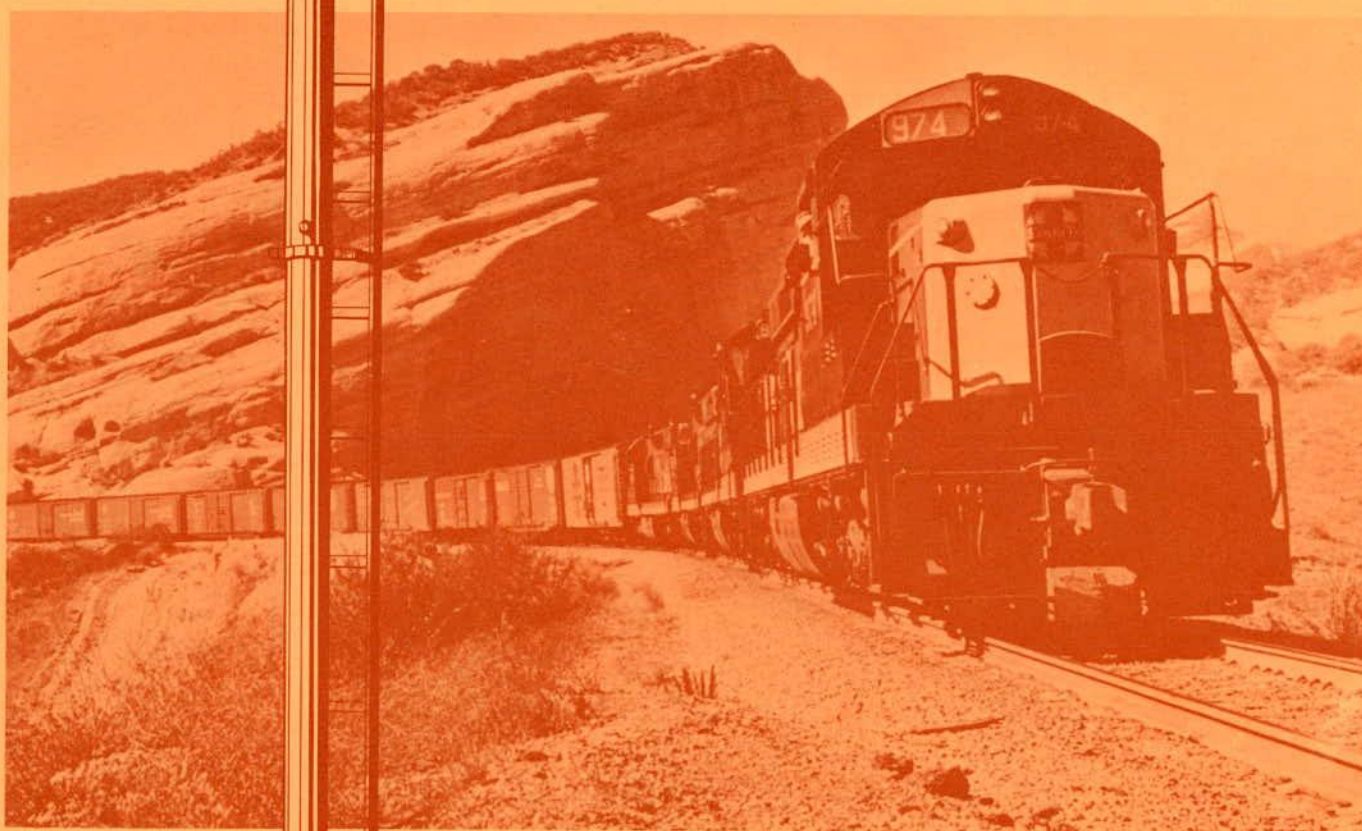


# **Review of Rail Transport Research Needs**

**Special Report 188**



**Transportation Research Board  
National Academy of Sciences**

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# **Review of Rail Transport Research Needs**

**Special Report 188**

**Committee on the Railroad Research Study  
Transportation Research Board  
Commission on Sociotechnical Systems  
National Research Council**

**National Academy of Sciences  
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The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competence and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

The views expressed in this report are those of the authors and do not necessarily reflect the view of the committee, the Transportation Research Board, the National Academy of Sciences, or the sponsors of the project.

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# Preface

This report is a follow-up of a Transportation Research Board (TRB) study on rail transport research needs conducted in 1975. The 1975 study was sponsored by the Association of American Railroads (AAR) and the Federal Railroad Administration (FRA). The objectives of the study were to develop a comprehensive framework for a coordinated national research effort by industry and government and to suggest priorities for a program of research. The study was based on a conference held in July 1975. A group of about 200 individuals selected for their knowledge on almost every facet of railroading provided informed viewpoints concerning research needs related to the provision of rail transport in the years ahead. The papers from the conference were published in Railroad Research Study Background Papers (1). The findings and recommendations were presented in Rail Transport Research Needs (2).

In 1978, AAR suggested a review of the 1975 recommendations to determine whether the research was still needed, whether priorities had changed, and whether any new research needs had arisen—in effect, to examine the objectives and to determine whether a mid-course correction is needed. TRB agreed to organize and conduct such a review under the general support contracts from AAR and FRA. A study committee, with Guerdon

S. Sines as chairman, was organized to plan the review.

The review of rail transport research needs was conducted by means of a four-day workshop at the Summer Studies Center of the National Academy of Sciences at Woods Hole, Massachusetts, June 17-21, 1979, and subsequent analysis and organization of material generated at the workshop. The agenda for the workshop was based on the research groupings in the TRB report (2): planning, plant and equipment, operations, management, and general (i.e., all other); the same groupings are used in the bibliography in Appendix B.

TRB and its Committee on the Railroad Research Needs Review express their thanks to the individuals and agencies who contributed to this study, including the AAR and FRA staff members who prepared the background papers. The participants are listed in Appendix A.

## REFERENCES

1. Railroad Research Study Background Papers. Richard B. Cross Company, Oxford, IN, July 1975.
2. Rail Transport Research Needs. TRB, Special Rept. 174, 1977.

# Summary

Review of the recommendations for railroad research made in the 1975 railroad research study resulted in the finding that, although substantial progress has been made, most of the research is still needed. The current research recommendation agenda contains 42 items, compared to 41 from the 1975 conference. Of the 42,

10 are new. Since the 32 remaining from the original agenda include several combinations, only a half-dozen items were completely deleted because sufficient research has been completed or because circumstances have changed and the need has disappeared. The table summarizes the current recommended research agenda.

Table. Outline of the recommended research agenda.

Type of Research	Priority 1	Priority 2	Priority 3
Planning	Corporate structure of the railroad industry Economic regulation Horizontal regulation	Transport demand and commodity flow Restructuring planning data	Marketing studies Production and distribution of energy materials
Plant and equipment	Track systems Track strength Train-fuel performance Trade-offs: way-and-structure investment versus equipment investment	Energy systems Terminal and yard design Measurement of dynamic forces and flaw detection Component improvements	Signals and traffic control Locomotive design Car design Urban facilities Electrification
Operations	Service quality Equipment utilization and management Terminal management	Line capacity Blocking and scheduling Operating-service planning	Hazardous materials
Management	Resource productivity Railroad costs Accounting methods	Demand and marketing Management processes Human resources studies Training requirements Data acquisition technology Integration of information systems and management systems	Industry financial issues
General		Safety Continuing role of railroads in economic development Data	Public enterprise: interfaces, interactions, and management Management of railroad research Railroads and national defense

The conference consisted of a review of progress by the AAR and FRA, followed by discussions of the five research groupings as shown in the following agenda.

