not have the opportunity to improve his skills on the job is apt to leave the job. And, as a study made by the Louisville & Nashville a couple of years ago showed, a railroad will have a minimum of \$409 invested in a new employee before he actually begins work. Included in this figure are the costs of recruiting, screening, interviewing, physical examinations, required paperwork, background investigation and 10 days' training in the basic requirement for the job.

The locomotive and train operations simulators represent perhaps better than anything else the full extent of modern training methods being used by the railroads today. Santa Fe's simulator, for example, which can reproduce the sights, sounds, motions and actions of a diesel-electric locomotive with uncanny realism, is part of a 25-week training program for prospective locomotive engineers.

The Santa Fe program requires 18 weeks of qualifying road trips for firemen preparing for promotion to locomotive engineer, six weeks of instruction including use of the simulator, and finally one week of examination on road trips in the student's home district. Written and oral examinations are conducted throughout the training period on such subjects as air brake equipment and train handling, locomotive operation, operating rules, and so forth. Simulator operation, in which trains of various sizes and configurations can be introduced electronically to the trainee in the cab seat simply by flipping a few switches on the control console of the computer-controlled unit, is scheduled in seven two-hour sessions. Astonishing results are being reported by Santa Fe officials on the quality of locomotive engineers who have enrolled in the course.

● **Training via the tube.** Television represents another excellent example of how railroads are employing modern

technology in their training programs. The use of tv is widespread on the railroads. Recently, the AAR conducted a survey to determine to what extent tv and other audio-visual aids were being used. Thirty-six roads, a good cross-section of the industry, responded to the survey questionnaire. Here's what the survey indicated:

-The majority felt that a clearing house for audio-visual training aids was definitely desirable and they would be willing to support it with information exchange and the payment of nominal service charges.

-Almost two-thirds of the respondents indicated that they have produced or plan to produce audio-visual aids which they would offer for sale or use through such a clearing-house.

-Most roads recommended that a clearing house should also include other training material.

-Almost two-thirds of the roads that replied have video tape equipment, and the majority who do also have tape production units. A few have color production capabilities.

-Of those who don't have tape equipment, the majority reported that they were planning to invest in it.

-Subjects currently covered by video tape training aids include: safety, operating rules, mechanical instruction, personnel matters, computer operation, public relations, sales, track maintenance and management training.

-Most of the responding roads indicated that they would be interested in purchasing or leasing video tapes made by other railroads, with the subject of prime interest being safety and mechanical training.

Aside from the tv-assisted training programs that are produced in-house, there are those that are developed commercially. One of the firms that produces these video tape training programs is Advanced Systems Inc. With over 600 program titles on hand, ASI can tailor the training system to meet specific needs. The programs lean heavily toward management and data processing subjects and are applicable to most businesses and industries, including the railroads.

For those railroads that wish to produce their own video tape training programs, the costs will vary all over the lot. A ballpark cost range for a complete program produced by outside specialists with everything—from script to the tv tape that will be used in actual training—is \$80-\$200 per minute. The purchase price of a basic—but complete—tv production system is about \$6,000, including cameras, recorder, monitors, etc. The cost, however, will vary in different parts of the country. But, tv tapes are not cheap to produce, no matter where they're made, and a blank tape itself is not cheap—\$25 per hour for black-and-white.

But, the video tapes have much more flexibility than movie films, and the trend in training is definitely in their direction. It is the desire of a number of railroad training departments—and of certain members of the railroad supply industry who are frequently called upon to furnish training material to their customers—to see some form of standardization develop in the near future so far as training tapes are concerned. Some feel that, should a clearinghouse be established for training material, standardization will be a primary objective.

• Show and tell is best. It was determined a long time ago—and confirmed many times after that—that the method of instruction which gets the best results is the one where telling and showing are blended. And the best way for students to retain information that has been studied is to say what they're doing as they actually do it. Many roads encourage these methods of instruction and learning. The "hands on" system is especially popular.

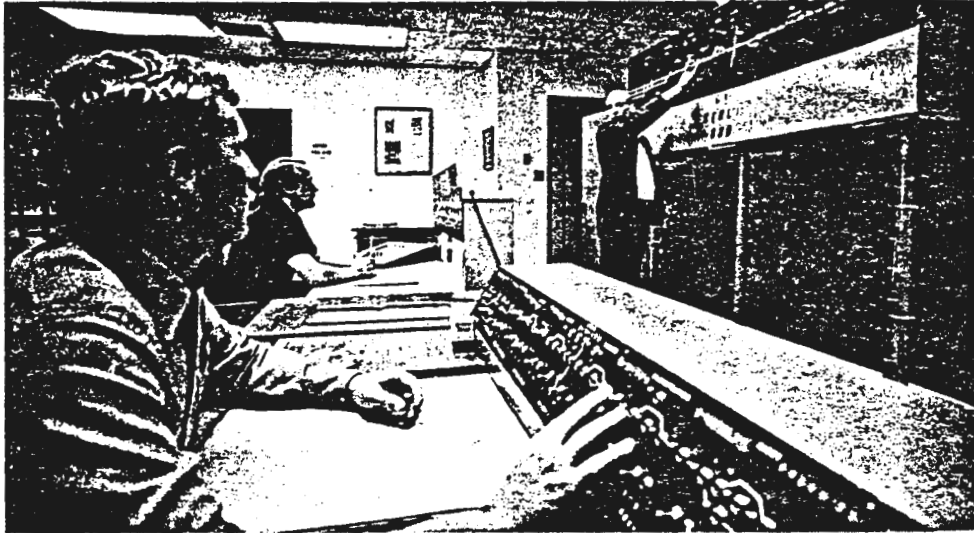
The trend in the industry is definitely toward more—and better—training programs. Some roads have as many as three dozen training programs which are offered employees, and they're planning more. Unquestionably, the industry is rapidly becoming one of the nation's better-trained industries.

February 25, 1974

Who will run the railroads?

By Frank E. Shaffer

Half of 1978's railroaders will retire within the next 10 years. Recruiting replacements is an urgent matter



Canadian National operates the only simulator for training dispatchers. A CTC board at Gimli, Manitoba, can receive inputs from the instructor, at the trainee's right.

"People want to work for the railroad," Chessie System's Norman G. Halpern says.

As senior vice president, labor relations, personnel and organization planning, he is impressed with the large volume of letters from job applicants.

"People working elsewhere want to come to the railroad. Congressmen have even written about constituents who want jobs. And this past year we got the highest quality group of engineers we've had in many years."

Of course, there's another side to the story. Consider the following incident, which occurred at a yard office in 1976.

An enthusiastic young man had just begun his first job—as a clerk. The work was challenging. He worked hard and enjoyed every hour. But some old-timers in the office complained that he was working too fast and making them look bad. Finally, they ordered him to slow down. He left.

Such are the challenges of the 70's—compounded often by a negative image of the railroads. New federal regulations and mandates for "affirmative action" in seeking out minority workers also spell problems for railroads.

The challenges show no sign of stopping. For example, by the time 1987 rolls

around, Union Pacific points out, about half of its 26,000 workers will have retired. Indeed, about half of the industry's workers have celebrated 52 or more birthdays.

Uncle Sam believes he should pitch in to help. FRA conducted a training conference in St. Louis, Jan. 31-Feb. 2, "to establish a dialogue to enable public sector education and training people to understand the needs, the requirements and future employment possibilities within the railroad industry." There, the U.S. Dept. of Labor, the Job Corps, and other agencies described programs available to railroads.

In the past decade, rail-

36/MODERN RAILROADS APRIL, 1978

Source: Shaffer, Frank E., "Who Will Run the Railroads?," *Modern Railroads*, April 1978, pp. 36-39. (Reprinted by permission of the publisher.)

roads have begun vast new training programs. Conrail has a signal school in Columbus, Ohio. Chessie and Conrail are training section foremen. CP Rail, in its first year of operating four track worker schools, will graduate 2000 this year. Locomotive training highlights the new wave of training programs. Southern Pacific and Santa Fe led the way with simulators in 1970. SP installed its equipment in a training center at Carritos, near Los Angeles. The ATSF mounted its equipment in a special car which tours the system. Canadian National developed a center at Gimli, Manitoba (north of Winnipeg), where engineers and dispatchers receive training, and, along with officials, learn railroad rules.

Much training for enginemen is handled in units designed by Freight-Master and leased to railroads (see *MR*, Dec. 1977, p. 85). The units are in service or on order for BN, CP Rail, Chessie System, Conrail, Family Lines, ICG, Quebec Cartier, Soo Line, Southern, and UP.

Overview

The Railway Personnel Association—the industry organization which monitors and exchanges employee programs—held its training and development session in Atlanta a month ago. RPA members discussed employment and selection, organizational planning and development, compensation and benefits,

Talent scout

The key to success in railroading is picking the right people and delegating responsibilities to them. Such was the philosophy of Alfred E. Periman, former president of the New York Central, Penn Central, and Western Pacific. The 76-year-old executive began his career in the engineering department of the Northern Pacific.

"Picking the right people and delegating responsibilities to them was a great influence on the success of our railroads," he said.

"A man might be the greatest salesman on earth but when he's promoted to sales manager, that's a different situation and he might fall flat on his face."

When the late Robert R. Young selected Mr. Periman to help rescue the New York Central in June 1954, he was relatively unknown to the general public as president of the D&RGW. But his methods of management had attracted considerable attention.

"In our first year on the Central," Mr. Periman recalls, "we had 400 men in 30-day management training sessions. There were 200 a year in in-house training."

To expose his men to a wide variety of conditions, they were taken on inspection trips ("we took lawyers along so they could see what the railroad was"). In budget meetings each department had to justify its requests in the presence of its peers.

"Traffic would have to prove the soundness of its request for more cars. Master mechanics had to justify the need for new machinery."

Officers were watched for their performances on inspections and at budget meetings as well as at their regular jobs.

"When you have a flow of new people coming in at the lower level, you keep your thinking modern. Young people ask questions."

A famous Periman dictum was: "When you've been doing something for five years, take a good hard look at it. When you've been doing it for 10 years, throw it out and get something better."

Recruiting was not confined to Ivy League schools. Regional managers scouted local college talent.

"We all learn by trial and error," Mr. Periman pointed out. There are patterns in life. Some days everything seems to go wrong. Other days things are worse but you find you can handle everything that comes along.

"No two individuals can be handled alike by their superiors. Some go to pieces when you correct their mistakes. Others have to be chewed out to get them going."

Is a hard taskmaster shunned?

"Five guys back there (Penn Central) took cuts to come out here with me. People don't want to work for a sloppy boss. I was hard but I rewarded them. I'm not insecure; I built them up with praise."

D&RGW chairman G.B. "Gus" Aydelott was one of "Periman's men" on the Rio Grande. On the NYC he trained three from different schools who became railroad presidents: R.G. "Mike" Flannery (Purdue), Western Pacific; John W. Ingram (Columbia), Rock Island; and John C. Kenefick (Princeton), Union Pacific.

and employee assistance.

SCL's Earl Holcomb, RPA president, points to the strength of the industry's programs:

"Railroad training is much better than its reputation. One need only look at the turnover rate to see how valuable our people believe their jobs are. The rate is much lower than in other industries."

Results

One of the better-known railroad training programs—run by the former Baltimore & Ohio—grew out of industrial engineering.

"I wasn't part of the program during the Langdon-Dixon-Bertrand era," David A. Watts Jr. recalls. Mr. Watts was v.p.-operations, Amtrak, but now is v.p.-service operations, Fruit Growers Express. "I started on the Western Maryland, then controlled by the B&O under the training of George Leilich."

Training programs on the B&O began in the late 50's. President Jervis Langdon put them under the executive department in 1961. In 1964 they were combined with C&O programs.

William J. Dixon, then director of industrial engineering, looks back at the program's results.

"The people we had in the program included Paul H. Reistrup, now president of Amtrak; Robert A. Sharp, president of Detroit, Toledo & Ironton; Kent Shoemaker, also a DT&I president; Dick

Campus visits are successful

(Richard G.) Rayburn, Chessie's v.p.-transportation; Charles D. Leddon, v.p.-operations, Louisville & Nashville; George L. Stern, v.p.-operations, DT&I; and Bill (William F.) Howes Jr., v.p.-Casualty Prevention Dept. for Chessie."

From another program, one with special training for existing employees, came Jack Humbert, who became v.p.-operations on Reading and later on Illinois Central Gulf.

More training

More than 2000 first-line supervisors have gone through Norfolk & Western programs since 1971.

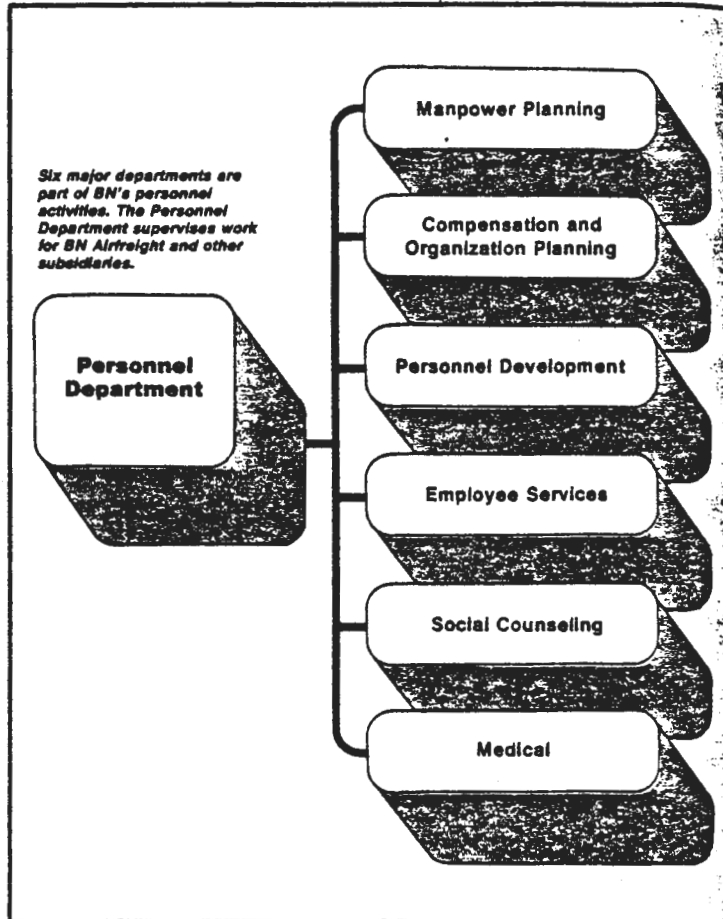
"We work with the University of Virginia in these programs," N&W's Al Graham, asst. v.p.-personnel, says. "Some of our classes have been held off campus, some on. We've provided courses for 200 middle managers in 'management by objective' training."

General Motors' Electro-Motive Division uses a unique type of training, which Max Ephraim, chief engineer, says began a year ago. "We needed to broaden the engineers who came to us in order that they could learn mechanical problems, operating conditions, and maintenance. We have three or four out on the line at any one time.

"There are three-month standing assignments on the UP at North Platte, Neb., the SP at Roseville, Cal., and the Santa Fe at Barstow. They work with the sales and service department, ride the locomotives, and see the shops."

EMD finds the programs successful.

"These people are moving up," says Mr. Ephraim. "In the beginning of the program we sent a trainee named John Gable to the UP for a year. He's now



running our South African operation."

EMD encourages engineers to work for their MBA degrees at one of three cooperating universities.

"We expect our men to be bulldogs—because from the customer's viewpoint, the engineer is the guarantor of the locomotive," Mr. Ephraim says.

Southern Railway operates what may be the largest individual training school in the U.S. at McDonough, Ga. A class of 577 graduated from here in 1977.

"Courses for engineers and shopcraft workers, as well as technical training for management, have been joined by new classes for

signalmen and agency personnel," said Pat Weldon, SR's director of training.

"We are now completing a film studio where we'll make videotapes to be used there as well as out on the property."

Admission to the locomotive engineer's school is available to all who have one year's experience as a switchman-trainman and are recommended by supervisors.

Says Mr. Weldon: "We have tapes on 7500 mi of our major routes for use in the simulator. Those are used in a program where the trainee controls the train. We have another 2000 mi of tapes for use on our 'poor man's simulator,'

where trainees respond to problems."

College degrees

Most railroads are satisfied with their ability to recruit qualified personnel on college campus visits.

BN made 38 college visits in the 1976-77 school year, conducted 1052 interviews, made 38 offers and received 22 acceptances. The road begins corporate training classes each spring and fall, says David Ylkanen, BN personnel director.

UP's Vernon Krider, director of personnel, reports acceptance of offers by 92 students in 1977 as the result of 444 interviews at 30 schools.

"We recruit heavily in the southeastern states where we operate," Family Lines' Earl Holcomb reports. "We seldom have a turndown from students once they accept our offer to visit the property."

Conrail hired 50 civil engineers a year ago and will add mechanical and civil engineers this year.

"While we want civil, industrial, and electrical engineers, we find that we get three applications with business backgrounds for each one from an engineering graduate," John Lynch, Conrail's management recruiting chief, says.

Are colleges and universities graduating enough engineers for railroads' needs?

Mr. Lynch says "no," perhaps because Conrail has a greater need than any other road. Part of that need is based on the road's major rebuilding programs in road and equipment. Part

is based on the loss of some to Amtrak's Northeast Corridor project.

The retirement of Professor William Hay, at the University of Illinois, leaves the U.S. without any institution granting a degree in railroad engineering. One of Prof. Hay's students, Prof. A.J. Reinschmidt, is at Penn State University. He hopes to add undergraduate courses in operating economics and construction and maintenance.

"I'm patterning this on the basis of what Prof. Hay had done. We're now looking into master's degree programs, as well as a two-year undergraduate railroad technology course at our Wilkes-Barre campus. We have a highway technicians' program there and with minor changes could center it on railroading."

Do railroads recruit at Penn State?

"Amtrak comes here," he says. "So do Chessie Sys-

tem and ICG along with Conrail. Amtrak took six or seven of our people last year."

Prof. Reinschmidt adds a word of caution for recruiters.

"A few are particularly bad. After an interview they'll promise a reply. When the student doesn't hear from them and decides to call, he's told it's right there on the personnel man's desk and that he'll send it right out. But he doesn't."

There's irony in the words of Prof. Hay as he views the railroad scene:

"A delegation from Brazil came to this country to learn how to establish a school of railroad engineering. They asked me to spend six months there but I didn't want to be away that long."

For a nation that fostered so much of the world's railroad growth, the lack of a school seems tragic.

Educators who are still active lament the lack of industry support, especially since the world boom in heavy freight lines and high-speed passenger systems, coupled with petroleum supply problems, seems to hold the promise of a new rail era.

Postscript

Federal regulations have added a new dimension to personnel work in the form of "equal opportunity" mandates. A female engineer, either in the cab or in the engineering department, no longer is a novelty.

BN's recruiters regularly visit schools with large numbers of women and minority students. As other roads have done, it has established goals for minorities.

BN's Ylkanen explains: "We have established goals for hiring and promotion. Women make up 25 percent of our new hires and 15 percent of promotions. Minorities are 10 percent of hires and five percent of promotions."

"All departments have their goals and we monitor them to track their progress."

A story from a nameless road illustrates one of the minor problems on the path to equality.

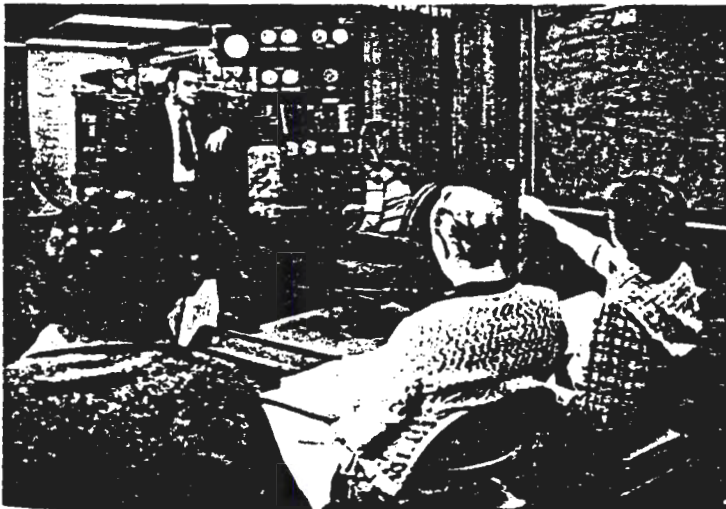
A switching foreman shouted instructions to one of his crews: "Kick four down two."

The switch person attempted to operate the turnout but was unable to move and secure it.

As the yard engine held its cut on the lead, the foreman ordered another member of his crew to go and do the job.

"Hell, no," was the reply. "If she can't do it, then it must be busted. Call the section crew." ■

UP trains its locomotive engineers at Cheyenne. A simulator will be in service later this year. There are 15 roads with some type of simulators used for training engineers.



Recruiting

Southern harvests the colleges

By TOM ICHNIOWSKI
Associate Editor

In a conference room at the Holiday Inn Four Seasons in Greensboro, N.C., a group of about 20 young men and women, all neatly dressed, are sitting quietly. They are at the Holiday Inn to be interviewed for jobs with the Southern Railway. Already, they have passed an initial screening, either in an interview at the college they attend, or from a review of the resume they sent to Southern. As Ronald S. Mack, Southern's manager of professional recruitment, stands before the group, hands in his pockets, and begins to talk about the company, it signals the start of a day-long scrutiny by Southern officials. By the end of the day, Southern representatives will have a good idea which students they will recommend to the company for a closer look.

"It's a long-established practice at Southern to infuse college-trained people into our company," says D. Henry Watts, vice president-personnel. As far back as the turn of the century, Southern has had a management training program. Those in the program used to be called "student apprentices."

Watts notes that Southern's present recruiting effort is part of a larger program of college relations. "You've really got to get yourselves, your management, involved on campus, and we try to do that in a vari-

ety of ways." Some top Southern officials work closely with specific colleges, either as members of the board or on advisory groups. College placement officers are invited to visit Southern's facilities. And Southern representatives speak before campus organizations. Besides being good public relations, this college relations program has a more direct payoff for the company.

Watts explains: "Many of the people that come to us in an interview session already know us, and that's really our objective." Ronald Mack says that 35-40% of the students who come to Southern's campus interviews cite as a reason for coming that they had heard someone from the company speak on campus previously. Watts feels that if a company waits until the time when a student is signing up for job interviews to make its presence known, it has already "lost the battle." He believes, "You've got to get your company in front of the student well in advance of that last three months that he's going to be on campus."

• **Side benefits for Southern.** Even if a student does not apply to work for Southern, Watts feels those presentations benefit the company. "If you go on campus and tell a group of civil engineers about Southern and show them a progressive company—so you don't recruit them for Southern, so they go into other fields—you haven't hurt yourself by any stretch of the

imagination. Maybe they become the traffic manager for General Foods, or something of that type."

Southern says it is strongly committed to its college recruiting program, and does not believe in cutting it back severely when business is slack. Roland Arrigoni, director of employment, notes that even in the recession year of 1975, Southern kept its recruiting at a 90% level. Arrigoni adds that the company is careful not to lay off new recruits: "One offer that is pulled back by a company has tremendous public-relations impact."

In the campus interviews, Southern does get questions about the health of the railroad industry, since students are concerned about job security and growth possibilities. But the company says it has no trouble filling up its interview schedules on campus. Watts thinks it's really a function of a couple of things: "One, there is a concern about the industry, but Southern is pretty well-known for its financial strength; and two, the work that we've done on campus, the work that we've done with individual professors of engineering, transportation, and so on. They know us, and they know that the company is strong."

Southern does most of its recruiting in colleges and universities in the territory it serves—primarily in the Southeast. Mack notes that since many students are close to Southern's main line, they can see that its



Recruitment Manager Ronald Mack outlines Southern's organization setup for potential job candidates in classroom-type session at Greensboro, N.C.

March 27, 1978

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Source: Ichniowski, Tom, "Southern Harvests the Colleges," Railway Age, March 27, 1978, pp. 41-44. (Reprinted by permission of the publisher.)



In a special-interest session, student job candidates question Southern's Employment Director Roland Arrigoni (left) and Training Coordinator Fred McCarty and trainee Scott Snow, both of the m/w and structures department.



facilities and equipment are up to date.

● "High-paying jobs." R.D. Hedberg, assistant vice president-personnel administration, adds. "The truth of the matter is, and you can go back 30, 40 years, railroad jobs were always considered high-paying jobs—jobs much in demand throughout the United States. And they still are high-paying jobs, whether it's a union job you're talking about or a management job."

What kind of student does Southern look for? Hedberg uses the adjectives all potential employers would use: "bright, energetic, highly motivated, work-oriented." But, Watts adds, "We are also looking for the person who is interested in our kind of work. And not all electrical engineers, civil engineers, or mechanical engineers are really interested in our kind of work." He explains that Southern is not primarily involved in "pure engineering," but more in "hands-on" work, out in the field, as a track supervisor or a shop foreman in the mechanical department, for example.

Competition for engineers is keen, because they are in great demand and the supply is relatively small. Southern's competition comes from "all over the lot," says Watts, including coal and oil companies, and occasionally head-to-head with other railroads.

The Southern officials feel that while

salary is an important factor, it is not the prime reason why students choose to go with their firm. Watts says, "We don't want to be the highest paying, we want to be high-average. And we maintain that rate so that we assure ourselves that the rate we're offering on campus is competitive with what other people are offering. You can't stick your head in the sand." But he adds that Southern does not engage in bidding wars for particular students. Instead, all trainees in a given department are paid at the same rate: "We don't go out with individual rates for individual students." Mack believes that a more important factor than salary for those who choose Southern is the responsibility they are given early in their career. For example, Watts says, a track supervisor has complete responsibility for 100-125 miles of track.

On another point, Hedberg says that Southern has set a goal of having 30% of its new hires come from minority groups, a goal the company says it has met. In order to reach that target, one Southern effort has been to recruit at several predominantly black schools in the South, such as Tuskegee Institute in Alabama and Grambling State University in Louisiana. Watts says, "If you think the overall competition on campus is severe, the competition for the black engineer is fantastic."

● **Recruiting procedures.** Southern's re-

cruiting takes place in two seasons: fall and winter. The process has three steps: the campus interview, the regional interview (such as the one at Greensboro), and the plant interview. The railroad has eight personnel officers and two employment managers who recruit, and each is assigned specific schools. In all, they visit about 40 schools and see between 800-900 students. On an average day, they will interview between 15 and 20 students. After the campus interview, the recruiter reports to the Washington, D.C., office, and recommends those students he feels should be invited to the regional interview. About 40% of those initially interviewed are asked to come to the second interview.

The regional interview is something relatively new for Southern. After the campus interviews, Southern used to invite the students it wanted to see again to either its Atlanta or Washington office, depending on the department the applicant was interested in. In fall, 1974, Southern ran an experiment at Mississippi State, and held the second interview near campus, not in Atlanta and Washington. As a result of that experiment, Southern began in 1975 to hold about 14 regional interviews each recruiting season.

The regional interviews have been a big success, Southern feels. They have received highly favorable response from students and, more significantly, have saved

the company money. Arrigoni estimates that Southern's cost per hire is down 30% from what it was before the regional interviews began. Now, instead of paying an applicant's way from, say, Raleigh, N.C., to Atlanta, Southern can cut its costs and invite him to a regional interview in Greensboro.

The next step is the plant interview. From those seen at the regional interviews, Southern trims the candidate list down drastically. To indicate the degree of selectivity involved, here is a breakdown of those interviewed in the last two years:

	Campus	Regional	Plant
1976:	809	298	43
1977:	889	392	45

Those who go to plant interviews will meet with a top officer of the department they are interested in. And those visits to the plant almost always lead to a job offer.

Of those offered positions, over 75% accept. In 1976, 33 of the 43 persons who were offered jobs decided to accept. In 1977, 35 of 45 said yes. Mack says, "That's not bad at all."

● **Recruiting recruiters.** In choosing its recruiters, Southern takes people with two to four years experience in another department (for example, m/w or marketing) and plucks them out for a two-to-three-year assignment as a personnel officer. After that, they may decide to stay in personnel or return to their original department. Since they recruit for all of Southern's departments, personnel officers learn about the workings of the entire company—good experience for future advancement. Arrigoni acknowledges that in choosing personnel officers, "We look for high-potential people," but adds, "I don't want to give the impression these are crown princes."

Arrigoni himself has an extensive background in college recruiting of the most serious kind. In 1958, he was at Florida State and from 1959 to 1965 at the University of Maryland, as an assistant football coach. While at Maryland, he was responsible for recruiting in western Pennsylvania, a region rich in high-school football talent, where college coaches battle over top prospects every year. After leaving coaching, Arrigoni went into personnel work. In 1971 he came to Southern as manager of college relations, and in 1976 he became director of employment.

● **The informal approach.** At the Greensboro interview, Arrigoni is sitting at a table in the back of the room. While Mack talks to the group, Arrigoni takes notes, evaluating the presentation. He says that Southern aims for a "classroom-type" setting in the interview, and tries to make it informal, so it doesn't seem like a "canned" presentation.

After Mack's brief remarks, a film is shown that emphasizes the modern aspects of running a railroad, such as the growing importance of computers, classification yards, and microwave communications. Following the film, Mack rolls out

a blackboard, sketches in the organization of the company, and then talks about the specific jobs the students are interested in. He covers salaries, job location, and what each position entails. By this time, most of the applicants, though not asking many questions, are taking lots of notes.

A slide and tape show on fringe benefits is next. Then, the applicants move into small groups, according to their department of interest—m/w, mechanical, marketing, sales—for discussions with a Southern official who has a background in that area. By far the largest number listen to Fred McCarty, training coordinator, maintenance of way and structures department, and Scott Snow, a trainee in the m/w department. "That's typical of the regionals," says McCarty. The Greensboro session is the only regional interview in North Carolina in the winter-spring recruiting season. This group is a bit larger than usual, the average at a regional interview being about 12. Schools represented include the University of North Carolina, North Carolina State, North Carolina A&T, Meredith College, and Winston-Salem State University.

After lunch, the group returns to the conference room for a series of tests. While the tests are going on, the students are called out one by one for interviews. Each Southern interviewer has staked out a table in the Skylight Cafe, and each interview lasts about a half-hour. Finally, if the tests have been completed, the student is free to go. By then, it is after 4 p.m.

● **"...a warm feeling..."** Christa Burris, a math major from Meredith College interested in marketing, finds the regional interview convenient. "This way I just miss one day of class." However, she does say that a trip to Washington would have been appealing.

Daryl King, a 1976 graduate of Winston-Salem State, says he got "a warm feeling" about the Southern from its presentation, and that the picture the company gave was realistic: "They'll show you both sides—the sunny side and the dull side."

Karen Hurst, whose husband Roger was being interviewed for a position in the m/w department, appreciates Southern's inviting her to come to her husband's interview. "It's impressed me a lot that they've gone to all the trouble."

Robert Russell, a civil engineering major at North Carolina State, notes that his interviewer asked about his long-range as well as short-range goals. Russell feels that "a company that will look out for your future—you've got a future with them."