## Monday, June 18

Purpose and Methodology of Study, Guerdon S. Sines  
Review of Recommendations from 1975 Meeting, Harmer E. Davis  
Review of AAR and FRA Actions on 1975 Conference Recommendations  
Planning Recommendations, Harmer Davis and John Gratwick, discussion leaders

## Prepared Remarks:

Frances Shaine  
Henry Livingston  
Paul Banner

## Discussion by All Participants

Summary of Discussion, Harmer Davis

## Tuesday, June 19

Plant and Equipment Recommendations, Don P. Ainsworth, discussion leader

**Prepared Remarks:**

William J. Harris, Jr.  
 Robert A. Matthews  
 A. E. Hinson  
 Donald L. Spanton

**Discussion by All Participants**

Summary of Discussion, Don P. Ainsworth  
 Operations Recommendations, Donald G. Wooden,  
 discussion leader

**Prepared Remarks:**

A. D. Dingle  
 Donald L. Spanton  
 Joseph M. Sussman  
 D. R. Kirk

**Discussion by All Participants**

Summary of Discussion, Donald G. Wooden

**Wednesday, June 20**

Management Recommendations, D. Henry Watts,  
 discussion leader

**Prepared Remarks:**

Virgil Davis  
 A. Scheffer Lang  
 Paul Banner

**Discussion by All Participants**

Summary of Discussion, D. Henry Watts  
 General Recommendations, Aaron J. Gellman,  
 Discussion leader

**Prepared Remarks:**

William J. Harris, Jr.  
 A. Scheffer Lang  
 Leavitt A. Peterson

**Discussion by All Participants**

Summary of Discussion, Aaron J. Gellman

**Thursday, June 21****Writing of Summaries and Conclusions**

Planning Discussion Findings, John Gratwick  
 Plant and Equipment Discussion Findings, Don P.  
 Ainsworth

Operations Discussion Findings, Donald G. Wooden  
 Management Discussion Findings, D. Henry Watts  
 General Discussion, Aaron J. Gellman  
 Discussion of Overall Priorities and New Opportuni-  
 ties, Guerdon S. Sines



# Observed Progress

Before this review was begun, there seemed to be a general opinion in the railroad community that not very much had been done to attack the research needs identified at the 1975 conference. However, after the 1979 conference opened with the AAR and FRA statements, the discussion that followed indicated a consensus among the participants that the research under way since 1975 represents a better response than had been realized. Those statements are included here for the reader's own assessment, but first the significant accomplishments since 1975 are highlighted.

The hardware research and development has been well covered; in fact, it may have received more attention than the 1975 group believed necessary in the light of other priority research needs. The major item that has had no action or serious consideration is the national cooperative research program. There is general agreement between FRA and AAR that the form of a national cooperative research program, as it exists for highways in the form of the National Cooperative Highway Research Program, is not appropriate for the special circumstances existing in the railroad industry and that cooperative programs as they currently exist in the industry with FRA, AAR, the Railway Progress Institute, individual railroads, and other agencies cooperating, on a project-by-project basis, is a more appropriate structure.

The rail planning area has seen many studies completed by federal agencies, as well as a drastic change in circumstances in the industry. In 1975, the Railroad Reorganization and Regulatory Reform (4R) Act had not been passed, few state rail plans had been prepared, freight car leasing had not reached its present proportions, the Consolidated Rail Corporation (Conrail) was only being discussed, speculation on the ideal structure of the railroad industry was a major activity, the problem of bankrupt carriers had not shifted from the Northeast to the Midwest, the National Transportation Policy Study Commission had not yet been formed, and the present legislative proposals for lessening of economic regulation were three years away. All these changes have inevitably caused a shift in thinking on research needs that has been reflected in the research that was initiated in the last four years. For example, the idea of federal ownership of the railroad infrastructure is again dormant. There has been a void caused by the inattention of individual railroads to studies of the optimum corporate structure of the rail plant for freight service. At the same time, outstanding progress has been made in implementing management and control systems that will affect company organization and structure.

In the four years 1975-79, research in plant and equipment has benefitted from two outstanding programs. The Track-Train Dynamics (TTD) program had just gotten under way in 1975. Since then, TTD has produced a steady stream of useful information. The second program is the Facility for Accelerated Service Testing (FAST), which had not been started in 1975. Since then the facility has been constructed and put into operation, and it is producing new insights into both track and rolling-stock stresses and wear rates. This facility provides the North American railroad industry with its first opportunity to perform field tests under controlled conditions.

AAR has recently placed a Track Structures Dynamic

Test Facility in service at its Chicago Test Center. This facility will provide quantitative measures of performance of any given track configuration or components under controlled, known conditions of construction and loading, with load applications that approximate service conditions. The facility adds a new dimension to test capability for characterizing track assembly, ballast sections, and roadbed strengths.

A rapidly moving development in track has been the use of geotextiles under the ballast. At first, the fabrics were limited to test installations. With surprising speed, some railroads proceeded from the experimental stage to routine use where subgrade conditions are bad.

Although little physical progress has been made toward improving urban rail facilities, federal funds have been made available. There are now 19 projects in various planning stages. Because of institutional problems, there are long lead times for such projects.

The management of operations has seen its greatest effort placed in research to improve freight car utilization, as evidenced by the AAR-FRA joint project. Progress in this research has been aided by the development of management information systems (discussed below), which can improve railroads' ability to locate and dispatch cars promptly.

Other significant developments have been the increase in intermodal traffic and the growth in the numbers of unit trains, along with the carriage of new commodities, such as fertilizer and petroleum, where the tank train has found application.

As for research into management, by far the greatest effort has been on information technology. Real-time information (or something close to it) is becoming widely available. In addition to individual railroad computer systems and the AAR TRAIN II, FRA is sponsoring a computer program that will provide short lines with operating information that will enable them to make some of the advances in operating methods that the class 1 roads are making. The development of an automated process for preparing waybills is an important advance.

Freight demand forecasting has seen a major advance in the development of a disaggregated model that provides commodity flow data that should enable railroad marketing departments to specifically identify marketing opportunities by route. Information from the AAR Truck and Waterway Data Center is revealing for the first time commodity movements by truck, which is also a major advance in providing marketing information.

Safety research has been the fastest-growing program in the general area. The FRA budget and the number of research projects in safety have doubled since 1975.

Further details of progress since September 1975 may be found in the reports from FRA, AAR, the U.S. Department of Transportation (DOT), and the Interstate Commerce Commission (ICC) that are listed in the bibliography in Appendix B. The amount of activity can be roughly estimated by the numbers of reports. As mentioned earlier, hardware research and development predominates—the number of reports in "plant and equipment" far exceeds those in the other areas on the agenda of recommended research:

Planning	42
Plant and equipment	212
Operations	31

Management	32
General	75 (safety = 64)
Industry overviews	4

Ongoing research has also been included in the bibliography in Appendix B; the count of ongoing research projects is

Planning	3
Plant and equipment	61

Operations	8
Management	21
General	26 (safety = 20)

Comparison of the reports and ongoing research projects reveals essentially the same mix; hardware ("plant and equipment") holds the majority, but "management" is receiving a larger share, which follows the recommendations of the 1975 study.

## Summary Statement by AAR on Recommended Research Agenda

AAR has programs of research and analysis in many fields. Support was provided to TRB to create a conference on rail research in 1975 to look into problems with respect to rail transportation and to suggest relevant research. As a result of that conference, TRB published a report, Rail Transport Research Needs (Special Report 174), in which the conference findings were summarized.

Nearly four years later, it is appropriate to discuss what has been done in regard to these issues. This report constitutes such a brief commentary. It is organized in the same way as Chapter 15 (Recommended Research Agenda) of the TRB report.

### PLANNING

#### Basic Research

##### Structure of the Railroad Industry and Trade-Offs (Priority 1)

A substantial amount of work has been done pursuant to Title IX of the 4R Act. This is primarily reflected in the activities of DOT and the industry that are directed at reducing regulation or are generally subsumed under deregulation. These all have to do with new arrangements in regard to the capability of the industry to respond more effectively to the marketplace.

##### Methods of Restructuring (Priority 2)

Deregulation activity has dealt in part with the question of mergers and has led to careful examination of coordinative arrangements, none of which have been found to be particularly attractive beyond joint trackage rights and other measures currently in use on a limited basis.

##### Regulation (Priority 1)

Regulation of the economic activities of the industry under the ICC has been given very vigorous attention by the industry and is being pursued by comments on the DOT bill for deregulation and in drafts of possible language for consideration as an industry bill. The impact of certain regulations made by the U.S. Environmental

Protection Agency (EPA) are under continuing study as a result of pending regulations in the fields of noise and solid-waste disposal.

Continuing testimony and analysis has identified a number of problems in the regulatory area to which solutions have not yet emerged.

##### Multimodal Ownership (Priority 3)

There has not been continuing and serious study of the multimodal ownership issue except under the National Transportation Policy Study Commission, which has investigated this area and finds that it may have some merit.

#### Developmental Research

##### Public Service Responsibilities (Priority 1)

The work of the railroads in the area of deregulation has been directed in part at issues that relate to the ways of establishing a network that should exist in order to provide the level of railroad service needed in the United States. If there is a proper relationship to the marketplace, these issues can be resolved by normal commercial decisions. However, the amount of research directed toward this problem has not been adequate for a full exploration of all relevant issues.