Christa Burris says there was some hesitation in her family when she told them she was going for an interview with Southern. "The first thing my mother said was: 'Railroads are dying. You don't want to go in with them.'" But then, after learning about the Southern, she says, "Of course, I corrected her right away." ■

E. MINUTES OF RAILROAD EDUCATIONAL NEEDS MEETINGS

Railroad Education June 5, 1978

Introduction

Under its contract with the Transportation Research Board (TRB) the Federal Railroad Administration (FRA) has asked TRB to examine the state of railroad education in the United States and determine whether or not the situation indicates need for action by FRA.

A proposed task was forwarded to TRB expressing concern that American universities are not preparing graduates for a career in railroading. The task work statement asked if FRA should do anything and listed specific questions to help in deciding what might be done. See Attachment 1.

In response to receipt of the proposed task an ad hoc meeting was held on June 5, 1978 in the TRB offices to discuss the situation. The attendees are listed in Attachment 2. The following is a summary of the discussions held during that meeting.

Background

R.E. Parsons reported FRA has attempted unsuccessfully for the last two years to obtain approval for funds to support development of railroad curriculums in several universities and provide fellowships for students taking such courses. Theodore Vass reported FRA is working with the Department of Labor to start vocational training for technicians.

Next the available university programs were discussed. There are about six universities which include one or two railroad engineering courses in their civil engineering curriculums and one which is starting a course in mechanical engineering. There are courses in transportation, usually at the graduate level in a number of civil engineering, regional planning and business administration departments but there is little railroad content. There are no schools known to have railroad courses in electrical engineering.

Railroads in the past have hired more civil engineers than any other college major. A number of railroads have

training programs for college graduates that last from 6 months to 2 years. However, the marginally profitable railroads who most need to upgrade the quality and supervision of their management have little or no formal training.

Need for Railroad Curriculum

The first point made in the discussion of need was that railroads are not the only employers of personnel handling railroad matters. Now that there are 36 state DOTs the states are becoming a significant factor. Many states have or are preparing state rail plans. Knowledgeable people are needed to assess the demand for commuter service and branch line operations. Applications for capital grants and operating subsidies must be prepared and funds received should be managed by people acquainted with railroad management and technology. States are also setting up railroad inspection organizations to enforce safety standards. The federal government has for some time needed technical and management staffs with railroad knowledge in the Interstate Commerce Commission (ICC), the FRA, the Office of the Secretary of Transportation, the National Transportation Safety Board (NTSB), the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA). Consultant firms hired by these agencies also need people with knowledge of railroads. At present the only sources of people with railroad knowledge are the railroads.

Another point made was that World War II produced an increase in hiring that led to a near hiatus in hiring when business dropped off, resulting in a bulge of management and technical personnel and up to 25% may retire in the next five years on some railroads.

On the other hand L.A. Hoel pointed out that there has not been a demand for railroad courses--if there were universities would have created them. A major reason for the lack of courses may well be the railroads' public image does not attract students to choose railroading as an occupation.

J.A. Scott suggested the UMTA program of university support started in 1964 might be an analogy worth examining. At that time students were not interested in transit and the transit industry did not perceive the need to interest students. With a yearly funding of \$2-3 million the effect was almost immediate interest from students and today many students are interested in entering transit as a career. The UMTA program was broadly based perhaps as many as 80 universities participated.

David Glickstein of Conrail reported that he is able to readily hire civil engineers but has more difficulty hiring mechanicals or electricals. In his opinion the sophisticated problems of signaling, controls, communications and automated maintenance-of-way machinery call for mechanical and electrical in the railroad engineering departments. He also stated that the needs of civil engineering graduates who finish a company training program and are put into supervision are for not only technical skills, but also for management skills such as knowledge of labor relations, budget preparation, report writing, and an ability to communicate one's thoughts upward in the management chain.

Subsequent discussion indicated some railroads are using industrial engineers and find no need for specialized training as industrial engineering principles apply to almost any industry.

One approach suggested for getting students interested in working for a railroad is coop or work study programs. Even summer work programs would be helpful.

Another need--to improve the skills of personnel already employed by railroads--was brought up. There was general agreement that short courses of one or two weeks which have been given by two or three universities have been well received. This will be the fifth year Dr. W.W. Hay at Illinois has run a two-week refresher course for young engineers of Chicago-based and western railroads. Such courses appear to fill real needs and should be an important part of any university program. Possibly they would be the first program to start. UMTA's program provides funds for training of managerial employees in the transit industry.

In other industries funding of university research projects on which graduate students can be employed has created interest in that industry. There was general agreement that there is a high probability that a graduate student employed on a railroad research project would become interested in the industry and decide to make a career of it.

Rather than to develop railroad courses for a number of departments in the universities a better approach would be to include railroad content in existing courses. Business management could include carrier management and specially railroad management as case studies. One way to develop railroad content would be to provide fellowships for faculty members to spend a sabbatical year working with a railroad. This could have a byproduct of producing new textbooks with railroad content. The suggestion was made that HEW's Office of Education be approached for grants to prepare railroad

textbooks to be used in existing courses or new all railroad courses.

Summary

The UMTA program appears to have shown that students can become interested in a career field which has not been popular if funds are made available to universities for curriculum development, fellowships and research.

The consensus of the group was that degrees in railroad are not necessary. The best approach to undergraduate education is to include one or two optional courses on railroading in civil, mechanical and electrical engineering curriculums. For graduate level the best approach appears to include railroad content in existing transportation courses.

For current railroad employees an initial phase could be short courses to improve their skills in very specialized areas.

What appears to be needed is funding for development of course content and texts for both graduate and undergraduate courses to be included in existing curriculums in engineering and business administration. Funds are also needed to provide grants for fellowships and small railroad research projects to acquaint graduate students with railroad problems.

The question unresolved is whether this should be done in a few universities or broadly based. Since degrees in railroading were not recommended by the group the broad based approach seems to be the better suited. It has the potential of interesting larger numbers of students in railroading.

Proposed Task for TRB

Background

In recent years there has been a growing concern that American universities are not providing an adequate pool of trained entrants for the railroad industry. Only a few institutions offer degrees in transportation; none offer a degree in railroad engineering, although a few offer selected courses with emphasis on civil engineering.

In discussions on the subject of the reason for this situation, the most frequent response is the lack of career opportunity at a competitive salary. At present, however, the operating railroads, rail equipment suppliers, consultants, and the Federal and State governments are all searching for trained personnel. Many observers now believe that railroads cannot be allowed to wither; in fact, they must be improved and made more efficient. It is true that financing must be found and regulations must be altered, but gains will not be made without qualified human resources.

Objective

In light of the above, should the FRA (or DOT) do something? If so, what? When a similar situation was recognized in the transit industry, the response was the Urban Mass Transportation Act of 1964 and various amendments. This Act provided for two types of training: (1) university course and research work, and (2) refresher/upgrading training for current property employees. Several attempts to initiate parallel efforts within the FRA have been rebuffed by OST as not needed.

The present task is intended to develop a consensus on what is needed and, if appropriate, prepare a legislative proposal and accompanying budget request for FY80.

Approach

To develop a consensus it will be necessary to solicit the views of an adequate number of industry and academic personnel on a number of questions. Those views may be obtained through the use of survey questionnaires, conferences, or interviews.

Typical questions include, but are not limited to, the following:

1. Is a degree program necessary or are specific courses adequate?
2. What is the desirability of graduate work vs. undergraduate work?
3. Is "vocational" training a necessary element of the program?
4. Should courses be housed in a single department or should the program be multi-disciplinary?
5. Would a "certificate" (series of courses) be an alternative to a full degree program?
6. Should funds be channeled to a few selected institutions (perhaps geographically dispersed) or widely distributed?
7. Should funds be used to subsidize students or focused on strengthening faculty and developing materials?
8. What should be the mix of grants vs. contracts?
9. Should research projects/reports be a required output of any monies given out?

10. Is there a role for industry cooperative programs?
11. What form of "marketing" is required to make the program a success?
12. What level of funding is required and reasonable?
13. Is there a preferred agency location for program management?

Deliverables

The end product of the above approach will include:

- a. A final report of findings including an estimate of demand for trained personnel, a summary of the pros and cons of the above questions, and conclusions/recommendations.
- b. A proposed legislative package for submission to OST/OMB in Fall 1978.
- c. A proposed budget justification for inclusion in the FY1980 budget (Summer/Fall of 1978).

Attachment 2

List of Attendees
Railroad Educational Needs Meeting
June 5, 1978

John E. Buckingham	Safety and Special Services Division - AAR
David Glickstein	Asst. Director, Non-Agreement Personnel - Conrail
Scott B. Harvey	Consultant - AAR
Lester Hoel	Chairman - Dept. of Civil Engineering University of Virginia
T.D. Kern	Engineer - Administration Illinois Central Gulf
Marilyn (Mickey) Klein	Transportation Policy Analyst Policy & Program Development - FPA
A. Scheffer Lang	Assistant to the President - AAR
Ronald S. Mack	Manager-Professional Recruitment Southern Railway
A.J. Reinschmidt	Professor-Railway Engineering Penn State University
James A. Scott	TRB Staff
Paul Settle	Vice Pres.-Commercial Trans. Prod. Portec & Associates, AREA Committee 24
Robert E. Parsons	Assoc. Administrator-R&D, FRA
Theodore Vass	Acting Chief, Labor Mgmt. Relations Policy and Program Development - FRA
Edward J. Ward	TRB Staff
George H. Way, Jr.	Assistant Vice President Research and Test - AAR

Notes of an Ad Hoc Meeting on Railroad Education
August 16, 1978

The objective of the meeting was to provide FRA with the status of railroad education at the university level to assist FRA in requesting appropriations to support development of additional railroad curriculum if it is deemed necessary. A previous meeting on June 5, 1978 had been held to discuss the need for more people to be educated in railroading.

The attendees at the meeting are listed in Attachment 1. All in attendance had the notes of the June 5, 1978 meeting on the same subject attended by representatives of the railroad industry.

The opening discussion concerned the public image of the railroad industry and the consequent lack of interest by students. The lack of railroad courses in college catalogs contributes to the lack of interest by high school students. If railroad courses were found in catalogs more students entering college might be thinking of railroading as a career. The participants contributed a list of four year universities which are known to offer railroad courses. These are:

Universities known to have specific railroad courses within existing departments are:

Civil Engineering

Penn State
Bucknell
Carnegie-Mellon
Texas A&M
Michigan Tech
Virginia (starting this coming year)
San Jose State
West Virginia

Mechanical Engineering

Bucknell

Business Administration

Tennessee
Penn State
Northeastern
Northwestern
Harvard
Syracuse
Indiana
Berkeley

Obstacles to Universities Developing Railroad Courses

The discussion next turned to the obstacles which are preventing universities from developing railroad courses. There was general agreement the principal obstacles are:

1. Lack of funds to pay faculty for the time to develop course content.

Available discretionary funds are being used to develop courses where funding help is available from other government agencies. The time to develop railroad courses will be among the longest for any type of courses because of the lack of organized reference material. There are no up-to-date textbooks around which a course could be designed.

2. Lack of NSF Support

Attempts to obtain National Science Foundation funds for curriculum development have been rebuffed because the funds would be used to support interests of a "specialized industry."

3. Limits on faculty positions.

Many universities are requiring all departments to relinquish all vacated positions to the administration for possible reassignment as the total number of faculty is either being held fixed or being reduced. With no outside funding there is little or no chance of a position being made available for railroad curriculum development.

4. Lack of external impetus

With few exceptions the development of new curriculum by universities has come about because of outside motivation. To date no external motivating forces have appeared from either the railroad industry or government agencies. The most common motivating element - money - has been conspicuous by its absence. Several universities have had railroad research contracts, MIT, SUNY Buffalo, Illinois and Princeton but none have developed railroad courses. The MIT representative stated their research contracts from DOT prohibit expenditure of funds to convert research results into teaching material. Funds need to be specifically allocated to translate research results into classroom materials.

Difficulties in Preparing Railroad Course Materials

The difficulties which increase the cost of preparing railroad course materials over other fields were discussed further.

Technology has made great strides in the railroad industry since the last department of railway engineering disappeared from the University of Illinois in 1956. The 20-year gap has seen electronics advance from vacuum tubes to integrated circuits

which affects locomotive controls, track geometry inspection, communications and a myriad of computer uses. Maintenance-of-way has seen the development of automated trains which do almost every maintenance operation replace individually operated machines and manual labor.

The advances in technology have brought about a need for more sophisticated management techniques and there is little understanding in the academic world of railroad management as a system.

In both technical and management fields, much will have to be done in review of the literature in research reports and technical papers presented at professionals societies to obtain the needed material. A number of disciplines must come together to produce the most useful curriculums. This is not likely to happen without some catalyst such as the proposed FRA program to support graduate students.

University needs

In order to develop good railroad curriculums, there are three things the universities need. These are:

1. Development of suitable curriculum - both railroad material to be included in transportation courses
2. Fellowships to attract top flight students to the industry.
3. Research support - grants for support fo non-directed projects

Fellowships and research support can be combined by offering research assistantships for up to half time employment of graduate students on railroad research projects. Graduate student support generally runs \$400-500 per month.

The group thought continuity of research support is very important. A two-year research contract if not renewed will accomplish little towards a stable flow of graduates with railroad knowledge. There should be a serious commitment on both sides to a long term effort. The view of the group was also that universities will do a better job with small efforts over a long period of time rather than a large effort for a short time.

A university should be given time to develop courses through iteration - develop, teach and revise.

The types of courses which should be offered were also discussed. The consensus was that courses which can be offered as senior year electives and graduate courses simultaneously would be the most useful. Confining railroad courses solely to the graduate level was not considered to be the answer as a number of railroads are known to refuse to hire people with graduate degrees - some railroads say the pay for graduate degrees and graduate programs should be created.

The group also thought that any grant program should be on a broad basis to permit various colleges to specialise in certain aspects of railroading. Perhaps from this approach centers of excellence covering many aspects of railroading might develop at a few universities. Some universities should develop coop programs perhaps in conjunction with a railroad.

Precedents for university support were discussed including the UMTA grant program, the FAA internal fellowship program at Berkeley and the FHWA fellowship program.

There was general agreement that if FRA offered support along the lines discussed many universities will be interested.

A letter was received from Arnold Kerr, now professor of civil engineering at the University of Delaware, that generally agreed with the group's discussion. In summary, he proposed:

1. Establishment of a FRA fellowship in Rail Transportation for Masters' students
2. Grants to faculty members for preparation of class notes
3. Grants for railroad research to generate student interest.

He noted that short courses for practicing railroad engineers and managers are available without support from the government.

Professor J. M. Sussman of MIT also wrote and stated he would favor a FRA program which would provide continuing (rather than year to year) support for research and recommends that such programs be in an intermodal and interdisciplinary approach.

Professor A. J. Reinschmidt of Penn State wrote that interdisciplinary efforts are not likely to come about without a catalyst -- FRA support could be such a catalyst.

Professor C. L. Monismith of Berkeley wrote to point out that the Forest Service also provides training for their personnel.

RAILROAD EDUCATION MEETING
Transportation Research Board
August 16, 1978

Attendees

Charles Coder
Bucknell University
Lewisburg, PA

D. L. Spanton
Federal Railroad Administration
Washington, DC

Lester A. Hoel
University of Virginia
Charlottesville, VA

Carl Martland
M.I.T.
Cambridge, MA

Glenn Keitel
Bucknell University
Lewisburg, PA

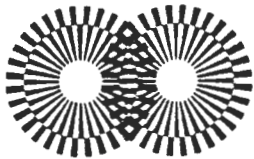
Carl L. Monismith
University of California
Berkeley, CA

A. J. Reinschmidt
Pennsylvania State University
University Park, PA

TRB Staff

E. J. Ward & T. H. Myers

Transportation Center



Research/Service

The University of Tennessee
Knoxville, Tennessee 37916
Phone (615) 974-5255

F. PERSONAL LETTERS SENT

LETTER SENT TO RAILROADS

Dear:

I am in the process of developing an annotated catalog of railroad-related education programs for a project sponsored by the Federal Railroad Administration, and would like to request your assistance during the information-gathering effort.