##### Railroad Models (Priority 2)

Some analysis has been continuing on railroad models, with a view toward identifying deficiencies and strengths of some of those models. Substantial progress has been made by Princeton University in improving the quality of original network models. In addition, the Freight Car Utilization Program (FCUP) has developed additional useful models.

##### Ownership of Equipment (Priority 2)

Studies of the car cycle under FCUP are just now being completed that will give some indication of the impact of a variety of methods of taking care of ownership by way of pooling, etc., and of their impact on utilization.

Other aspects of car ownership are also under detailed study in FCUP. A number of companies have moved into ownership of short-line railroads and have provided third-party leasing arrangements, which have brought additional freight cars into the fleet. These car ownership processes are predicated in part on a special arrangement—incentive per diem—that provides for extra payment to car owners who provide cars. This extends the concept covered by ownership of equipment. Continuing studies of that process may illuminate some of the questions that were proposed.

#### Ownership of Infrastructure (Priority 3)

No effective means of separating railroad operations from ownership of the infrastructure has emerged since the time of the 1975 study. Further studies in this area do not appear to be productive.

#### Applications Research

##### Transport Demand and Commodity Flow (Priority 3)

There has been only a modest amount of work carried on to identify transport demand and commodity flow issues as a basis for more effective planning. Work in this area is in progress at the Transportation Systems Center (TSC), which has a mandate to create an effective data base for all modes of transportation.

Government data collection programs remain difficult for many analytical purposes. The AAR Staff Studies Group has made substantial progress on some of these problems.

##### Restructuring of Planning Data (Priority 2)

It is not clear that it is possible to achieve the objectives that are set forth in this commentary in a way that will take into account realistically the dynamics of the economy. Therefore, no work has been pursued in this field except for the work at TSC.

##### Marketing Studies (Priority 3)

It is the consensus of the industry that under deregulation, if it is achieved by actions previously described, each railroad will be required to learn more about the market in order to establish the deregulated rates. On this basis, an academic exercise does not appear to be necessary, since commercial necessity will establish the requirement for such studies.

#### PLANT AND EQUIPMENT

##### Basic Research

##### Trade-Offs Between Way and Structures Investment and Equipment Investment (Priority 2)

There is substantial effort in progress at FAST and in other analytical studies to examine the relationship between heavy-axle and high-speed operations and damage to the track system. In fact, as a result of those studies, work is currently in progress toward the design of equipment that will carry loads equivalent to those now carried but that will reduce the effect on the track. Substantial progress has been made in this field. On the high-center-of-gravity cars, work is also in progress directed at identifying means of controlling undesirable dynamic action of these cars. Analytical models and

experimental work have brought our understanding substantially beyond its level on this issue in 1975. These analyses are being vigorously pursued, and the calibrations and validation of the supporting models is advancing. FAST data are being incorporated, as are AAR studies on fatigue.

##### Energy Systems (Priority 3)

No comprehensive studies on energy systems have been completed. Arrangements are being made to provide locomotive engines for a research facility directed at studies of alternate fuels. These studies have proceeded more slowly than was contemplated in the 1975 report, but progress is being made.

##### Terminal and Yard Design (Priority 2)

Research by FRA has been examined and is being utilized by some railroads. Operations research techniques are being applied to work improvements by individual railroads in their own yard design. FCUP has sponsored work in this area.

#### Developmental Research

##### System Design (Priority 3)

A series of iterative improvements is in progress with respect to components of track and cars. These are being translated into systems design concepts and into evaluation of hardware based on those concepts as rapidly as is feasible within the limited budgets that are now available.

##### On-Board Measurement (Priority 3)

There is a specific program in progress under TTD in on-board measurement in locomotives; it is based on microprocessors and appropriate transducers. In addition, there have been some advances in wayside measurement techniques that are under continuing evaluation at the Transportation Test Center (TTC) in Pueblo, Colorado. Experimental work in the field and analytical techniques have gone far toward establishing much about the dynamic environment within which equipment operates, minimizing to some extent the probable need for monitoring of all vehicles in the system by these techniques. On-board detection of passenger car hotboxes has been developed.

##### Car Design (Priority 3)

Specific studies are being made of the size of cars and of car-coupling mechanisms to establish what type of car-coupling system is most effective in switching operations. Car designs have been examined carefully in their relationship to train handling under the TTD program.

#### Applications Research

##### Component Improvements (Priority 3)

Specific performance specifications are being issued with respect to many components. New technology, including fracture mechanics and finite-element analysis, have been brought to bear on the examination of opportunities for improving components. Additional programs under way in TTD are examining couplers and braking systems. The dynamic redesign of equipment will lead to major changes in suspension and car-body designs.

A program under way at FRA called Truck Design Optimization Project (TDOP) is looking at the truck problem. In short, all of these issues are currently being attacked.

With respect to improved freight cars, research in progress in 1975 has been carried to completion. Regulations stipulating improved freight car design have resulted in significant improvement and upgrading of existing cars. Changes in new cars aimed at reducing the risks of transporting hazardous materials are continually being made. A safety systems analysis has been performed in this field that has identified only a limited number of opportunities for further advances.

#### Life-Cycle Design (Priority 3)

Life-cycle costing models developed under TTD sponsorship have been developed for some components, and they are currently being evaluated to assess how far they can be taken. Comparisons are being made of car-repair billing and accident data to establish the frequency of costs and what the trade-off is between maintenance practices and safety. So far the results are inconclusive.

#### Urban Facilities (Priority 3)

There has been little progress toward rail relocation or yard consolidation because of the enormous cost of these projects and their enormous political complexity.

### OPERATIONS

#### Basic Research

##### Service Quality (Priority 2)

Studies of service quality are continuing under FCUP. There have been no major breakthroughs in terms of agreement on measures or issues that should be taken into account in this field.

#### Developmental Research

##### Equipment Utilization (Priority 1)

There has been continuing work on car utilization that has identified improved organizational structures within railroads and improved practices within the industry to lead to more effective utilization of equipment. These studies are continuing, and means of application of findings are being sought.

##### Hazardous Materials (Priority 3)

Major improvements in monitoring the transport of hazardous materials are being adopted under continuing pressure to improve the safety record of the industry in this area. Railroads are beginning to identify and exchange information on consists in terms of cars carrying hazardous materials. Significant progress is being made toward better shipper identification of hazardous commodities and toward better railroad identification of measures that need to be taken, should there be problems.

##### Electrification (Priority 3)

Some studies have been made in the field of electrification, but they have not shown that advanced systems can be put in place economically except in the Northeast Corridor, where a government commitment has been made to extend electrification from New Haven to Boston. There have been continued studies, none of which has

identified economically attractive opportunities for electrification at present costs and prices. The availability of electrical energy has changed dramatically, and the balance between costs of electrical energy and petroleum products is still uncertain.

#### Applications Research

##### Blocking and Scheduling (Priority 2)

There have been careful studies in the development of the concept of an operating plan that is based on operations analysis techniques. One approach to this problem is currently being studied on a cooperative basis and put into practice on one railroad. A second railroad has indicated an interest in pursuing the same field.

##### Terminal Management (Priority 3)

There have been continuing studies, in conjunction with labor, on means of improving the effectiveness of terminals. Some progress has been made in reducing detention time in a few terminals. This information is being widely disseminated in the hope that it will have a good effect on the industry as a whole.

### MANAGEMENT

#### Basic Research

##### Cost Structures (Priority 1)

Some activity has been pursued in identifying the cost of services under the expectation of deregulation. Additional studies are being made in this field by individual companies. This is not necessarily a field appropriate for primary focus by FRA or DOT.

##### Demand and Marketing (Priority 2)

Only a modest amount of work has been done on the modal-choice issue. More needs to be done. The AAR Staff Studies Group's work is the most promising. Under deregulation, railroads will be in a position to be much more aggressive in their own internal analyses on this subject.

#### Developmental Research

##### Sources of Capital (Priority 1)

The greatest activity in this area rests in the car acquisition field. Here, as stated before, incentive per diem has brought substantial capital into the equipment area as a result of normal financial analysis as biased by ICC regulations. However, additional studies of per diem structure are being made that suggest entirely new approaches to this problem.

##### Studies of Human Resources (Priority 1)

This area has not proved feasible for industry-wide research because of the variety of styles of management and historical procedures in place and the complexity of launching a research program that has any substantial expectation of demonstrating its value.

#### Applications Research

##### Training Methods (Priority 2)

Railroads have concluded after some analysis that training is a subject of concern to individual railroads, not the

industry in general. Accordingly, this area has not been pursued by AAR. However, individual railroads (e.g., Canadian National, Southern, and Southern Pacific) and Conrail have carried forward major programs. The University of Tennessee, under contract to FRA, is in the process of studying this issue.

#### Information Technology (Priority 1)

There has been continuing work in the area of railroad technology. Some railroads have made significant progress in developing a basis for distribution of empty cars and in notifying other railroads of their anticipated receipt of empty cars so that action can be taken to maximize their early dispatch to places of need.

Automatic car identification (ACI) has not been found to be cost effective by the industry. Means are actively being sought to introduce closed-circuit television as a means of monitoring car location in the consist more accurately.

#### Indirect Costs and Benefits (Priority 3)

No direct research attack has been made on this problem.

#### Management Structures (Priority 3)

The primary work in management structures is related to the work on car utilization. Some progress is being made in identifying structures that are more amenable to improved car utilization than those currently in place.

#### Accounting Methods (Priority 3)

A substantial amount of effort is being directed toward ensuring that accounting methods are not changed capriciously; this is aimed toward preserving what has been good in the past and achieving change as appropriate. There has been only a modest amount of research in this field.

#### Demand Pricing (Priority 2)

Demand pricing is currently being experimented with to the degree permitted by ICC. Deregulation may permit much more extensive application of these techniques.

#### Productivity (Priority 1)

Cooperation with labor in railroad operation has identified some opportunities for improved productivity. These have had only a modest effect on the industry as a whole. U.S. productivity is lower than ever before; much of the cause has been shown to relate to reduced capital, reduced research and development, and diversion of research and development to EPA and Occupational Safety and Health Administration regulation.

### GENERAL PROBLEM AREAS

#### Safety (Priority 2)

Through analysis of accident causes, a much broader

insight is available today as to where opportunities for safety arise. Studies are in progress directed at trying to improve the safety record of all components or of systems that fail. No marked reduction in accidents has been achieved, but there has not been any dramatic increase in large accidents. Employee safety remains at a reasonable level by comparison with other industries. Analysis of accident data has been a very powerful influence on safety research.

#### Role of Railroads in the Economy (Priority 2)

There has not been a major study or analysis of the role of railroads in the economy, because it was considered much better to achieve deregulation and allow the economy to dictate the role of the railroads than to do a lot of artificial studies in this field.

#### Cooperative Research Program Management (Priority 2)

There has been no action to parallel NCHRP to manage a recommended rail research program.

#### Data (Priority 2)

It is clear that data are deficient in many areas. Studies have been pursued in certain areas, and progress is being made in clarifying the nature of those improvements, especially in the field of safety.

#### External Data Needs

There has only been a modest improvement in information on traffic flows. This issue has been studied by a number of committees, including TRB committees. An example of an action taken to improve data inputs or the capacity for data analysis is the establishment of the Truck and Waterway Information Center.

#### Internal Data Needs

There has not been a major impact or set of studies with respect to costing or other in-house data.

#### Implementation of Results

A substantial number of activities has aimed at dissemination of information or the establishment of improved specifications that can reflect improved technology or other matters that can translate railroad research into productive activity. It is clear that much of the current railroad research under way at FAST and in cooperative programs is moving into application with reasonably modest delays.

# Summary Statement by FRA, Office of Research and Development, on Recommended Research Agenda

FRA conducts technology research and development, as well as studies on the structure and operation of the industry. This summary addresses the technology research and development. The report is organized to correspond to the topical headings found in Chapter 15 (Recommended Research Agenda) of TRB Special Report 174. In some instances, however, certain research projects support one or more of these topical headings. Although the same project may be mentioned under different topics, the information content addresses that specific topic.

## PLANNING

### Applications Research

#### Marketing Studies

The Milwaukee demonstration project is showing how marketing techniques in specific markets can increase utilization of current equipment.

## PLANT AND EQUIPMENT

### Basic Research

#### Trade-Offs Between Way and Structures Investment and Equipment Investment

Most of the work in the Office of Freight Systems and some of the Office of Passenger Systems research and development address this subject. Results are sought that will assist railroad decision makers in optimizing their procurements. TDOP, for example, will produce technical and economic data to determine whether premium trucks, which have higher first costs, are a better choice than standard trucks that have higher life-cycle costs. FAST will similarly indicate the long-term value of premium rails and other track components. In the longer term, FAST should also correlate maintenance costs to axle loading. If there is a specific shortfall, it is in the area of classification yards, where the only current research involves modifications of yard designs to improve service and efficiency. The final technical report describing a more efficient and productive yard will be completed in 1980. The Improved Passenger Equipment Program (IPEEP) is aimed at providing data for Northeast Corridor and off-corridor National Rail Passenger Corporation (Amtrak) capital and equipment decisions. For example, a proposed tilt-vehicle evaluation project, including the lateral loading of the track structure, is to establish an optimum trade-off between curve straightening in the Northeast Corridor and purchases of more forgiving equipment. Amtrak, building on past FRA research and development on the E-60 and SDP-40 locomotives, is moving toward lighter axle weights in the AEM-7 electric locomotive. The Safety Assessment Facility for Equipment (SAFE) concept discussed in more detail below was initiated during the evaluation of axle loads and certain maintenance practices for the SDP-40 locomotive.

## Energy Systems

FRA has continued research and development on energy conservation and alternative energy sources. Specific items completed since the 1975 report include

1. Fuel-saver evaluation—FRA evaluated a device that was designed to reduce fuel consumption by trains that have several locomotives. It enables the engineer to reduce the throttle setting on one or more trailing locomotives when these units are not needed. The results were favorable; fuel savings achieved during test runs ran as high as 16 percent. The device is being evaluated by several railroads, and others have already procured some fuel savers. It is our understanding that a few railroads and several suppliers are developing more sophisticated devices.
2. Computer models—Several of the models developed by FRA now include energy costs as a trade-off against scheduled running time and track conditions. As fuel costs increase, we can expect greater attention in this area.
3. Aerodynamic drag—Following the development of basic analytic models, a rather extensive set of wind-tunnel tests has been conducted on scale models. To validate those results, FRA conducted full-scale tests at Pueblo. The correlation was very good, and we are now confident that wind tunnels can be used to evaluate existing or new designs in order to show the effects of drag on energy consumption.
4. Flywheel energy storage system (FESS)—In parallel with UMTA activities in flywheel applications, FRA studied the concept in a switch-yard locomotive application. Given the present state of the art, we found that the economics are no better than those for current equipment. Consequently, this activity was terminated.
5. Wayside energy storage system (WESS)—Heavy trains going downhill obviously produce a lot of energy. Rather than dissipate this through heated brakes, why not try to capture this for subsequent use on the uphill trip? After analyzing major grades throughout the United States, we concluded there were only a few where the economics would look good. But this study led to the next item.
6. Dual-mode locomotive—The USSR has a few dual-mode locomotives in operation in mines and quarries where electrified lines are nonexistent, so we know it is not impossible. Our WESS study indicated that it would be advantageous to supplement electric power with diesel power in order to avoid the need for additional units or to operate off-line. We are about to procure more systems engineering and feasibility studies. Prototype development is still a long way off.
7. Alternative fuels—In conjunction with the U.S. Department of Energy and AAR, we are using Southwest Research Institute to look at "off-spec" diesel fuel. Various cetane ratings, flash points, etc., will be tried in actual diesel engines to see how well fuels other than the standard no. 2 fuel will perform. Eventually, we hope to get around to methanol and liquid synthetics derived from coal.

## Terminal and Yard Design

Intermodal terminal considerations are included in our intermodal systems engineering effort. Our multiphase effort on classification-yard design methodology is now being tested by Conrail and Boston and Maine; the results should be known next year. FRA has developed an improved optical ACI system. We are currently looking at retarders and sensors to identify potential improvements.

## Developmental Research

### System Design

The cooperative industry and government TTD project treats the freight vehicle as a system rather than as an assemblage of components. This project investigates causal equipment deterioration and lading damage that result from adverse dynamic interaction between the track and the train. Present research includes an examination of the relationship between freight car trucks and car-body parameters, track stiffness studies, and analysis of freight car stresses under varying conditions. These data will be incorporated into computer models to provide a comprehensive and predictive device for studying dynamic interactions.