Specifically, my first concern is to become acquainted with any in-house offerings by your company of courses or programs designed to educate employees regarding the various aspects of railroading and/or railroad management. In addition to a listing of courses or programs of this type, I would appreciate as much detail as possible regarding specific course content or program format.

Secondly, in an effort to learn more about any engineering, interdisciplinary, or management educational programs related to the railroad industry, I would like your suggestions as to any such offerings which you feel would be valuable for me to survey. It would be helpful if you would take the opportunity to identify any college or university, continuing education, seminar-type or industry-sponsored programs with which you are acquainted.

A brief form has been attached for convenience in responding to this request. Please feel free to include other information which you feel would be of assistance in this effort.

Thank you for your assistance and interest in this study. Your efforts will help to produce a hopefully relevant and useful document.

Sincerely,

C. John Langley Jr., Ph.D.
Associate Professor of
Transportation and Logistics

P.S. Since members of our project team have had the opportunity to conduct personal interviews with many railroad industry representatives, it is possible that we have made contact already with some of your employees. If such is the case, please accept my personal apology, and please consider this letter as a kind of thank you for your previous assistance.

CJL/jed
Attachment

RAILROADS TO WHICH LETTERS WERE SENT

Mr. V. M. Malanaphy
Chairman and Chief Executive Officer
Ann Arbor Railroad System
P. O. Box 619
Owosso, MI 48867

Mr. J. S. Reed
Chairman of the Board and Chief Executive Officer
Atchison, Topeka and Santa Fe Railway Company
80 E. Jackson Boulevard
Chicago, IL 60604

Mr. M. S. Toon, President
Bessemer and Lake Erie Railroad Company
P. O. Box 536
Pittsburg, PA 15230

Mr. Alan G. Dustin, President
Boston and Maine Corporation
150 Causeway Street
Boston, MA 02114

Mr. N. M. Lorentzsen
President and Chief Executive Officer
Burlington Northern
BN Building
176 East 5th Street
St. Paul, MN 55101

Mr. J. T. Collinson, President
Chessie System
P. O. Box 6419
Cleveland, OH 44101

Mr. J. R. Wolfe
President and Chief Executive Officer
Chicago and Northwestern Transportation Company
400 W. Madison Street
Chicago, IL 60606

Mr. W. L. Smith
President and Chief Executive Officer
Chicago, Milwaukee, St. Paul, and Pacific Railroad
Union Station, 516 West Jackson Boulevard
Chicago, IL 60606

Mr. J. W. Ingram, President
Chicago, Rock Island, and Pacific Railroad
332 South Michigan Avenue
Chicago, IL 60604

Mr. T. D. Moore, Jr., Executive Vice-President
Clinchfield Railroad
229 Nolichucky Avenue
Erwin, TN 37650

Mr. G. F. Defiel, President
Colorado and Southern Railway
1405 Curtis Street
Denver, CO 80202

Mr. E. G. Jordan
Chairman and Chief Executive Officer
Consolidated Rail Corporation
6 Penn Center Plaza
Philadelphia, PA 19104

Mr. K. P. Shoemaker, President
Delaware and Hudson Railway
Delaware and Hudson Railway Building
40 Beaver Street
Albany, NY 12207

Mr. G. B. Aydelott, Chairman of the Board
Denver and Rio Grande Western Railroad
1515 Arapahoe Street
P. O. Box 5482
Denver, CO 80217

Mr. R. A. Sharp, President
Detroit, Toledo, and Ironton Railroad
One Parklane Boulevard
Dearborn, MI 48126

Mr. D. B. Shank, Vice-President and General Manager
Duluth, Mesabe, and Iron Range Railway
Mesabe Building
Duluth, MN 55802

Mr. F. A. Fitzpatrick, Vice-President-Operations
Elgin, Joliet, and Eastern Railway
P. O. Box 536
Pittsburg, PA 15230

Mr. W. L. Thornton, President
Florida East Coast Railway
7150 Phillips Highway
Jacksonville, FL 32216

Mr. J. H. Hertog, Sr., Vice-President
Fort Worth and Denver Railway
176 East 5th Street
St. Paul, MN 55101

Mr. J. H. Burdakin, President
Grand Trunk Western Railroad
131 W. Lafayette Boulevard
Detroit, MI 48226

Mr. W. J. Taylor, President
Illinois Central Gulf Railroad
233 N. Michigan Avenue
Chicago, IL 60601

Mr. R. B. Hasselman, President
Indiana Harbor Belt Railroad Company
6 Penn Center Plaza
Philadelphia, PA 19104

Mr. W. N. Deramus, III
Chairman and Chief Executive Officer
Kansas City Southern Railway
114 W. Eleventh Street
Kansas City, MO 64105

Mr. F. S. Gabreski, President
Long Island Railroad
Jamaica Station
Jamaica, NY 11435

Mr. P. F. Osborn III, Chairman and Chief Executive Officer
Louisville and Nashville Railroad
Jacksonville, FL 32205

Mr. R. N. Whitman, Chairman and Chief Executive Officer
Missouri-Kansas-Texas Railroad Company
701 Commerce Street
Dallas, TX 75202

Mr. J. W. Gessner, President
Missouri Pacific Railroad Company
Missouri Pacific Building
St. Louis, MO 63103

Mr. J. P. Fishwick, President
Norfolk and Western Railway
8 N. Jefferson Street
Roanoke, VA 24042

Mr. H. G. Allyn, Jr. President
Pittsburg and Lake Erie Railroad
Pittsburg and Lake Erie Railroad Terminal Building
Pittsburg, PA 15219

Mr. R. C. Grayson
Chairman of the Board and President
St. Louis-San Francisco Railway
906 Olive Street
St. Louis, MO 63101

Mr. D. K. McNear, President
St. Louis Southwestern Railway
San Francisco, CA 94105

Mr. A. P. Funkhouser, President
Seaboard Coast Line Railroad
Jacksonville, FL 32205

Mr. L. H. Murray, Chairman and Chief Executive Officer
Soo Line Railroad
800 Soo Line Building, Box 530
Minneapolis, MN 55440

Mr. L. S. Crane, President and Chief Executive Officer
Southern Railway
P. O. Box 1808
Washington, DC 20013

Mr. B. F. Biaggini, Chairman and Chief Executive Officer
Southern Pacific Transportation Company
San Francisco, CA 94105

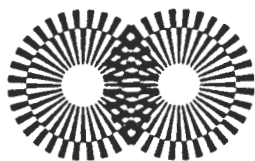
Mr. F. A. Fitzpatrick, Vice President - Operations
Union Railroad Company
P. O. Box 536
Pittsburg, PA 15230

Mr. J. C. Kenefick, President
Union Pacific Railroad
1416 Dodge Street
Omaha, NE 68179

Mr. W. P. Coliton, President
Western Maryland Railway
2 N. Charles Street
Baltimore, MD 21201

Mr. R. G. Flannery, President and Chief Executive Officer
Western Pacific Railroad
526 Mission Street
San Francisco, CA 94105

Transportation Center



Research/Service

The University of Tennessee
Knoxville, Tennessee 37916
Phone (615) 974-5255

LETTER SENT TO UNIVERSITIES

Dear :

I am in the process of developing an annotated catalog of railroad-related education programs for the Federal Railroad Administration, and would like to request your assistance during the initial information-gathering effort.

Specifically, my first concern is to become acquainted with any offerings by your university of engineering, interdisciplinary, or management educational programs or courses related to the railroad industry. In addition to a listing of courses or programs of this type, I would appreciate as much detail as possible regarding specific course content or program format.

Secondly, and regardless of the extent of the offerings at your own institution, I would like your suggestions as to any other program or programs which I should survey during this phase of the project. It would be helpful if you would take the opportunity to identify any college or university, continuing education, seminar-type, or industry-sponsored programs which you feel would be helpful for me to learn more about.

A brief form has been attached for convenience in responding to this request. Please feel free to include other information such as any brochures or catalogs which might be helpful.

Thank you for your assistance and interest in this study. Your efforts will help to produce a hopefully relevant and useful document.

Sincerely,

C. John Langley Jr., Ph.D.
Associate Professor of
Transportation and Logistics

CJL:ghm
Attachment

UNIVERSITIES TO WHICH LETTERS WERE SENT

University of Alabama
School of Commerce & Business
John S. Fielden, Dean
University, AL 35486

College of Engineering
William Lear, Dean
University, AL 35486

University of Alaska
School of Business & Pub. Admin.
Garth N. Jones, Chairman
Anchorage, AK 99504

University of Arizona
College of Business & Pub. Admin.
Dr. Rene P. Manes, Dean
Tucson, AZ 85721

College of Engineering
R. H. Gallagher, Dean
Tucson, AZ 85721

University of Arkansas
College of Business Administration
John P. Owen, Dean
Fayetteville, AR 72701

College of Engineering
Loren Heiple, Dean
Fayetteville, AR 72701

Bucknell University
Department of Business Administration
Sidney L. Miller, Dean
Lewisburg, PA 17836

College of Engineering
Glenn Keitel, Dean
Lewisburg, PA 17837

Carnegie-Mellon University
Grad. School of Industrial Admin.
Robert S. Koplán, Dean
Pittsburgh, PA 15213

Carnegie Institute of Technology
Herbert L. Toor, Dean
Pittsburgh, PA 15213

University of California, Berkeley

Department of Civil Engineering
Carl L. Monismith, Professor
Davis Hall, Room 760
Berkeley, CA 94720

Case Western Reserve University
School of Management
Theodore M. Alfred, Dean
Cleveland, OH 44106

Case Institute of Technology
Joseph Row, Provost
Cleveland, OH 44106

Clarkson College of Technology
School of Management
Ross L. Gable, Dean
Potsdam, NY 13676

School of Engineering
Herman Shulman, Dean
Potsdam, NY 13676

Clemson University

College of Engineering
Lyle C. Wilcox, Dean
Clemson, SC 29631

University of Colorado
School of Business
William H. Baughn, Dean
Boulder, CO 80309

College of Engineering
William Pietenpol, Dean
Boulder, CO 80309

University of Connecticut
School of Business Administration
Ronald J. Patten, Dean
Storrs, CT 06268

School of Engineering
Peter McFadden, Dean
Storrs, CT 06268

Cooper Union

School of Engineering
Chor-Weng Tan, Dean
Cooper Square, NY 10003

Columbia University
Graduate School of Business
Boris Yavitz, Dean
New York, NY 10027

Dartmouth College
Amos Tuck School of Business Admin.
Richard West, Dean
Hanover, NH 03755

Thayer School of Engineering
Carl Long, Dean
Hanover, NH 03755

University of Delaware
College of Business & Economics
Eric Brucker, Dean
Newark, DE 19711

College of Engineering
Irwin Greenfield, Dean
Newark, DE 19711

University of Florida
College of Business Administration
Dr. Robert Lanzillotti, Dean
Gainesville, FL 32611

College of Engineering
Wayne Chen, Dean
Gainesville, FL 32611

Georgetown University
School of Business Administration
Ronald Smith, Dean
Washington, DC 20057

University of Georgia
College of Business Administration
Dr. William L. Flewellen, Jr., Dean
Athens, GA 30602

Georgia Institute of Technology

College of Engineering
Dr. William Sangster, Dean
225 North Avenue, N.W.
Atlanta, GA 30332

Harvard University
Graduate School of Business Admin.
Lawrence E. Fourakes, Dean
Cambridge, MA 02163

University of Idaho
College of Business Administration
Gerald L. Cleveland, Dean
Moscow, ID 83843

University of Illinois
College of Commerce & Bus. Admin.
U. K. Zimmerman, Dean
Urbana, IL 61801

Illinois Institute of Technology

College of Engineering
M. L. Jackson, Acting Dean
Moscow, ID 83843

College of Engineering
D. C. Drucker, Dean
Urbana, IL 61801

Railroad Engineering Laboratory
Sudir Kumar, Director
IIT Center
Chicago, IL 60616

Indiana University
School of Business
Schuyler F. Otteson, Dean
Bloomington, Indiana 47401

University of Iowa
College of Business Administration
J. Richard Zeecher, Dean
Iowa City, IA 52242

College of Engineering
Robert Hering, Dean
Iowa City, IA 52242

University of Kansas
School of Business
Joseph A. Pichler, Dean
Lawrence, KS 66045

School of Engineering &
Architecture
David L. Kraft, Dean
Lawrence, KS 66045

University of Kentucky
College of Business & Economics
W. W. Ecton, Dean
Lexington, KY 40506

College of Engineering
Dr. James Funk, Dean
Lexington, KY 40506

University of Maine
College of Business Administration
Dr. Stanley Devino, Dean
Orono, ME 04473

College of Engineering
James Clapp, Dean
Orono, ME 04473

University of Maryland
College of Business & Management
Dr. R. P. Lamone, Dean
College Park, MD 20742

College of Engineering
George Dieter, Jr., Dean
College Park, MD 20742

Massachusetts Institute of Technology

Alfred Sloan School of Management
William Pounds, Dean
Cambridge, MA 02139

School of Engineering
Robert Seamans, Dean
Cambridge, MA 02139

University of Michigan

Graduate School of Business Administration
Floyd Bond, Dean
Ann Arbor, Michigan 48104

Michigan State University

College of Engineering
Lawrence Von Tersch, Dean
East Lansing, MI 48824

Michigan Technological University

Department of Civil Engineering
Eugene Y. Huang, Professor
Houghton, MI 49931

University of Minnesota

College of Business Administration
David M. Lilly, Dean
Minneapolis, MN 55455

The Institute of Technology
Roger Staehle, Dean
Minneapolis, MN 55455

University of Mississippi

School of Business Administration
Ben B. McNew, Dean
University, MS 38677

School of Engineering
Karl Brenkert, Jr., Dean
University, MS 38677

University of Montana

School of Business Administration
Dr. Jack J. Kempner, Acting Dean
Missoula, MT 59801

Montana State University

College of Engineering
Byron Bennett, Dean
Bozeman, MT 59715

University of Nevada

College of Business Administration
Dr. Robert C. Weems, Dean
Reno, NV 89557

College of Engineering
Charles Breese, Acting Dean
Reno, NV 89557

University of New Mexico

Robert Anderson School of Business
Robert R. Rehder, Dean
Albuquerque, NM 87131

College of Engineering
William Gross, Dean
Albuquerque, NM 87131

University of North Carolina
School of Business Administration
Harvey Wagner, Dean
Chapel Hill, NC 27514

North Carolina State University

College of Engineering
Larry Monteith, Dean
Raleigh, NC 27607

University of North Dakota
College of Business & Public Admin.
Dr. Clair D. Rowe, Dean
Grand Forks, ND 58201

School of Engineering & Mines
Alan Fletcher, Dean
Grand Forks, ND 58201

Northwestern University
Graduate School of Management
Donald P. Jacobs, Dean
Leverone Hall
Evanston, IL 60201

The Ohio State University
The School of Admin. Science
Edward H. Bowman, Dean
Columbus, OH 43210

The College of Engineering
Donald O. Glower, Dean
Columbus, OH 43210

University of Oklahoma
College of Business Administration
Lawrence E. McKibbin, Dean
Norman, OK 73069

College of Engineering
W. R. Upthegrove, Dean
Norman, OK 73019

University of Oregon
School of Business Administration
James Rhinemuth, Dean
Eugene, OR 97403

Oregon State University

College of Engineering
F. J. Burgess, Dean
Corvallis, OR 97331

University of Pennsylvania
Wharton School
Donald Carrol, Dean
Philadelphia, PA 19174

College of Eng. & App. Science
Arthur Humphrey, Dean
Philadelphia, PA 19174

Pennsylvania State University
College of Business Administration
Eugene J. Kelley, Dean
University Park, PA 16802