The Rail Dynamics Laboratory will be available soon for use in testing dynamic effects of cars, locomotives, and transit vehicles. Many of the locomotive-located train-handling aids developed in previous research and development efforts will be evaluated on a systems basis (i.e., the interaction of the engineer and train) by means of the research locomotive and train-handling evaluator. In addition, SAFE will provide a uniform evaluation of the performance of vehicles as part of a vehicle-track system.

With regard to passenger rail service, system-type analysis has been incorporated into the IPEEP program. Train Performance Simulator (TPS) programs have been used to trace acceleration, braking adhesion, and line-haul speeds in order to optimize the vehicle specification to meet a given schedule with existing trackage that Amtrak leases. Other projects involve a systems and trade-off analysis of various intermodal designs in order to determine their technological and economical feasibility, followed by a plan of action for implementing a selected intermodal freight system.

### On-Board Measurement

As part of TTD, FRA developed a draft buff indicator (DBI) which senses and displays to the locomotive engineer the stretching (draft) and compressing (buff) forces being exerted throughout the train, thereby allowing the engineer to take corrective actions. The Locomotive-Borne Track Measurement System (LTMS) project has stimulated the development of a simple, inexpensive system that can be installed on a locomotive to measure and record track geometry. A method of detecting track irregularities by means of an on-board detection system resulted from a project in which facility-tested predictions from a perturbed track produced a high correlation with field test results. In addition, current research involves the assembling of a Locomotive Data Acquisition Package (LDAP) that will record 48 channels of locomotive data. Hotbox and local derailment detectors, a signal inspection system, and detectors of degraded performance are other projects currently being examined.

## Car Design

As a result of the joint FRA and industry FAST project, stress measurements on hopper cars have been taken and these results forwarded to car builders and railroads. FRA also sponsored a human factors engineering systems analysis of U.S. rail-car and locomotive designs to identify those equipment designs that contribute to personal injury hazards to employees. In addition, countermeasures were tested to evaluate their effectiveness in minimizing car-design hazards. A few computer models are beginning to supply dynamic information to assist car designers. In addition, TTD's future efforts will focus on improvements in car design.

Research has provided requirements for a lightweight, low-profile intermodal rail car. In passenger operations, research has concentrated on advanced tracked intercity passenger technology that could improve urban transportation.

## Applications Research

### Component Improvements

Research in this area has included projects involving the rail transport of hazardous materials. Pool and torch fire tests have been conducted to evaluate the effectiveness of thermal shields in providing fire protection. Full-scale impact tests have been used to assess the effectiveness of puncture-prevention systems. Initial efforts focused on the transport of flammable or toxic compressed gases, and regulations for certain compressed-gas tank cars were promulgated for the first time in the form of performance specifications developed under FRA's Safety Research Program. This type of specification leaves the options of implementation with the user. Similar research is now under way for rail cars that carry other hazardous commodities, such as explosives and radioactive materials.

Research has also been conducted to make safer the interiors of rail vehicles that carry passengers or crew members. Performance specifications have been developed to reduce sharp corners, falling baggage, and other factors or situations that can produce injuries and fatalities. In another ongoing project, FRA and Amtrak are investigating the flammability of proposed interior materials.

Another FRA-sponsored study has produced performance specifications for improved glazing protection that is currently being used in 70 percent of the locomotives being built. Projects in progress involve studies of wheel and brake interactions to prevent wheel failure caused by high temperatures, examinations of safety valves, and an evaluation of improved braking and coupling systems.

### Life-Cycle Design

FRA has initiated a Safety Life-Cycle Testing Program that will evaluate life-cycle concepts and integrate these ideas into present safety programs. Additional activities involve the formulation of a life-cycle methodology and guidelines for locomotive inspection, maintenance, and operation of railroad rolling stock. TDOP and FAST are life-cycle operations; the former program investigates mechanical equipment and the latter emphasizes track life-cycle testing. Future research includes the building of a maintenance-of-way (MOW) life-cycle cost model.

## OPERATIONS

### Basic Research

#### Service Quality

A rail-car lading damage project identified the causes of lading damage and delineated preventive mechanisms that would minimize the damage and associated costs. The use of a GSI truck for Amtrak operations has produced a quieter and smoother ride for passengers.

### Developmental Research

#### Hazardous Materials

A systems approach has been used to examine fire-safety concepts in transporting flammable materials. Projects concerning the transportation of nuclear waste have concentrated on testing shipping casks and evaluating radiation-detection equipment and other monitoring devices. Land-spill tests of anhydrous ammonia sought to improve cloud-dispersion techniques for hazardous gases. To ensure the safety of railroad employees and to prevent major catastrophes, current research is identifying and testing techniques for detecting and monitoring abnormal conditions in hazardous cargos that are being transported by rail vehicles.

#### Electrification

Conrail has agreed to install a chopper propulsion system on an E-44 electric locomotive in order to conduct engineering and performance tests. Through simulation procedures, the feasibility of AC traction for diesel-electric locomotives is being examined. TTC will soon complete an electrified test track at Pueblo to evaluate Amtrak electric locomotives and to conduct further category research for the Northeast Corridor.

### Applications Research

#### Terminal Management

The major thrust of research in this area centers around an intermodal management information system (IMIS) that has several modules, one of which is equipment control in the terminal area.

## MANAGEMENT

### Applications Research

#### Information Technology

FRA-sponsored research has developed an improved ACI system that is more compact, inexpensive, and reliable than present systems. Unfortunately, the railroad industry chose not to implement the technology. An electromagnetic compatibility (EMC) design project will evaluate the impact of electrification on signal, computer, and communication circuits adjacent to existing and proposed electrified freight right-of-way. Other re-

search will select the most promising (cost-effective and technically stable) car-speed control concepts and technology for use in classification yards.

#### Productivity

The intermodal systems engineering projects represent key research in the area of equipment utilization. Capital productivity has not been addressed explicitly, but it is part of all information in support of investment decisions.

## GENERAL PROBLEM AREAS

### Safety

One of the most fruitful projects for evaluating the effectiveness of components in the total system is FAST, a test track in which two years of testing can provide the equivalent of 14-16 years of in-service train experience.

Numerous tank-car tests and hazardous-material transportation studies have produced performance specifications for shelf couplers, thermal shields, safety relief systems, and thermal insulation. Automated track-inspection technology accomplishments include improved rail flaw-and-wear detection systems, all-weather servo-magnetic gage systems, profilometers and alignometers, and various other track-geometry equipment and software. A prototype wayside vehicle inspection station has been developed and installed at TTC to test derailment and safety-detection devices and concepts.

Grade-crossing programs are attempting to identify causes for crossing accidents and to suggest feasible countermeasures. A joint FRA and industry project has led to the controlled testing of strobe lights on locomotives to make them more conspicuous at grade crossings. Locomotive window specifications and development of new glazing materials will help to protect railroad employees from acts of vandalism. Current research involving a brake-inspection system, development of truck performance safety standards, preliminary planning for SAFE, and various other programs will continue to emphasize FRA's first-priority commitment to safety research.

### Cooperative Research Program Management

Cooperative research programs not only provide for the sharing of ideas but also increase the frequency of implementation through industry participation and cost sharing. Notable examples of cooperative programs are FAST (industry support in excess of \$3 million), SDP-40 field tests, tank-car experiments, MOW planning, the Wayside Detection Research Facility, TTD, analysis of railroad safety programs, vandalism-suppression studies, the Wheel-Brake-Shoe Interaction Program, and the grade-crossing-oriented strobe-light project. Cooperative efforts continue to receive increased emphasis, with greater industry and labor involvement in periodic program reviews and research and development planning and with participation of FRA researchers in programs sponsored by industry.



# Summary Statement by FRA, Office of Policy and Program Development, on Recommended Research Agenda

## PLANNING

### Structure of the Railroad Industry and Trade-Offs, Methods of Restructuring, Ownership of Infrastructure, Multimodal Ownership, Ownership of Equipment, and Restructuring of Planning Data

Some research has been performed relating to these issues, but essentially these issues contain some of the thorniest topics in the field of railroad research because of their direct relationship to the future fate of each railroad company. Every topic in this area, with the exception of "methods of restructuring," relates to the desired end state of the restructuring process. "Methods of restructuring" relates to the means of restructuring, and in this field not much new ground has been covered.

The principal studies pursuant to section 901 of the 4R Act were the retrospective studies of the mergers of the Norfolk and Western—Nickel Plate—Wabash and the Seaboard Air Line—Atlantic Coast Line railroads. The conclusions reached were that, while neither merger achieved the goals stated for a variety of reasons (regulatory, market-related, and management-related), it is very difficult to judge the success of any merger by any simple objective standard. Practical attempts to achieve facilities coordinations through the powers of the Secretary of Transportation under Section 401 have not yielded major gains or improvements to date.

In the area of "ends" research related to restructuring, a number of studies were performed, but some areas were essentially neglected.

Progress was not made on the question of what the ultimate structure of the industry should be, in terms of number of companies, competitive structure, service levels, and the like. Indeed, in view of the political and economic dynamics affecting railroads, taken together with the theoretical and practical problems of analyzing an industry the size of the rail industry, there is a serious question whether research in the conventional sense can be used to get at these issues.

While no real progress was achieved toward defining the perfect end state of the rail industry under essentially the existing corporate structure, there was some progress made in examining alternative structures for the rail industry. In the area of ownership of infrastructure, an analysis was conducted of the concept of public ownership of right-of-way pursuant to the mandate of Sections 504 and 901. The study, performed by Reebie Associates, was designed to define the concept of public ownership plans that have been proposed and to analyze the principal characteristics and likely effects of each type of plan. A summary of this information was presented in the preliminary 504-901 report, A Prospectus for Change in the Freight Railroad Industry (1, pp. 94-97). Further work on public ownership is expected to be accomplished both as part of the Section 401 study and pursuant to Section 10 of the Federal Railroad Safety Authorization Act of 1978.

Preliminary work on system structure was also done to determine, pursuant to Section 901(3), how much of

the rail system should be rehabilitated to meet the needs of national defense and interstate commerce. While it was not conclusive, the research did reveal some indications that seemed counter to the conventional wisdom about excess trackage. The principal indication of this sort was that only a relatively small portion of existing trackage can be abandoned [perhaps as little as 16 000 km (10 000 miles)], regardless of the degree to which traffic is concentrated within the limits of existing line capacities, if it is assumed that the existing traffic base will continue to be handled by rail. In a deregulated environment, however, one in which the common-carriage obligation does not apply to all shipments (especially those on light-density lines), a substantially greater amount of trackage can be abandoned.

### Railroad Models

A major development in the rail modeling area was the adaptation of work initiated by the United States Rail Association to develop a financial forecasting model for the railroad industry. The principal application of the model was in the analysis of rail capital needs for the period 1976-1985, as mandated by Section 504 of the 4R Act. Chapter 3 of the preliminary 504/901 report (1) describes the results of the analysis; Appendix A of the report describes the manner in which the model works, lists the assumptions that were used in the analysis, and provides more detailed financial information on each of the principal railroad regions used in the analysis.

Also with respect to models, we are in the continuing process of updating or increasing the capabilities of our models with current data. For example, in the case of the "playing board" or network model and the strike-impact model, we are putting in the ability to study safety movements, longer strikes, and energy problems.

### Transport Demand and Commodity Flow

Based on FRA's successful studies of corn and soybean transportation in Iowa in 1973 and 1976, a major study of wheat transportation in the Southwest was undertaken in late 1976. The study, involving Kansas State, Oklahoma State, Texas A&M, and Houston Universities is designed to develop and analyze alternatives for light-density branch-line shippers in Kansas, Oklahoma, and North Texas. The study, to be completed later in 1979, is expected to show the potential for substantial improvement in grain-gathering systems by using appropriate combinations of local truck, mass storage, and multiple-car rail services. A similar study of the potential of transloading systems to serve small coal mines in Appalachia will be under way later in 1979.

### Regulation

The case for regulatory reform has been made in a variety of forums. The theoretical arguments that use economic theory, the success of the less-regulated barge and trucking industries, and past studies by FRA, such as the Midwest abandonment studies, have all contributed to our conviction that such a bill should be given the

highest priority. We now have many additional studies under way in support of this effort. One set of studies can be described as issue oriented. For example, we have asked whether it is possible to develop a working definition of a captive shipper and whether, by using available data, we can get a fix on the magnitude of the problem. A second study is looking at the question of seasonal rates and their likely impact on a selected industry. A third study is considering the overall inflationary impact of railroad deregulation. A second set of studies examines individual economic sectors, such as grain, coal, or chemicals, and attempts to measure the impact the bill will have on these groups. The special problems of Conrail and the Conrail region are also being analyzed. A final set of studies is strictly geographic and looks at the effects of deregulation on specific areas. This effort involves extensive field work and discussions with shippers and carriers.

In the end, we expect to know much more than we know now about many of the aspects of our deregulation proposal. The overall effort should give new insights into the nature of the distribution system and the role of railroads therein. It will not involve a systematic collection of new data, and many of the existing gaps (such as demand elasticity estimates and complete rate information) will still not be filled. We nonetheless feel that the effort will be making a significant contribution to the state of the art.

#### Marketing Studies

FRA has reached several major milestones in the development and application of business logistics techniques to pressing rail transportation problems. A principal contribution to commodity-oriented research was the successful completion of a major study of the potential for intermodal transport of fresh fruits and vegetables.

In recent years, rail's market share of the fresh fruit and vegetable traffic has fallen to less than 10 percent; trucks have captured the remaining market share. An FRA study, completed in 1978, made comprehensive recommendations for structuring rail service to recapture some portion of that lost market share. The recommendations were based on the most comprehensive analysis yet undertaken of the business logistics of the fresh fruit and vegetable industry.

The recommendations called for the establishment of scheduled, volume trailer-on-flat-car (TOFC) operations for fresh fruits and vegetables between strategic market corridors that would operate completely exempt from ICC regulation. The study found that effective competition with unregulated motor carriers precluded continuance of rail price and service regulation for those commodities. Based on those recommendations, a major carrier petitioned the ICC pursuant to Section 207 of the 4R Act for exemption of rail for such commodities. The ICC, after due investigation, broadened the scope to include all railroads and approved the economic deregulation of those commodities—the first exemption ever generated by the ICC.

#### PLANT AND EQUIPMENT

##### Trade-Offs Between Way and Structures Investment and Equipment Investment

FRA has not conducted any research in this area from a purely policy standpoint; the technical and cost research is described in the preceding summary statement.

#### Urban Facilities

The particular problems of urban rail facilities have not received a great deal of attention, although this issue is receiving increasing attention in the context of overall urban policy. Three modest pieces of research have been completed, however: (a) a report, *Relocation of Railroads in Ottawa, Canada*, has been submitted in draft to FRA; (b) a status report on urban railroad relocation in the United States has been submitted in draft to FRA; and (c) the section on public ownership of rights-of-way in Chapter 4 of *Prospectus for Change* contains a discussion of the manner in which public ownership could be used as a means to fund the upgrading of urban rail facilities (1, p. 96).

#### OPERATIONS

##### Electrification

In accordance with the mandate of the 4R Act, FRA analyzed the feasibility of railroad electrification. The basic findings of that analysis are outlined below.

The investment in electrifying a network of 16 000 km (10 000 miles) of high-density main-line railways would yield a financial rate of return greater than 12 percent and reduce petroleum consumption by 5 million m<sup>3</sup> (31 million bbl) annually.

The investment in electrification on 42 000- and 64 000-km (26 000- and 40 000-mile) networks would yield financial rates of return between 9 and 10 percent and would reduce annual petroleum consumption by 9 and 12 million m<sup>3</sup> (56 and 77 million bbl), respectively.

The investment in electrifying individual route segments of 480-1600 km (300-1000 miles) of very high-density [between 77 and 110 t (70-100 million gross tons)] rail lines would yield financial rates of return between 18 and 21 percent.

The national benefits, particularly in terms of reduction of petroleum consumption, do not appear to be sufficiently large to warrant government sponsorship of a major program of railroad electrification.

The rates of return for individual route segments appear to be sufficient to justify some investment in electrification by railroad companies. The Title V financial assistance program would be structured to permit loans to be made to any railroad company for those electrification projects that are economically and financially justified.

#### MANAGEMENT

##### Cost Structures, Information Technology, Productivity, Indirect Costs and Benefits, Management Structures, Accounting Methods, and Sources of Capital

This important area has been the focus of a significant amount of activity by FRA over the past several years. The key topic in this area may be "management structures"—unless the incentives to perform in a manner directly related to the commercial success of the enterprise are present (along with incentives not to perform in a manner contrary to or unrelated to the firm's commercial interests), it is exceedingly difficult to develop an environment in which optimal approaches will be taken to cost structures, accounting methods, information technology, productivity, and sources of capital.