College of Engineering
N. J. Palladino, Dean
University Park, PA 16802

Princeton University

College of Engineering
Alain Kornhauser
Princeton, NJ 08540

Purdue University

School of Civil Engineering
Gilbert T. Satterly, Professor
West Lafayette, IN 47907

Rensselaer Polytechnic Institute

George Ansell, Dean
110 8th Street
Troy, NY 12181

University of Rhode Island
College of Business Administration
Robert Goff, Assoc. Dean
Kingston, RI 02881

College of Engineering
Robert H. Goff, Acting Dean
Kingston, RI 02881

Rutgers University
Grad. School of Business Administration
Horace J. DePodwin, Dean
Newark, NJ 07104

College of Engineering
Ellis Dill, Dean
New Brunswick, NJ 08903

San Jose State University

Department of Civil Engineering
Thomas G. Schultz, Professor
San Jose, CA 95192

University of South Carolina
College of Business Administration
James F. Kane, Dean
Columbia, SC 29208

University of South Dakota
School of Business
Dale Clemont, Dean
Vermillion, SD 57069

South Dakota State University

College of Engineering
Junius Storry, Acting Dean
Brookings, SD 57006

University of Southern California
School of Business Administration
Jack D. Steele, Dean
Los Angeles, CA 90007

School of Engineering
Dr. Zohrab A. Kaprielian, Dean
Los Angeles, CA 90007

Stanford University
Graduate School of Business
Arjay Miller, Dean
Stanford, CA 94305

School of Engineering
William Kays, Dean
Stanford, CA 94305

Syracuse University
School of Management
L. Richard Oliker, Dean
Syracuse, NY 13210

L. D. Smith College of Eng.
James Luker, Dean
Syracuse, NY 13210

University of Texas
College of Business Administration
George Kozmetsky, Dean
Austin, TX 78712

College of Engineering
E. F. Gloyna, Dean
Austin, TX 78712

Texas A & M University

Department of Civil Engineering
Robert M. Olson, Professor
College Station, TX 77843

Tulane University

Grad. School of Business Administration
Harper W. Boyd, Dean
New Orleans, LA 70118

School of Engineering
Hugh Thompson, Dean
New Orleans, LA 70118

University of Utah

College of Business
A. Blaine Huntsman, Dean
Salt Lake City, UT 84112

College of Engineering
Lawrence H. Lattman, Dean
Salt Lake City, UT 84112

Vanderbilt University

Owen Grad. School of Management
Samuel B. Richmond, Dean
Nashville, TN 37240

School of Engineering
Howard Hartman, Dean
Nashville, TN 37203

University of Vermont

Dept. of Business Admin.
Elmer L. Gaden, Jr., Dean
Burlington, VT 05401

College of Engineering
Elmer L. Gaden, Jr., Dean
Burlington, VT 05401

University of Virginia

Graduate School of Business Administration
C. Steward Sheppard, Dean
Charlottesville, VA 22904

Department of Civil Engineering
Lester A. Hoel, Chairman
Charlottesville, VA 24450

Virginia Polytechnic Institute

College of Engineering
Paul Torgersen, Dean
Blacksburg, VA 24061

University of Washington

College of Business Administration
Kermit O. Hanson, Dean
Seattle, WA 98195

College of Engineering
Dale Carlson, Dean
Seattle, WA 98195

Washington University

School of Business Administration
Robert Virgil, Acting Dean
St. Louis, MO 63130

School of Eng. & App. Science
James McKelvey, Dean
St. Louis, MO 63130

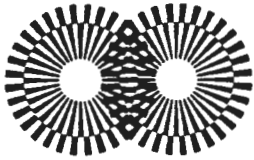
West Virginia University
College of Business & Economics
Jack T. Turner, Dean
Morgantown, WV 26506

College of Engineering
Bill Atchley, Dean
Morgantown, WV 26506

University of Wyoming
College of Commerce & Industry
Timon Walther, Acting Dean
Laramie, WY 82071

College of Engineering
Samuel Hakes, Dean
Laramie, WY 82071

Transportation Center



Research/Service

The University of Tennessee
Knoxville, Tennessee 37916
Phone (615) 974-5255

LETTER SENT TO EQUIPMENT SUPPLIERS

Dear :

I am in the process of developing an annotated catalog of railroad-related education programs for the Federal Railroad Administration, and would like to request your assistance during the initial information-gathering effort.

Specifically, my first concern is to become acquainted with any educational programs with which you might be involved as an equipment supplier. In addition to a listing of courses or programs which you may possibly offer, I would appreciate as much detail as possible regarding specific course content or program format.

Secondly, and regardless of the extent of offerings by your company, I would like your suggestions as to any other program or programs which I should survey during this phase of the project. It would be helpful if you would take the opportunity to identify any industry-sponsored, college or university, continuing education, or seminar-type programs which you feel would be helpful for me to learn more about.

A brief form has been attached for convenience in responding to this request. Please feel free to include other information such as any brochures or catalogs which might be helpful.

Thank you for your assistance and interest in this study. Your efforts will help to produce a hopefully relevant and useful document.

Sincerely,

C. John Langley Jr., Ph.D.
Associate Professor of
Transportation and Logistics

CJL:ghm
Attachment

EQUIPMENT MANUFACTURERS TO WHICH LETTERS WERE SENT

A. & K. Railroad Materials
M. H. Kulmer
Executive Vice President
P. O. Box 1276
Building #12
Freeport Center
Clearfield, UT 84016
(801) 773-3236

Aeroequip Corporation
(Gustin-Bacon)
J. L. Price
Vice President & General Manager
P. O. Box 927
Lawrence, KS 66044
(913) 841-4000

ASEA, Inc.
O. Ewers
4 New King St.
White Plains, NY 60604
(914) 428-6000

Automatic Equipment Co.
G. M. Egart
80 E. Jackson Blvd.
Chicago, IL 60604
(312) 427-0910

Bethlehem Steel Corp.
W. T. Anthony
Manager Sales
Bethlehem, PA 18016
(215) 694-3651

Briggs & Turvias, Inc.
P. B. Paull
President
Box 270
310 Grant St.
Dennision, OH 44621
(614) 922-5994

Comet Industries, Inc.
F. Picht
4800 Deramus Avenue
Kansas City, MO 64120
(816) 483-3157

Abex Corporation
C. E. Almeyer
Executive Vice President
Valley Road
Mahwah, NJ 07430
(201) 529-3450

Anbel Corporation
K. R. Nichols
President
2323 S. Voss Road
Houston, TX 77057
(713) 977-9737

Atlantic Track & Turnout Co.
R. H. Dreesen
270 Broad St.
Bloomfield, NJ 07003
(201) 748-5885

Baldwin-Hamilton Co.
W. H. Dallas
Vice President
One Country View Rd.
Malvern, PA 19355
(215) 647-9900

Bombardier, Inc.
H. Valle
Chairman
1505 Dickson St.
Montreal PQ H1N 2H7
(514) 255-3681

Central Equipment Co.
G. D. Beck
President
1933 Ridge Road
P. O. Box 317
Homewood, IL 60430
(312) 799-4810

T. J. Fleming Co.
T. J. Fleming
President
645 Southwest Blvd.
Kansas City, KS 66104
(913) 236-9000

Garett Railroad Car & Equip.
F. J. Garrett
President
P. O. Box 2208
New Castle, PA 16102
(412) 658-9061

General Railway Signal Co.
R. F. Anderson
Manager, Marketing Development
P. O. Box 600
Rochester, NY 14602
(716) 436-2020

Harmon Electronics
F. H. Ballinger
Chief Engineer
Grain Valley, MO 64029
(816) 249-3112

Hoesch America, Inc.
H. Schroeder
Executive Vice President
3340 Peachtree Rd.
Atlanta, GA 30326
(404) 261-7111

Industrial Track Supply Co.
C. D. Kelley
President
2230 Cleveland Ave.
East St. Louis, IL 62202
(618) 271-3170

Joliet Railway Equipment Co.
R. Piolet
P. O. Box 100
McCook, IL 60525
(312) 485-0500

L & W Industries, Inc.
H. W. Watkins
President
3033 Malmo Drive
Arlington Heights, IL 60005
(312) 956-8310

General Electric Co.
J. C. Dwyer
General Manager
2901 East Lake Rd.
Erie, PA 16531
(814) 455-5466

Great Lakes Rail Limited
W. Baziuk
President
359 Burbidge St.
Thunder Bay, ON P7B 5R3
(807) 344-6226

Hawker-Siddeley Canada Ltd.
C. Davidson
Manager, Marketing
800 Dorchester Blvd. W.
Suite 1515
Montreal, PQ H3B 1X9
(514) 871-9750

Hyman-Michaels Co.
K. DeCamp
1800 LaSalle St.
Chicago, IL 60601
(312) 332-5422

Industry-Railway Suppliers, Inc.
N. J. Gregorich
President
15501 Commerce Park Drive
Cleveland, OH 44142
(216) 433-4900

L. B. Foster Co., Inc.
J. L. Foster
Vice President
415 Holiday Drive
Pittsburgh, PA 15220
(412) 928-3400

Midland Reclamation Co.
R. R. Linsin
President
5841 Hamilton Ave.
St. Louis, MO 63136
(314) 383-6200

Modern Industries, Inc.
J. C. Holston
President
100 Outer Loop
P. O. Box 14287
Louisville, KY 40214
(502) 361-1113

Morrison Railway Supply Corp.
R. L. Morrison
Chairman
5500 Main St.
Buffalo, NY 14221
(716) 631-5420

Naporano Iron & Metal Co.
J. Naporano
Foot of Hawkins St.
Newark, NJ 07105
(201) 344-4570

Ortner Freight Car Co.
N. S. Adams
Engineering Assistant to
Vice President
2652 Erie Ave.
Cincinnati, OH 45208
(513) 871-2600

Pohl Corporation
W. W. Pohl
President
P. O. Box 3613
Reading, PA 19603
(215) 926-2132

Power Parts Co.
R. Fugiel
1860 Wilmont Avenue
Chicago, IL 60647
(312) 772-4600

Railroad Products Co.
P. E. Holton
President
1940 Queen City Ave.
Cincinnati, OH 45214
(513) 921-5447

Modern Track Machinery, Inc.
J. W. Lawson
Executive Vice President
1061 Davis Rd.
Elgin, IL 60120
(312) 697-7510

Multi-Service Supply Co.
G. D. Kravetz
Vice President and Gen-
eral Manager
Herr's Island
Pittsburgh, PA 15222
(412) 261-2460

Nelson Iron Works
G. C. Nelson
President
3423 13th Ave.
Seattle, WA 98134
Box 80816
Seattle, WA 98108
(206) 623-3800

Pettibone Corporation
T. M. Cavender
Vice President
4700 W. Division
Chicago, IL 60651
(312) 772-9300

PORTEC, Inc.
J. Battershall
Manager, Materials
300 Windsor Drive
Oak Brook, IL 60521
(312) 325-6300

The Purdy Company
R. M. Boyle
2400 95th Street
Chicago, IL 60642
(312) 329-4200

Railroad Repair & Supply Co.
G. P. Cullen
Office Manager
332 Michigan Ave.
Chicago, IL 60604
(312) 427-7340

Railway & Industrial Services
D. T. Schwarz
2201 N. Center St.
Joliet, IL 60435
(815) 726-4224

Safety Electrical Equip. Corp.
J. G. Matheis
Vice President, Marketing
26 Barnes Park Rd.
P. O. Box 798
Wallingford, CT 06492
(203) 265-7131

Transcontrol Corporation
G. Erno
Vice President & Chief Engineer
6 Manhasset Ave.
P. O. Box 231
Port Washington, NY 11050
(516) 883-6900

Vapor Corporation
B. W. Beloit
Railroad
6420 W. Howard St.
Chicago, IL 60648
(312) 631-9200

WABCO-Westinghouse Air Brake
E. B. Vrenneman
Wilmerding, PA 15148
(412) 273-1000

D. A. Wilson Company
D. A. Wilson
2017 E. Lincolnway
Ames, IA 50010
(515) 233-2436

Safetran Systems Corp.
R. B. Wyland
President
7721 National Turnpike
Louisville, KY 40214
(502) 361-1691

Standard Steel Division
S. A. Boova
General Manager, Marketing
Burham, PA 17009
(717) 248-4911

United States Steel Corp.
S. N. Pool
Manager, Railroad Products
600 Grant St.
Pittsburgh, PA 15230
(412) 433-3630

WABCO-Union Switch & Signal
C. B. Ramsdell
Group Vice President
3 Gateway Center
Pittsburgh, PA 15222
(412) 471-3241

Western Cullen-Hayes
C. F. Chambers
Manager, Engineering
2700 W. 36th Place
Chicago, IL 60632
(312) 254-9600

Transportation Center

The University of Tennessee
Knoxville, Tennessee 37916
Phone (615) 974-5255



Research/Service

LETTER SENT TO CONSULTANTS/MANAGEMENT DEVELOPMENT PROGRAMS

Dear :

I am in the process of developing an annotated catalog of railroad-related education programs for the Federal Railroad Administration, and would like to request your assistance during the initial information-gathering effort.

Specifically, my first concern is to become acquainted with any offerings by your company of engineering, interdisciplinary, or management educational programs or courses related to the railroad industry. In addition to a listing of courses or programs of this type, I would appreciate as much detail as possible regarding specific course content or program format.

Secondly, and regardless of the extent of offerings by your company, I would like your suggestions as to any other program or programs which you feel I should survey during this phase of the project. It would be helpful if you would take the opportunity to identify any college or university, continuing education, seminar-type, or industry-sponsored programs with which you are acquainted.

A brief form has been attached for convenience in responding to this request. Please feel free to include other information such as any brochures or catalogs which might be helpful.

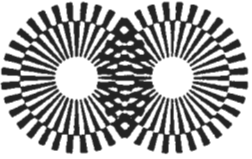
Thank you for your assistance and interest in this study. Your efforts will help to produce a hopefully relevant and useful document.

Sincerely,

C. John Langley Jr., Ph.D.
Associate Professor of
Transportation and Logistics

CJL:ghm
Attachment

Transportation Center



Research/Service

The University of Tennessee
Knoxville, Tennessee 37916
Phone (615) 974-5255

LETTER SENT TO INTERESTED PERSONS

Dear :

I am in the process of developing an annotated catalog of railroad-related education programs for the Federal Railroad Administration, and would like to request your assistance during the initial information-gathering effort.

In an effort to learn more about any engineering, interdisciplinary, or management educational programs or courses related to the railroad industry, I would like your suggestions as to any such offerings which you feel would be valuable for me to survey. It would be helpful if you would take the opportunity to identify any college or university, continuing education, industry-sponsored, or seminar-type programs with which you are acquainted. A brief form has been attached for convenience in responding to this request.

Thank you for your assistance and interest in this study. Your efforts will help to produce a hopefully relevant and useful document.