Work on management structures has gone forward in two projects. First, in response to Section 901(5) of the 4R Act, a study entitled *Organization of Needed Programs Within the National Rail Transportation System* was per-

formed. It advocated that the internal corporate organization of railroads be modified to incorporate "traffic-lane profit centers" that would measure the performance of personnel based on achievement of profit goals that would require the productive use of capital, labor, energy, and materials in the provision of transportation service.

The second approach to management structures has been from the standpoint of asset management. Studies of three asset groups—terminals, cars and power, and rights-of-way—have been conducted to examine how other industries structure the management of such important and expensive assets. The studies on terminals and cars and power were done by using Yellow Freight and United Parcel Service as models for terminals and Ryder Truck Rental as a model for equipment management. The study on rights-of-way was modeled on how pipeline companies account for their rights-of-way and associated structures. None of these studies has yet been submitted in final form; it is hoped that they will be released by the end of 1979. These studies deal directly with the issue of the proper determination of the cost structure associated with a particular asset group.

Work has continued in the area of accounting methods under the FRA's cost research program. Of the six activity or asset groups treated—way, terminals, communications and signals, cars and power, accessorial services, and general and administrative—basic work has been completed in the areas of maintenance-of-way and rolling stock (except for locomotives).

Information technology work has centered on the problems of freight car management and has largely been coordinated through AAR's Freight Car Utilization Steering Committee. Work has also moved forward in applying improved information technology to freight car management in the nation's class 2 railroads.

Although no specific work has been directed at the area of indirect costs and benefits associated with changes and improvements in these areas, it is precisely because of the expectation of substantial net benefits that so much attention is being focused on these matters.

Productivity research is just beginning; a pilot effort is due to get under way soon to develop a system for measuring the productivity of capital, labor, energy, and materials in the railroad environment. Should the development of a prototype measurement system prove promising, it is likely that further work will be conducted in this area.

Other than the monies made available under Title V of the 4R Act and the equipment investments made through leasing companies in recent years, we are not aware of any new sources of capital made available to the rail industry. Given current rail financial prospects and assuming no fundamental changes, it does not appear that any new capital will be forthcoming from the private sector.

### Studies of Human Resources

#### Changing Views of the Organization and Management Process

Two studies, performed for FRA as part of the program of studies conducted for Sections 504 and 901 of the 4R Act, are relevant to this topic. One, Organization of Needed Programs Within the National Rail Transportation System, starts from the premise that corporate organizations are not ends in themselves but tools to facilitate efficient and effective management of an enterprise. The dual objectives of public service and profit are discussed in detail. The report found that a princi-

pal need of the rail industry is to develop cost-and-profitability measurement and responsible programs, in order to stimulate the improvement of service quality, and the identification (and, ultimately, correction or elimination) of uneconomic services and practices. The second report, *The Rail Situation: A Perspective on the Present, Past, and Future of the Railroad Industry* (2) provides an overview of the industry. It describes the present situation and how it evolved, concentrating on the period 1929-1976. The study concludes with a summary of how the railroad situation is currently perceived by railroad management, labor, shippers, and other concerned parties. This report served as the basis for discussion of the environment of labor-management relations in Chapter 2 of *A Prospectus for Change* (1).

#### Change in Working Conditions

New approaches to operation and working conditions are needed in railroading. FRA continues to support the concepts developed by the Task Force on Rail Transportation through contracts with AAR and individual railroad companies. Funding now goes to several programs located in key railroad terminal areas throughout the country. These programs support joint participation, by labor and management, in experiments with new procedures. Although the experiments deal with a broad range of problems, some of the new procedures involved working conditions, and the experiments have facilitated the changing of work rules. FRA will continue to contribute financing and encouragement to the implementation of this concept.

#### New Approach to Discipline

FRA's current alcohol and drug abuse research will address ways to maintain discipline other than the paralegal approach in use by the railroads today. FRA has contracted with University Research Corporation (URC) to conduct comprehensive studies of alcohol abuse in the railroad industry and currently used countermeasures. URC will be required to estimate the prevalence of alcohol abuse problems in the railroad industry and the cost of that abuse. They will also make recommendations as to the most effective countermeasures, with particular emphasis on employee-assistance programs. The final report is due September 30, 1979. In addition, FRA has contracted with Amtrak for the development and pilot testing of a training program for employee-assistance program counselors. This contract has been completed. Further research into alcohol and drug abuse countermeasures will be carried out. The development of training programs for local supervisors and union officers will begin in the near future, and awareness training for employees is contemplated.

In addition to these efforts, FRA contemplates research in the application of similar concepts to other aspects of the maintenance of discipline. Present countermeasures to the loss of discipline seldom do more than apply a paralegal procedure to the identification of individuals who have suffered a loss of discipline and the imposition of penalties designed to coerce the employee into suppressing the problem. Little is known of the root causes of an employee's loss of discipline and, consequently, little is done to actively aid the employee in its restoration. This often results in real and perceived injustices from the employee's point of view and leads to a deterioration in labor-management relations. Research will be directed at reducing injustice, early identification of the signs of employee disaffection or perturbation and the causes (if possible), and the development of constructive countermeasures.

## Training Methods

In order to address the need for improved skills for railroad professionals and managers, FRA has contracted with the University of Tennessee's Transportation Center to determine the requirements in the railroad industry for specific educational background and expertise in management and engineering. The consultants are also surveying existing university programs that offer engineering, interdisciplinary, and management courses related to the railroad industry. Recommendations will include steps that might be taken by FRA or others to develop new programs or to strengthen existing ones.

The recommendations of the study will be reviewed by a panel of representatives from industry, universities, transportation associations, and government. The consultants are considering the relative merits of short courses for current employees, co-op programs, and longer college and post-graduate programs, and courses that include railroad management and engineering content. The final report will be available in late 1979.

FRA conducted a study of technical training practices on seven representative railroads. The study, performed by D. A. Stewart and Associates, was designed to give a general idea of present railroad training practices and to suggest ways in which FRA research resources could be used to aid the development of training methods within the railroad industry. The study served as the beginning of a dialogue on the subject with the industry. A few of the study's suggestions have been implemented; these were chiefly efforts to spur the industry's use of available public support for industrial training. A conference was sponsored, and FRA is attempting to implement a joint project with the U.S. Office of Education for the development of railroad-oriented vocational and technical school curricula. FRA plans to continue the development of a research program that will rely heavily on industry input.

## GENERAL PROBLEM AREAS

### Role of Railroads in the Economy

Perhaps the most significant research done into the role of railroads in the economy was performed pursuant to the mandate of Sections 504 and 901 in The Railroad Situation (2). This report served as the basis for chapters 1 and 2 of the preliminary 504-901 report (1), which addressed the present status of the rail industry and the causes of the railroads' problems.

### Data

Railroad transportation research can be limited by the availability of quality data. Research efforts are further plagued by limits on our ability to prepare and present railroad data. Steps have been taken to remedy some of these difficulties, and additional improvements are planned.

The rail freight waybill sample continues to provide much of the data used to support operational, financial, and economic research. Shortcomings in the use of sample data have been addressed in the literature. Two difficulties frequently mentioned are (a) nonrepresentative information for small shipments (hazardous materials, for example) and (b) cyclical bias that may dis-

tort single-year samples.

In an effort to overcome these criticisms, a five-year working file of waybill information was developed. Pertinent rail data for the years 1973-1977 (inclusive) were compiled and made available to industry analysts. We have found that a multiple-year record smooths out some previous abnormalities and helps to provide a more effective and efficient data base for many types of rail research programs.

We have taken steps to collect and computerize railroad line-clearance information; for example, files of speed, distance, gradient, curvature, weight limit, train frequency, and numbers of bridges, grade crossings, and tunnels have already been created for the "A main-line" subset of the rail system. This subset represents about one-fourth of the route kilometers of track in the country.

Several new efforts are planned in FY 1980. First, the data-collection effort will be expanded to include the "B main-line" track subset, representing another 25 percent of the system. New information will be added for all main-line (A and B) track; it will include number of running tracks, type of signal system, and track-age agreements. Next, our file of rail classification yards will be examined, and the necessary additions, deletions, and/or locational corrections will be incorporated. Finally, for the A and B main lines, all interlockings (along with their function and location) will be identified, and the ability of trains to pass between the tracks at an interlocking will be determined and noted in the file.