Sincerely,

C. John Langley Jr., Ph.D.
Associate Professor of
Transportation and Logistics

CJL:ghm
Attachment

G. AMERICAN RAILWAY ENGINEERING ASSOCIATION
RAILROAD EDUCATION SURVEY

AREA COMMITTEE 24 QUESTIONNAIRE

Undergraduate Curriculum Related to Railway Engineering

1. Name of Institution: 99 Schools - 73 Semester System, 26 Quarter System
2. Reported by: Head of Dept. - 83, Faculty - 16
Title: _____
3. Date: _____
4. Number of students currently enrolled in your C.E. undergraduate program: 26,481
5. Approximate number of students graduated since June 1973: 23,967
6. Total number of credit hours required at present for graduation:
(please fill only one)
132 semester hours or 195 quarter hours (Averages)
7. Please indicate the time in semester hours or quarter hours (circle one) devoted to required and elective coursework in the following areas in C.E. undergraduate curriculum:

	<u>Number of Credit Hours</u>	
	<u>Required Coursework</u>	<u>Elective Coursework</u>
	Sem. Hr.	Sem. Hr.
a. Surveying (including boundary surveys, construction surveys, and route surveying).....	89% (3.28)	44% (5.20)
b. Photogrammetry.....	6% (1.83)	39% (2.89)
c. Graphics.....	90% (2.85)	14% (3.48)
d. Geology.....	55% (2.95)	44% (4.08)
e. Airphoto Interpretation.....	1% (0.33)	18% (3.30)
f. Properties of Engineering Matl's....	93% (3.62)	25% (4.17)
g. Soil Mechanics and Foundation Eng...	96% (3.71)	60% (4.17)
h. Fluid Mechanics.....	96% (3.49)	20% (4.33)
i. Hydrology and Hydraulic Eng.....	69% (3.43)	63% (8.37)

		<u>Number of Credit Hours</u>	
		<u>Required Coursework</u>	<u>Elective Coursework</u>
		Sem. Hr.	Sem. Hr.
j.	Concrete Materials (including PCC and Bituminous mixtures).....	49% (2.90)	37% (3.37)
k.	Structural Analysis and Design (including bridge design).....	96% (7.77)	71% (8.35)
l.	Railroad Transportation Engineering (including roadway design, track structure, and operational characteristics of locomotives).....	0% (0.00)	7% (4.43)
m.	General Transportation Engineering (including railroad, highway, waterway air and pipeline transportation)...	74% (3.21)	43% (5.59)
n.	Highway Engineering.....	20% (2.83)	49% (4.29)
o.	Environmental Engineering.....	88% (3.96)	67% (7.50)
p.	Computer Programming and Numerical Analysis Techniques.....	97% (3.33)	35% (4.99)
q.	Engineering Economy.....	70% (2.66)	27% (3.48)
r.	Statistics.....	37% (2.42)	52% (3.64)
s.	Contract Specifications.....	28% (1.99)	29% (2.61)
t.	Construction Equip. & Methods.....	12% (2.25)	36% (3.43)
u.	Construction Management.....	18% (2.56)	41% (3.74)
v.	Report Writing and Business Correspondence.....	44% (3.05)	26% (2.86)
w.	Public Speaking.....	25% (2.25)	28% (2.87)

8. Additional Comments:

return address: E. Y. Huang
 Department of Civil Engineering
 Michigan Technological University
 Houghton, MI 49931

NUMBER OF GRADUATE CIVIL ENGINEERS EMPLOYED BY
RESPONDING RAILROAD COMPANIES AND CONSULTING FIRMS

	Railroad Companies	Consulting Firms
Number of organizations to which questionnaires were distributed	57	82
Number of organizations returning questionnaires	23	24
Number of organizations for which questionnaires were analyzed	19	24
Number of graduate civil engineers currently in organizations:		
Total	981	707
Size range	5-263	2-150
Number of newly graduated civil engineers employed and retained (1973-1977)		
Total	288	235
Retained percentage	69.2%	66.8%
Number of organizations with formal training programs	8 (42.1%)	0 (0%)

PERCENTAGES OF RECENTLY GRADUATED CIVIL ENGINEERS
HAVING BASIC EDUCATION AND ENGINEERING BACKGROUND
FOR SATISFACTORY PERFORMANCE OF VARIOUS ACTIVITIES

Activity	Evaluated by			
	Railroad Companies		Consulting Firms	
	With Training Program %	Without Training Program %	Average %	
a. Routine surveying operations (including boundary surveys, construction surveys, and route surveying).	91.4	87.2	90.1	25.6
b. Engineering evaluation of soil and rock materials.	75.9	8.0	55.5	33.8
c. Application of soil stabilization techniques to unstable soil conditions.	69.8	12.8	52.6	13.9
d. Engineering evaluation of ballast materials.	26.2	8.0	20.3	10.2
e. Interpretations of aerial maps for route location, network, layout, and drainage design.	82.8	80.8	82.2	67.1
f. Design of simple buildings and structures.	100.0	92.0	97.6	88.9
g. Routine hydrological studies and drainage design.	90.4	89.6	90.1	77.9

Activity	Evaluated by			
	Railroad Companies		Consulting Firms	
	With Training Program %	Without Training Program %	Average	
h. Routine track layout, including a basic understanding of track components.	70.4	19.2	55.0	16.5
i. Applications of high-speed electronic digital computers to engineering computations, including basic programming skills.	64.3	73.6	67.1	94.9
j. Preparation of detail drawings and specifications.	90.4	93.6	85.3	21.3
k. Interpretation of construction plans and specifications.	90.4	90.4	90.4	46.3
l. Inspection and supervision of construction to insure quality workmanship.	75.3	79.2	76.5	17.6
m. Maintenance operations involving routine procedures and equipment.	22.3	43.4	31.7	4.5
n. Application of routine methods and equipment to reduce or prevent air, water, and noise pollution.	57.4	12.8	44.0	23.6

Activity	Evaluated by			
	Railroad Companies		Consulting Firms	
	With Training Program %	Without Training Program %	Average	
o. Exercise of judgments involving economic alternatives based on principles of engineering economy regarding plant, equipment and operations for construction and maintenance.	80.8	60.0	74.5	37.1
p. Preparations of routine engineering reports.	100.0	90.4	97.1	48.9
q. Handling of business correspondence.	82.8	82.4	82.4	48.0
r. Effective communication with associates, superiors, and subordinates.	100.0	88.8	96.6	79.3
s. Effective public speaking	77.3	24.0	61.3	37.5
t. Application of basic knowledge of managerial principles to engineering operations.	71.8	4k,6	62,7	18.5

RAY A. MUNDY,
C. JOHN LANGLEY, Jr., and
THOMAS E. GIBSON

Industry Evaluation of a Transportation/Logistics Curriculum

INTRODUCTION

Many business leaders have argued that present-day curricula of universities do not properly prepare individuals for careers in the new physical distribution/logistics area. The following article is an evaluation by business executives of courses offered in a large Transportation/Logistics curriculum. Suggestions as to what specific courses are important are clearly drawn by the executives. New directions and specific course offerings are suggested for academic programs intent on providing the best education possible in the Transportation/Logistics area.

RESEARCH DESIGN

A questionnaire was sent to executives in 805 of the nation's leading firms. The ques-

Mr. Mundy is an Associate Professor, Department of Marketing and Transportation, and Associate Director, Transportation Center, Mr. Langley is an Associate Professor of Transportation and Logistics, and Mr. Gibson a Graduate Research Assistant, Department of Marketing and Transportation, all of the University of Tennessee.

tionnaire requested an importance rating of present and potential Transportation/Logistics courses offered at The University of Tennessee,¹ as well as suggestions for potential courses not listed on the questionnaire.

The sample consisted of 405 transportation firms—taken from the 1975 edition of *Moody's Transportation Manual*. This portion of the sample included all Class I and Class II railroads, all motor carriers exhibiting \$15 million or higher in total annual revenue, and all major airlines and water carriers. The remaining 400 firms sampled were taken from the May 15, 1974, issue of *Forbes*—consisting of the largest 400 firms in the nation in total revenue. Prior to selecting these firms, all banking institutions, holding companies, and those firms engaged in for-hire transportation services were eliminated (the latter due to their inclusion in the other portion of the sample).

A total of 179 usable responses was received, indicating a response rate of 22.2 per cent. Of these responses, 76 were

from firms in the transportation industry, while 103 were from firms which were engaged primarily in other economic activities. This represents response rates of 18.8 per cent and 25.8 per cent respectively.

The information provided by the questionnaire included course ratings, suggested courses, and certain company demographics. The format for course ratings, including a sample course description, is given in Table I. The importance ratings respective to each course will be valid only to the extent that the course descriptions match actual course content. The descriptions, extracted from course offerings listed in *The University of Tennessee Record*, are felt to be the best course descriptions available.

OVERALL COURSE RATINGS

The average importance ratings and their standard deviations are presented in Table II. Very few courses were rated below the "moderately important" level. The absence of government agencies, including those involved in urban transportation policy and management decisions, and the low number of water carriers and airlines among respondents (one and eight respectively) account for the low ratings given courses in these areas.

The low rating given "Doctoral Dissertation and Research" follows a general trend

of high ratings for practical and applied courses and lower ratings for more theoretical courses. As the respondents were asked to rate each course "relative to the company's needs," such results are not surprising. Courses which indicate their applicability to management procedures and strategy are more easily related to the operational needs of the company.

Logistics courses generally received high importance ratings. This result is consistent with the recent increase in the stature of logistics as a business function.

The courses devoted to single modes of transport were rated in the order: (1) Highway; (2) Railroad; (3) Water; and (4) Air. This ordering may be explained somewhat by sample characteristics. The low number of respondents primarily engaged in water and air transportation has been previously discussed. In addition, 39 motor carriers responded to the survey as compared with 21 railroads. However, the relative importance ranking remains the same if only firms other than transportation firms are considered. Therefore, this ranking may be considered as indicative of the importance of these courses as perceived by industry in general.

Finally, among the proposed courses included in the questionnaire, "Transportation Labor" and "Warehousing" were rated significantly more important than "Marketing Transportation Services," "International

Table I
Sample of Course Rating Format From Questionnaire

Course	Importance Rating				
	Extremely Important	Very Important	Moderately Important	Slightly Important	Unimportant
	1	2	3	4	5
3110 <i>Introduction to Transportation</i> Economic, social, and political aspects of national transportation system; economic characteristics of modes of transport; regulatory problems.					

Table II
Courses Listed in Order of Their Average Importance Rating

Course: Transportation	Average Importance Rating ^a	Standard Deviation
3120 Traffic Management	1.825	1.086
4720 Business Logistics: Systems Management	1.892	1.124
4920 Transportation Law and Procedures	1.898	1.066
5130 Transportation Management Problems	2.011	1.117
3115 Business Logistics (Introduction)	2.023	1.220
5220 Physical Distribution Strategy	2.057	1.268
3110 Introduction to Transportation	2.068	1.144
5210 Business Logistics (Management)	2.096	1.269
5910 Transportation Law and Carrier Liability	2.136	1.198
5120 Management and the Pricing Problem	2.144	1.205
3310 Transportation Rates	2.175	1.287
4910 Carrier Liability and Claims	2.210	1.164
4610 Carrier Pricing Strategy	2.223	1.242
4620 Carrier Management	2.260	1.367
4930 Transportation Policy	2.273	1.188
4730 Business Logistics: Applied Research Methods	2.307	1.304
• Transportation Labor	2.362	1.373
5110 Theory and Functions of Economic Regulation	2.423	1.238
4210 Highway Transportation	2.432	1.367
5100 Survey of Transportation and Logistics	2.457	1.338
• Warehousing	2.463	1.457
6220 Transportation and Logistical Systems	2.474	1.310
4820 Current Topics in Trans. and Logistics	2.509	1.274
5920 Current Topics in Trans. and Logistics	2.524	1.256
6210 Seminar in Trans. and Logistics Models	2.526	1.345
5990 Research in Trans. and Logistics	2.580	1.303
6110 Seminar in Natl. Trans. Policy	2.713	1.361
• Marketing Transportation Services	2.718	1.515
• International Transportation	2.743	1.578
4110 Railroad Transportation	2.771	1.566
4820 Supervised Readings in Trans. & Logistics	2.801	1.309
• Government Transportation	3.080 ^b	1.491
6000 Doctoral Dissertation and Research	3.101	1.673
4310 Water Transportation	3.244	1.561
4420 Air Transportation	3.303	1.574
5510 Urban Transportation Policy	3.608	1.621
4510 Urban Transportation	3.659	1.617

^a These are the proposed courses which were included on the questionnaire and do not therefore have course numbers.

^a (1 = Extremely Important, 5 = Unimportant)

^b Note that some of the lowest ratings may be misleading due to the small number of water carriers, airlines, and governmental agencies among respondents. See text.

Transportation," and "Government Transportation."

COURSE RATINGS BY RESPONDENT TYPE

A step-wise discriminant analysis was conducted to determine which course importance ratings best differentiated respondents in the transportation industry from all other respondents. This analysis was used as a descriptive technique, to lead to an understanding of the differences in course importance to the two respondent groups.

Table III presents the discriminant function derived from this analysis. Variables were allowed to enter when found to be significant at the 0.01 level.

The lesser importance ratings of "Railroad Transportation" and "Air Transportation" and the greater importance rating of "Carrier Management" by transportation firms as opposed to non-transportation firms is probably a result of the high percentage of motor carriers among transportation firm respondents. The greater importance ratings given "Physical Distribution Strategy" and "Warehousing" by nontransportation firms is indicative of the

greater applicability of these courses to the operation of these firms. Similarly, the greater importance rating of "Marketing Transportation Services" by transportation firms is predictable due to greater congruence with industry functions.

OTHER SUGGESTED COURSES

Respondents were given the opportunity to suggest courses not listed on the questionnaire. The response to this request was very gratifying. A total of 72 course suggestions were received (some overlapping).

The following course suggestions were made by the respondents:

1. *Communications*: Respondents indicated that greater emphasis on written and oral communications is needed in the curriculum for Transportation/Logistics majors. The importance of effective speaking and writing was felt by respondents to be generally underemphasized in Transportation/Logistics education.
2. *Labor Problems and Human Relations in Transportation*: Respondents who suggested courses in this area ex-

Table III
Discriminant Function for Transportation Firms Versus
Non-Transportation Firms

Standardized Discriminant Function Coefficients	Course	Average Importance Rating— Transportation Firms ^a	Average Importance Ranking— Other Firms ^a
-0.1712	4110—Railroad Transportation	3.368	2.862
-0.1629	4420—Air Transportation	4.035	3.588
0.4385	4620—Carrier Management	1.825	3.025
-0.3316	5220—Physical Distribution Strategy	2.930	1.838
-0.2373	° —Warehousing	3.544	2.312
0.3873	° —Marketing Transportation Services	2.160	3.625

° Proposed Courses.

^a From 1 = Extremely Important to 5 = Unimportant

pressed a desire for course work relative to interpersonal abilities at the corporate management level as well as with labor. Suggested areas of emphasis include motivation of personnel, leadership, labor contracts, and the psychology of negotiation.

3. *Quantitative Methods in Transportation/Logistics*: A variety of suggested courses were mentioned in this area. These included "Transportation Finance and Accounting," "Industrial Engineering / Materials Handling," "Distribution Engineering," and "Techniques of Transportation Data Analysis."
4. *Logistics Planning*: Several respondents indicated that additional emphasis is needed on long-range physical distribution planning as related to corporate objectives and strategy.
5. *International Transportation / Logistics*: The increasing importance of the multi-national corporation was mentioned as a reason for additional course work in this area.
6. *Private Carriage Management*: Suggestions in this area included economic, social, and political aspects of private carriage in an industrial or retail firm.
7. *Salesmanship*: These suggestions focused primarily on sales principles and techniques as related to the provision of transportation services.

Among the other courses suggested, two of particular interest were "Intermodalism" and "Purchasing Transportation Services."

IMPLICATIONS IN CURRICULA DESIGN

The major impact of the results of this study is in the area of course content and structure rather than in the actual addition or deletion of courses. In particular, survey results do not suggest that any of the courses presently in The University of

Tennessee curriculum in Transportation/Logistics are prospects for deletion. The more theoretical course offerings, no doubt considered as generally important by academicians, are of particular importance to those pursuing advanced studies and research in the Transportation/Logistics area. Water and air transportation are, and will no doubt continue to be, significant sectors of the transportation industry. Finally, no one can dispute the problems and challenges to be faced in urban transportation management and policy in future decades and the necessity for adequate training to meet these challenges.

On the other hand, two proposed course offerings received ratings indicating a need to consider their inclusion in Transportation/Logistics curricula. The first of these, "Transportation Labor," is also frequently mentioned by respondents in additional suggested courses. The course could not only include organized labor, negotiation, and nonunion alternatives in transportation, but also human relations at all levels of the transportation system. A logical extension might focus on the social aspects of the transportation system as a part of the economic system in this country and world-wide.

The other proposed course which received high importance ratings is "Warehousing." This course should include problems and theory in warehouse management, the role of warehousing in channels of distribution, and relationships to inventory management.

Implications of results to actual course content are subject to some debate, as these implications relate to current educational trends and theory spanning several disciplines. The role that courses devoted to one subject area can and should assume in promoting effective communication skills is subject to question. No doubt students develop and refine these skills by their actual use in subjects studied throughout

their college careers. However, certain fundamentals must be acquired in courses specific to communications (English and speech). If not acquired in such courses, communicative skills are very often not acquired at all. Many transportation and logistics courses include a fair amount of written and/or oral case work. If instructors in such courses accept poor communicative skills under the assumption that students were not adequately prepared in other college or even secondary level courses, students will enter the transportation industry unable to function to their full potential as they will not be able to communicate their ideas adequately. Educators must demand, to the fullest extent possible, the skills necessary to function in a business environment.

A similar argument may be offered in the area of quantitative skills. In this area, however, many discipline-specific subjects should perhaps be included in current course offerings. It would be remiss not to discuss the special financial and accounting problems of the capital-intensive airline industry in a course concerning air transportation. A Transportation/Logistics student should be exposed to the many and varied uses of the computer as an aid in analyzing relevant data. The inclusion of course work related to technical aspects of the engineering of distribution systems may be subject to some question, although certain preliminary courses, such as integral calculus, must be included in the overall preparation of each student. These are but a few suggestions—no doubt others of both theoretical and applied interest should be candidates for inclusion in existing course structure.

It should be noted that these suggestions are by no means entirely definitive. They only serve to indicate current opportunities and problems in the evolution of Transportation/Logistics education. In basing these suggestions on data from an industry

survey, it is hoped that a basis for including industry opinion into curricula design will be established.

IMPLICATIONS FOR THE TRANSPORTATION/ LOGISTICS STUDENT

Several aspects of the results are important to the student in Transportation and/or Logistics in the selection of courses. It is obvious that a student who has decided which portion of the transportation industry to enter should choose courses of particular relevance to that segment. Students interested in managing physical distribution for a manufacturer or retailer would be well advised to enroll in "Physical Distribution Strategy" and "Warehousing" (if available). Those who wish a career with motor carriers should take "Carrier Management" and "Marketing Transportation Services" (if available). Although these results are not surprising, they do illustrate the appropriateness of career decisions at an early stage of a college career.

On a broader scale, a student who desires a career in any phase of business (as well as in almost any area) should use every available opportunity to insure that effective communicative skills are developed. This should include electives in this area, if necessary. Such electives might include Business Communications, English, and Speech. Similarly, careful thought must be given to insure that quantitative abilities and knowledge are developed to a level congruent with career goals.

Educators have a tremendous responsibility in this respect. They must inform the student of the current attitude of industry concerning communicative and quantitative knowledge and skills and suggest courses for their development. Educators should also encourage the student to make an early career choice and to design the course work around career objectives.

CONCLUSION

As with all societal systems, education in Transportation and/or Logistics must be dynamic or properly serve the needs of society. It is hoped that the directions suggested by this article may be helpful to those responsible for planning Transportation/Logistics curricula.

FOOTNOTES

¹ Transportation education at The University of Tennessee, Knoxville, has been ranked among the

top programs in the nation since its inception in 1948. One very important factor contributing to this stature has been a continuing effort to provide training consistent with industry desires and needs. In order to accomplish this task, considerable communication with the transportation sector of American industry has been necessary.

In keeping with this tradition, the research upon which this article is based consists of an effort to obtain industry perspectives on current and proposed course offerings of the Transportation Department at The University of Tennessee. The research and results include implications for the area of curriculum design, as well as for course selection by the Transportation/Logistics students.

I. SCHOOLS OFFERING DEGREE PROGRAMS IN
TRANSPORTATION MANAGEMENT AND ECONOMICS

Degree Level: Doctorates

Columbia University, New York, NY
Georgia Institute of Technology, Atlanta, GA
Indiana University, Bloomington, IN
Michigan State University, East Lansing, MI
Portland State University, Portland, OR
Stanford University, Stanford, CA
Syracuse University, Syracuse, NY
University of Alabama, University, AL
University of Arkansas, Fayetteville, AR
University of Colorado, Boulder, CO
University of Maryland, College Park, MD
University of Minnesota-Minneapolis, Minneapolis, MN
University of Oregon, Eugene OR
University of Tennessee, Knoxville, TN
University of Texas at Austin, Austin, TX
University of Wisconsin-Madison, Madison, WI
University of Wyoming, Laramie, WY
Washington State University, Pullman, WA

Degree Level: Masters

Auburn University, Auburn, AL
California State University, Los Angeles, CA
City University of New York, New York, NY
Columbia University, New York, NY

Source: Excerpted with permission from Edward J. Marien, College and University Courses in Physical Distribution Management (Chicago, Illinois: National Council of Physical Distribution Management, 1979).

Degree Level: Masters (cont'd)

East Tennessee State University, Johnson City, TN
Florida International University, Miami, FL
Georgia Institute of Technology, Atlanta, GA
Golden Gate University, San Francisco, CA
Indiana University, Bloomington, IN
Iowa State University, Ames, IA
Michigan State University, East Lansing, MI
Northwestern University, Evanston, IL
Portland State University, Portland, OR
Stanford University, Stanford, CA
Syracuse University, Syracuse, NY
Texas A & M University, College Station, TX
University of Alabama, University, AL
University of Colorado, Boulder, CO
University of the District of Columbia, Washington, DC
University of Maryland, College Park, MD
University of Minnesota-Minneapolis, Minneapolis, MN
University of Oklahoma, Norman, OK
University of Oregon, Eugene, OR
University of South Carolina, Columbia, SC
University of Tennessee, Knoxville, TN
University of Texas at Austin, Austin, TX
University of Washington, Seattle, WA
University of Wisconsin-Madison, Madison, WI
University of Wyoming, Laramie, WY
Washington State University, Pullman, WA
Wichita State University, Wichita, KS

Degree Level: Bachelors

Auburn University, Auburn, AL
Boise State University, Boise, ID
Bowling Green State University, Bowling Green, OH
Bryant College of Business Administration, Providence, RI

Degree Level: Bachelors (cont'd)

California State University, Sacramento, CA
California State University, Los Angeles, CA
Christian Brothers College, Memphis, TN
City University of New York, New York, NY
East Tennessee State University, Johnson City, TN
Eastern Kentucky University, Richmond, KY
Elmhurst College, Elmhurst, IL
Florida International University, Miami, FL
Georgia Institute of Technology, Atlanta, GA
Golden Gate University, San Francisco, CA
Iowa State University, Ames, IA
Michigan State University, East Lansing, MI
Niagara University, Niagara Falls, NY
North Carolina A & T State University, Greensboro, NC
Northeastern University, Boston, MA
Northwestern University, Evanston, IL
Portland State University, Portland, OR
Robert Morris College, Coraopolis, PA
San Francisco State University, San Francisco, CA
Shippensburg State College, Shippensburg, PA
Stanford University, Stanford, CA
Syracuse University, Syracuse, NY
Tri-State University, Angola, IN
University of Alabama, University, AL
University of Arkansas, Fayetteville, AR
University of Colorado, Boulder, CO
University of the District of Columbia, Washington, DC
University of Maryland, College Park, MD
University of Minnesota-Minneapolis, Minneapolis, MN
University of North Florida, Jacksonville, FL
University of Oklahoma, Norman, OK
University of Oregon, Eugene, OR
University of South Carolina, Columbia, SC
University of Tennessee, Knoxville, TN

Degree Level: Bachelors (cont'd)

University of Texas at Austin, Austin, TX
University of Texas at El Paso, El Paso, TX
University of Wisconsin-Madison, Madison, WI
Virginia Polytechnic Institute and State University, Blacksburg, VA
Washington State University, Pullman, WA
Weber State College, Ogden, UT
Wichita State University, Wichita, KS
Wilmington College, Wilmington, OH
Youngstown State University, Youngstown, OH

Degree Level: Associates and Certificates

Belmont Abbey College, Belmont, NC
Catonsville Community College, Catonsville, MD
Colorado Northwestern Community College, Rangely, CO
Community College of Denver-Aurora, Denver, CO
Danville Junior College, Danville, IL
DeAnza College, Cupertino, CA
Delaware Technical and Community College, Wilmington, DE
Dickinson State College, Dickinson, NC
Central Virginia Community College, Lynchburg, VA
Delta College, University Center, MI
Florence-Darlington Technical College, Florence, SC
Florida International University, Miami, FL
Florida Junior College at Jacksonville, Jacksonville, FL
Fresno City College, Fresno, CA
Golden Gate University, San Francisco, CA
Henry Ford Community College, Dearborn, MI
Houston Community College System, Houston Community College, Houston, TX
Hudson Valley Community College, Troy, NY
Jefferson State Junior College, Birmingham, AL
Joliet Junior College, Joliet, IL
Kansas Technical Institute, Salina, KS
Los Angeles City College, Los Angeles, CA

Degree Level: Associates and Certificates (cont'd)

Lurleen B. Wallace State College, Andalusia, AL
Madison Area Technical College, Madison, WI
Middlesex County College, Edison, NJ
Milwaukee Area Technical College, Milwaukee, WI
Murray State University, Murray, KY
Muskegon Community College, Muskegon, MI
North Hennepin Community College, Minneapolis, MN
Northeast Wisconsin Technical Institute, Green Bay, WI
Northeastern University, Boston, MA
Norwalk Community College, Norwalk, CT
Pasadena City College, Pasadena, CA
Peralta College for Nontraditional Study, Berkeley, CA
Polk Community College, Winter Haven, FL
Richard J. Daley College, Chicago, IL
Rider College Evening School, Lawrenceville, NJ
Rochester Institute of Technology, Rochester, NY
Sacramento City College, Sacramento, CA
St. Louis Community College at Meramec, St. Louis, MO
St. Paul Technical Institute, St. Paul, MN
San Joaquin Delta Community College, Stockton, CA
Sinclair Community College, Dayton, OH
Sheffield Voc-Tech, Memphis, TN
State University of New York at Buffalo, Buffalo, NY
State University of New York, Delhi, NY
Tarrant County Junior College, Northeast Campus, Hurst, TX
Tulsa Junior College, Tulsa, OK
University College, Richmond, VA
University of Louisville, Louisville, KY
University of Missouri-Kansas City, Kansas City, MO
Westmoreland County Community College, Youngwood, PA
William Rainey Harper College, Palatine, IL

J. THE MARTIN F. SCHMIDT ENDOWMENT FOR
TRANSPORTATION AND DISTRIBUTION



THE MARTIN F. SCHMIDT ENDOWMENT
FOR TRANSPORTATION AND DISTRIBUTION

College of Business and Administration
Campus Box 419 University of Colorado Boulder, Colorado 80309

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**TO BEGIN A TRADITION
THAT WOULD ENCOURAGE EXCELLENCE IN
TRANSPORTATION AND PHYSICAL DISTRIBUTION**

**THE MARTIN F. SCHMIDT ENDOWMENT
FOR TRANSPORTATION AND DISTRIBUTION**

Martin F. Schmidt, Professor of Transportation Management and Organization at the University of Colorado will soon retire from the College of Business and Administration after more than forty-five years of distinguished service.

During his tenure at the University, Martin has distinguished himself in a variety of ways. He has won the Salgo-Noren national teaching award as well as other University teaching awards of excellence. The United States Air Force bestowed upon him the Civilian Award of Merit. He has worked for railroads in managerial capacities, served on the board of directors of a national trucking firm, and acted as a transportation consultant to many local, state, and national agencies.

The Endowment for Transportation and Distribution will honor a man who has devoted his life to education and the field of transportation. During his forty-five years of service at the University, Martin has been the catalyst for the transportation program. Students majoring in this discipline, over the years, can now be found working in all modes of transportation and distribution firms and in virtually every managerial position from corporate presidents to the most recent graduate. Contributions to the Endowment will ensure that this tradition is maintained.

To honor the significant achievements of Martin Schmidt, our goal is to establish the Endowment of Transportation and Distribution in the College of Business and Administration at the University of Colorado. The goal is \$750,000. To accomplish this goal, a fund raising committee has been established to invite gifts for the Endowment. Funds collected will be used to ensure that continued emphasis be given to the ideals of Martin F. Schmidt — teaching, research, and a working relationship with the needs of industry.

A College of Business advisory committee annually will allocate interest revenues from the Endowment to the following uses:

1. A fully funded professorship of transportation and distribution.
2. A perpetual scholarship and research fund to aid undergraduate and graduate students of transportation and distribution.
3. Provision of funds for conferences and seminars to promote and further the study of transportation and distribution for both students and faculty.

Monies for this fund will not be solicited annually. Therefore, your contribution at this time is critical. Will you please send your tax deductible check payable to the Martin F. Schmidt Endowment? Thank you.

Make your gift count! Your employer could be one of the more than 500 companies which will match its employees' contributions to educational institutions. Inquire about your corporate policy.

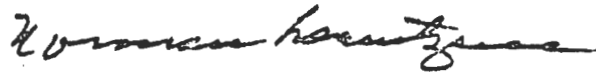
COMMENTS ABOUT AN EDUCATOR

... from his colleagues

Martin Schmidt truly is an **educator**, a teacher whose own education and wide experience enable him to offer his students a unique insight into our transportation industry and the private enterprise system itself.

Young people who have come under his tutelage have enjoyed and been stimulated by hours of informal discussions outside the classroom and the lecture hall. And he has carried their experience beyond books and led them into thoughtful discussion of life goals, spiritual beliefs, ethics, and morals. Our world needs more educators like Martin Schmidt.

So does the private enterprise system. Not only Burlington Northern, but the transportation industry of the nation has been able to draw rich benefits from his work. And thus, do I recommend this worthwhile program because it will further his life's work.

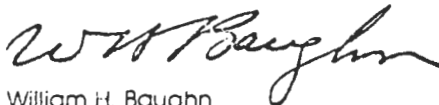


N. M. Lorentzen
President and Chief Executive Officer
Burlington Northern, Inc.

For forty years Professor Martin Schmidt has made a unique contribution to the College of Business here at the University of Colorado. He has been an active participant in the total development of this College, having been involved in all the major changes in the structure of the program during that period. In that process Martin has contributed purpose and stability to the program. It has been my pleasure to work closely with Martin Schmidt for a period of approximately 15 years and I know of no faculty member who is more completely dedicated to the well-being of the University of Colorado than is Martin.

Of special value to the College has been Professor Schmidt's personal commitment to the well-being of individual students. He has worked continuously to help students develop career plans and has worked with business and industry in searching out appropriate career opportunities for his students. His success in matching student and employer interests is reflected in the rapid advancement of his students in their positions.

It is most appropriate, as he approaches retirement, that the College, its alumni, and other business colleagues honor Martin Schmidt for all he has done for so many people.



William H. Baughn
Dean, College of Business
and Administration

Recent history has shown that there are no issues more critical to the continued well-being of our civilization than those involving transportation and distribution. Martin Schmidt has devoted nearly half a century to the study of these concerns, and his contributions — both as a teacher and as a researcher — have been towering. I can think of no more appropriate tribute to him than the establishment of this endowment, which will insure that the vitally important inquiries that he has done so much to initiate will continue to go forward. Here is a challenge that calls for the best the intellect can give. The University is proud to take it up.



R. C. Rautenstrauss for The Martin F. Schmidt Endowment For
Transportation and Distribution

... and from his students

"Professor Schmidt was an advisor, confidante, and friend . . . to those of us who have been his students. He was far more than an educator. He was a humanitarian. His extraordinary efforts on our behalf have produced significant and enduring effects in our lives and careers."

"Martin Schmidt is a man of unlimited talents . . . to me, he is a friend, teacher, mentor, father figure, and the one man I respect most in life. He raised a good family, his friends cherish him, he has the respect of transportation industry leaders, admiration of students, and is remembered by all of us each day."

"Martin Schmidt epitomizes excellence in education. He is willing to extend to all students his broad experience and understanding of transportation and management. Whether in a lecture situation or an informal conversation, prime educators such as Professor Schmidt bring the world into the classroom and help students become ready for the real world. Professor Schmidt gave me the opportunity to begin an effective professional career."

Please make your tax deductible check payable to:

**THE MARTIN F. SCHMIDT ENDOWMENT
FOR TRANSPORTATION AND DISTRIBUTION**
College of Business and Administration
University of Colorado, P.O. Box 419
Boulder, Colorado 80309

K. FEDERAL HIGHWAY ADMINISTRATION AND URBAN MASS TRANSPORTATION
ADMINISTRATION FELLOWSHIP PROGRAM DOCUMENTATION

ENABLING LEGISLATION FOR NATIONAL HIGHWAY INSTITUTE

§ 321. National Highway Institute.

(a) The Secretary is authorized and directed to establish and operate in the Federal Highway Administration a National Highway Institute hereafter referred to as the "Institute". The Institute shall develop and administer, in cooperation with the State highway departments, training programs of instruction for Federal Highway Administration and State and local highway department employees engaged or to be engaged in Federal-aid highway work. Such programs may include, but not be limited to, courses in modern developments, techniques, and procedures, relating to highway planning, environmental factors, acquisition of rights-of-way, engineering, construction, maintenance, contract administration, and inspection. The Secretary shall administer all authority vested in him by this title or by any other provision of law for the development and conduct of educational and training programs relating to highways through the Institute. Sums authorized to be deducted for administrative purposes by subsection (a) of section 104 of this title shall be available for carrying out this subsection.

(b) Not to exceed one-half of 1 per centum of all funds apportioned for any fiscal year beginning after June 30, 1970, to any State under paragraphs (1), (2), (3), and (6) of section 104(b) of this title shall be available for expenditure by the State highway department, subject to approval by the Secretary, for payment of not to exceed 70 per centum of the cost of tuition and direct educational expenses (but not travel, subsistence, or salaries) in connection with the education and training of State and local highway department employees as provided in this section.

(c) Education and training of Federal, State, and local highway employees authorized by this section may be provided by the Secretary, or, in the case where such education and training is to be paid for under subsection (b) of this section, by the State, subject to the approval of the Secretary, through grants and contracts with public and private agencies, institutions, and individuals.

Source: United States Code: Title 23; Highways, March 1977.

ENABLING LEGISLATION FOR UMTA FELLOWSHIP PROGRAM

92 STAT. 2744

PUBLIC LAW 95-599—NOV. 6, 1978

FELLOWSHIP ASSISTANCE

SEC. 306. Section 10 of the Urban Mass Transportation Act of 1964 is amended to read as follows:

“GRANTS FOR TRAINING PROGRAMS

49 USC 1607b.

Selections.

“SEC. 10. The Secretary is authorized to make grants to States, local public bodies, and agencies thereof (and operators of public transportation services) to provide fellowships for training of personnel employed in managerial, technical, and professional positions in the public transportation field. Fellowships shall be for not more than one year of training in public or private training institutions offering programs having application in the public transportation industry. The recipient of a fellowship under this section shall be selected by the grantee on the basis of demonstrated ability and for the contribution which the recipient can be reasonably expected to make to an efficient public transportation operation. The assistance under this section toward each fellowship shall not exceed the lesser of \$24,000 or 75 per centum of the sum of (1) tuition and other charges to the fellowship recipient, (2) any additional costs incurred by the training institution in connection with the fellowship and billed to the grantee, and (3) the regular salary of the fellowship recipient for the period of the fellowship (to the extent that salary is actually paid or reimbursed by the grantee).”

ENABLING LEGISLATION FOR TRANSPORTATION CENTERS

PUBLIC LAW 95-599—NOV. 6, 1978

92 STAT. 2745

TRANSPORTATION CENTERS

Sec. 307. Subsection (b) of section 11 of the Urban Mass Transportation Act of 1964 is amended to read as follows:

Grants.
49 USC 1607c.

“(b) (1) In addition to grants authorized by subsection (a) of this section, the Secretary is authorized to make grants for the purpose of establishing and operating transportation centers at nonprofit institutions of higher learning.

“(2) The institutions receiving assistance under this subsection shall be selected by the Secretary, in coordination with State transportation agencies or departments, on the basis of demonstrated research and extension resources capable of contributing to the solution of State and regional transportation problems.

“(3) The responsibilities and duties of each transportation center shall include, but not be limited to, the conduct of competent research investigations, both scientific and policy oriented, and experiments of either a basic or practical nature in relation to transportation problems.

Duties.

“(4) In order for an institution to receive Federal funds under this subsection, subject to the conditions set forth therein, such institution, in coordination with the State in which the institution is located (or, in the case of multi-institutional programs authorized under paragraph (6) of this subsection, in coordination with the States in which the participating institutions are located) shall submit to the Secretary for his approval a program or programs of proposed projects for the academic year for the utilization of such funds. The Secretary shall act upon programs submitted to him by March 15 preceding the fiscal year for which application for assistance is made (except in the case of fiscal year 1979, for which the Secretary shall act upon programs submitted to him as soon as practicable).

Projects program,
approval.

“(5) As a condition to project approval, the State in which a selected institution is located must equally match from other than Federal funds, the amount of the Federal grant.

State matching
grants.

“(6) Upon the joint application of two or more institutions of higher learning, the Secretary may approve a multi-institutional program to address regional transportation problems, subject to conditions set forth in this subsection.

“(7) On or before July 1 of each fiscal year for which funds have been appropriated under this subsection, each participating institution shall submit a report to the Secretary on its activities and progress in solving transportation problems. On or before October 1 of each such fiscal year, the Secretary shall submit a report to Congress on the activities and progress of the program authorized by this subsection in solving transportation problems and achieving national transportation policy objectives.”

Report.

Annual report to
Congress.



U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

FEDERAL-AID HIGHWAY PROGRAM MANUAL

VOLUME	3	NATIONAL HIGHWAY INSTITUTE
CHAPTER	2	GRANT PROGRAMS
SECTION	1	FELLOWSHIP AND SCHOLARSHIP GRANTS

Transmittal 218
October 13, 1976
HHI-3

- Par. 1. Purpose
2. Authority
3. Definitions
4. Policy
5. Eligibility
6. Selection
7. Responsibilities of Educational Institutions
8. Responsibilities of Employing Agencies
9. General
10. Equal Opportunity
11. Application Procedures

1. PURPOSE

- * *To establish policy and eligibility requirements and selection criteria for the Federal Highway Administration (FHWA) Fellowship and Scholarship Programs as administered by the National Highway Institute. These include the FHWA Fellowship Program in Highway Safety, the FHWA Fellowship Program in Highway Transportation Research and Education, and the FHWA Scholarship Program in Highway Technology.*

2. AUTHORITY

23 U.S.C. Sections 307(a), 315, 321, and 403; and 49 CFR 1.48.

3. DEFINITIONS

As used in this directive, the following definitions apply:

- a. Candidate. *One who has completed and submitted the necessary forms and documents in order to be considered for selection for a fellowship or scholarship.*

- * Regulatory material is italicized.

- b. Fellowship. The grant presented to the successful candidate's school and administered by the school to assist the candidate financially during the period of graduate study.
- c. Scholarship. The grant presented to the successful candidate's school and administered by the school to assist the candidate financially during the period of post-secondary study.
- d. Living Stipend. The portion of the fellowship or scholarship grant remaining after the direct educational expenses have been deducted.
- e. Direct Educational Expenses. Those expenses directly related to attending school including tuition, student fees, books, and expendable supplies but excluding travel expenses to and from school.
- f. Recipient. The successful candidate receiving a fellowship or scholarship.
- g. Employing Agency. The agency for which the candidate works. This may be either a State or local highway/transportation agency or the FHWA.
- h. State Highway/Transportation Agency. The agency with the responsibility for initiating and carrying forward a highway program or public transportation program utilizing highways at the State level.
- i. Local Highway/Transportation Agency. The agency or metropolitan planning organization with the responsibility for initiating and carrying forward a highway program or public transportation program utilizing highways at the local level, usually the city or county level.
- j. National Highway Institute (NHI). The organization located within the FHWA responsible for the administration of the FHWA Fellowship and Scholarship Grant Programs.

4. POLICY

It is the policy of the FHWA to administer, through the NHI, fellowship and scholarship grant programs to assist State and local agencies and the FHWA in developing the expertise needed for the implementation of their highway programs and to assist in the development of more effective transportation

programs at all levels of government. These programs shall provide financial support for up to 12 months of full-time or up to 24 months of part-time study in the field of highway transportation. The programs for each year shall be announced by FHWA Notices. These Notices shall contain application forms and shall announce the number of grants to be awarded and their value. These programs shall include the FHWA Fellowship Program in Highway Safety, the FHWA Fellowship Program in Highway Transportation Research and Education, and the FHWA Scholarship Program in Highway Technology.

5. ELIGIBILITY

- a. *Prior recipients of FHWA Scholarships or Fellowships are not eligible.*
- b. *Candidates shall be employees of State or local highway/transportation agencies, or the FHWA, or have commitments to work for State or local highway/transportation agencies upon completion of the fellowship or scholarship study period.*
- c. *Candidates for the fellowship programs shall have earned Bachelor's or comparable college level degrees prior to beginning advanced studies under these programs.*
- d. *Candidates shall submit evidence of acceptance, or probable acceptance, for study in programs that will enhance their contributions to their employers. Evidence of probable acceptance may be a letter from the department chairman or other school official.*
- e. *Candidates shall agree to pursue certain minimum study loads as determined by the FHWA and designated in the FHWA Notices announcing the programs each year.*
- f. *FHWA employees who receive awards will be required to execute continued service agreements, consistent with the Government Employees Training Act requirements, which obligate the employees to continue to work for the agency for three times the duration of the training received.*
- g. *Candidates for study periods of 9 months or longer who are employees of State or local highway/transportation agencies, shall agree, in writing, to work in public service with State or local highway/transportation agencies for at least 3 years after completing the study*

period, or to repay the grants or pro rata amounts of the grants. Candidates for study periods of less than 9 months who are employees of State or local highway/transportation agencies, shall enter into similar agreements to work for time periods specified in the FHWA Notice announcing the programs.

- h. Candidates shall agree to respond to brief questionnaires designed to assist the NHI in program evaluation both during and following the study period.*
- i. Candidates employed by the FHWA may not work part-time outside of FHWA concurrent with the FHWA grant. Other candidates may work part-time and accept salary or wages while studying under these programs. However, acceptance of salary support and part-time salary or wages is subject to the terms of the nonprofit criterion stipulated in paragraph 5k of this directive. Funds from this grant shall not be used to support the student's work on research projects for which the institution is being paid Federal funds. Candidates shall not accept other types of scholarship or fellowship assistance with the exception of benefits under programs administered by the Veterans Administration (VA) subject to the regulations governing VA programs.*
- j. Recipients of awards for full-time study shall agree to limit their part-time employment as stipulated in the FHWA Notice announcing the program.*
- k. Candidates shall not profit financially from FHWA grants. Where acceptance of the living stipend portion of the grant would result in a profit to the candidate, as determined by comparing the candidate's regular full-time salary with the candidate's part-time salary and employer salary support plus living stipend, the grant amount will be reduced accordingly. In cases where a candidate must relocate and maintain two households, exceptions to this condition will be considered.*
- l. Candidates shall be citizens, or shall declare their intent to become citizens of the United States.*

6. SELECTION

- a. Candidates shall be rated by a selection panel appointed by the Director of NHI. Members of the panel shall represent the highway transportation interests of*

government, industry, and the academic community. The factors considered by the selection panel are weighted in accordance with specific program objectives.

- b. The major factors to be considered by the panel are:
 - (1) candidate's potential to contribute to a public agency's highway transportation program,*
 - (2) relevance of a candidate's study program to the objectives of the fellowship or scholarship program,*
 - (3) relevant experience, and*
 - (4) academic and professional achievements.**
- c. Using ratings given by the selection panel, the Director of the NHI shall select candidates for awards and designate alternates.*
- d. The FHWA may designate in the FHWA Notice announcing the program the maximum number of awards that will be made to employees of any one agency.*

7. RESPONSIBILITIES OF EDUCATIONAL INSTITUTIONS

- a. The college or university chosen by the grant recipient shall enter into an appropriate agreement with the FHWA providing for the administration of the grant by the college or university.*
- b. The college or university chosen by the recipient shall designate a faculty advisor prior to the commitment of funds by the FHWA. The faculty advisor will be requested to submit reports of the recipient's study progress following completion of each study period. These reports are oriented toward total program evaluation. To assure the recipients' rights to privacy, the FHWA will obtain appropriate advance concurrences from the recipients.*

8. RESPONSIBILITIES OF EMPLOYING AGENCIES

- a. A candidate's employing agency is responsible for furnishing a statement of endorsement and information concerning the relevancy of the candidate's study to agency requirements. The agency is encouraged to identify educational and training priorities and to provide backup to support its priority candidates for these programs.*

- b. *Employing agencies are encouraged to give favorable consideration to the requests of candidates for educational leave and salary support for the study period to facilitate the candidates' applications. Agency decisions involving salary support and educational leave that will affect the acceptance of awards by recipients should be made at the earliest possible date to provide adequate time for the FHWA to select alternates to replace candidates that decline their awards.*
- c. *Agencies are responsible for negotiations with their candidates concerning conditions of reinstatement and the candidates' commitments to return to work.*
- d. *Employing agencies are encouraged to publicize the availability of these grants throughout the agencies, to implement procedures for internal evaluation of applications, and to forward the applications to the FHWA division office in their State.*
- e. *Employing agencies that choose to process their employees' applications are responsible for observing the cutoff date for the FHWA to receive applications. This date will be stipulated in the Notice announcing the program for each academic year.*

9. GENERAL

The U.S. Internal Revenue Service (IRS) has ruled that FHWA Fellowship and Scholarship Grants are considered to be taxable income for purposes of filing Federal Income Tax Returns (copies of this ruling are available from the NHI upon request). Questions or requests for clarification of this ruling should be directed to the IRS.

10. EQUAL OPPORTUNITY

- a. *Consistent with the provisions of the Civil Rights Act of 1964 and Title VI, Assurances Executed by each State, 23 U.S.C. 324, and 29 U.S.C. 794, no applicant, including otherwise qualified handicapped individuals, shall on the grounds of race, color, sex, national origin, or handicap, be excluded from participation in, be denied benefits of, or be otherwise subjected to discrimination under this program.*

- b. *In accordance with Executive Order 11141, no individual shall be denied benefits of this program because of age.*
- c. *Agencies should make information on this program available to all eligible employees, including otherwise qualified handicapped individuals, so as to assure nondiscrimination on the grounds of race, color, sex, national origin, age, or handicap.*

11. APPLICATION PROCEDURES

- a. *The FHWA Notices announcing each year's programs and containing the application forms may be obtained from FHWA regional and division offices, State highway agencies, metropolitan planning organizations, Governors' Highway Safety Representatives, and from colleges and universities. Forms may also be obtained from the NHI, HHI-3, FHWA, Washington, D.C. 20590.*
- b. *In order to become a candidate, the applicant shall complete and forward the application form according to the instructions in the FHWA Notices announcing the programs. The cutoff date for submitting the application stipulated in the Notices should be observed.*