We are planning improvements in data preparation and presentation techniques. For example, standard computer statistical and graphical packages are being interfaced with our waybill files and, in particular, with the five-year file described above. This is very useful in responding to requests for merger analyses and railroad financial research.

We are focusing on the consolidation of the FRA railroad network and the waybill file. Much of this effort is still in the planning stage, and we are still working on overcoming a few very basic obstacles. However, by FY 1980 we should be able to present much of the waybill information that is currently available to us only in tabular form on a geographically and operationally correct two-dimensional railroad system map. The potential of this enhanced technique to support current and planned rail research projects is considerable.

Our overall goal, in addition to constructing the most accurate and up-to-date portrayal of the current U.S. rail system, is to adopt a posture that will accurately assess impacts on the system caused by policy changes, investments, mergers, abandonments, and the like. We hope these ventures can continue to bear fruit.

## REFERENCES

1. A Prospectus for Change in the Freight Railroad Industry: A Preliminary Report by the Secretary of Transportation. U.S. Department of Transportation, Oct. 1978, 186 pp.
2. The Railroad Situation: A Perspective on the Present, Past, and Future of the Railroad Industry. Federal Railroad Administration, FRA-OPPD-79-7, March 1979, 487 pp.

# Restructured Research Agenda

The 41 agenda items in Special Report 174 were a selection of the most important research areas from among hundreds of research needs suggested to the 1975 study committee. This selection constitutes value judgments made by a cross section of persons highly knowledgeable in the field of railroad transportation. It is of interest that in the restudy, with a changed mix of people, the judgments as to what should be included in the top 41 (now 43, as shown in the table) did not really change much from the composite judgment made four years earlier.

There were new needs recognized, e.g., distribution of energy materials, shippers' needs in new freight car designs, track strength and track systems, fuel performance, signal and traffic control, locomotive design, operating-service planning, integration of information systems and management systems, public enterprise interfaces, and defense needs. The role of the states in rail planning, which was missing from the 1975 study, has been recognized in conducting this review, but a research need so stating was not considered necessary.

The same system of priorities has been used in this report as was used in Special Report 174. The explanation from that report is repeated here.

It has been possible to identify a considerable range of major researchable issues, questions, and problem areas from the papers and discussions of the study. In many cases, the subjects crystallized from a review of both written and oral material. No single dimension exists that would enable all of these disparate research areas to be simply ranked in priority order, nor would the perceived ranking be the same for all the parties involved. Rather, the topics have first been grouped into four general functional groups: (a) planning, (b) plant and equipment, (c) operations, and (d) management. These functional groups have been chosen because each is represented by an identifiable class of knowledgeable persons who can address the problem area. Thus, within each area, an assessment of research priorities could be made.

The research areas recommended by the committee for inclusion in the program were then assigned to a category that, in the judgment of the committee, indicated a degree of urgency and necessity. In a sense, these categories represent priorities. They were chosen by the committee because they are allied to expressions of relative urgency proposed by a number of the experts at the conference. These categories are (a) problems pertaining to the short-range survival of the railroad system (priority 1), (b) problems pertaining to maintaining the long-term health of the rail transport mode (priority 2), and (c) problems pertaining to improvement and extension of rail transport services (priority 3).

Although most of the priorities of the agenda items

Table. Outline of the recommended research agenda.

Type of Research	Priority 1	Priority 2	Priority 3
Planning	Corporate structure of the railroad industry Economic regulation Horizontal regulation	Transport demand and commodity flow Restructuring planning data	Marketing studies Production and distribution of energy materials
Plant and equipment	Track systems Track strength Train-fuel performance Trade-offs: way-and-structure investment versus equipment investment	Energy systems Terminal and yard design Measurement of dynamic forces and flaw detection Component improvements	Signals and traffic control Locomotive design Car design Urban facilities Electrification
Operations	Service quality Equipment utilization and management Terminal management	Line capacity Blocking and scheduling Operating-service planning	Hazardous materials
Management	Resource productivity Railroad costs Accounting methods	Demand and marketing Management processes Human resources studies Training requirements Data acquisition technology Integration of information systems and management systems	Industry financial issues
General		Safety Continuing role of railroads in economic development Data	Public enterprise: interfaces, interactions, and management Management of railroad research Railroads and national defense

were unchanged, there were some shifts:

Energy systems	from 3 to 2
Service quality	from 2 to 1
Accounting methods	from 3 to 1
Terminal management	from 3 to 1
Railroad costs	from 3 to 1

The new items and changed priorities reflect the committee's views of changed circumstances:

1. A greater appreciation of the increased track wear and deterioration caused by heavier wheel loads,
2. The impact of the energy crisis,
3. The need for improved knowledge of costs in order to improve profits, and
4. The recognition that opportunities for increased traffic depend to a large extent on better service to shippers.

The items in the restructured research agenda range from basic research through development to applications, but no attempt has been made in this report to classify the items into these three categories, as was done in the 1975 study. The Review Committee found that such a classification had not served any useful purpose in planning or managing research.

#### PLANNING

Four of the original agenda items—"structure of the railroad industry and trade-offs", "methods of restructuring", "ownership of equipment", and "ownership of infrastructure"—have been merged and combined with some new elements into a new item—"corporate structure of the railroad industry".

The former item "regulation", has been split, combined with the former item "public service responsibilities", and considerably expanded. "Transport demand and commodity flow" has been expanded. "Restructuring of planning data" and "marketing studies" are left virtually unchanged.

"Multimodal ownership" has been dropped from the agenda since a number of studies have been made and since the trend, aided by regulatory changes, is clearly toward integration and ownership of multimodal capability. "Railroad models" has also been dropped, since the situation now appears to be somewhat different than it was in 1975. Many models are in existence, but they are of varying quality; the very great uncertainties about the nature and state of circumstances 10 to 20 years in the future are the limiting factor in their application. This makes the methodology of relevant and appropriate use of such models the significant issue, rather than the models themselves.

A new item—"production and distribution of energy materials"—has been added. Its significance and rapid change give this topic an urgency that justifies its inclusion.

#### Corporate Structure of the Railroad Industry (Priority 1)

The recent series of new merger proposals, discussions, and takeover attempts among railroad companies further accents the need for research in several areas on which to base future policy about consolidations. The following eight areas require research in depth and broad exploration. New policy in this area is also required because of the current trend toward deregulation and its implications for future antitrust exposure.

1. The need for research into the development of an optimum corporate structure for both the near- and longer-term future of the industry should be examined.

2. The effect of market swaps on competition and service should be examined, as well as their potential to strengthen existing companies and to extend the joint use of facilities. (Market swaps can be made where two railroads compete in two similar markets and an agreement is reached whereby each railroad serves one of the two areas and duplicate facilities can be eliminated.)

3. The relatively larger number of options in efficient route selection presented by market swaps and other techniques rather than by mergers should be determined.

4. Adequate corporate objectives should be identified in order to provide better recognition of the private-sector requirements for financial viability and the importance of growth for corporate survival and future development. Changes in accounting practices are needed to provide a better understanding of the effects of inflation and to provide adequate measures of profit margin.

5. There should be a determination of the optimum numbers and size of independent corporations necessary and desirable to sufficiently drive the industry that it can hold an adequate place in the private sector under economic deregulation.

6. An effective process must be found for making a controlled transfer of rail segments that now belong to companies that will be unable to meet threshold tests of future viability except in the hands of other rail companies.

7. The rapid growth of alternative ownership arrangements such as the national fleets of Trailer Train and RailBox, leasing companies, the use of short lines for leasing freight cars, and holding companies has had and will continue to have a significant impact on the availability of capital. The future effects of these new arrangements are not fully understood and need to be studied.

8. Alternatives to the present ownership of infrastructure (such as expanded trackage rights, joint operation of facilities, consolidation of terminals, and new interchange construction) should be explored jointly by adjacent railroads.

#### Economic Regulation (Priority 1)

Although some notable studies of the economic regulation of railroads have been made in the past and both the executive branch and the ICC have called for changes in economic regulatory policies, neither the potential positive nor the potential negative impacts of changed regulation or requirements (economic, horizontal, or both in some combination) on transportation in general and on railroads in particular are sufficiently understood. There are lessons to be learned from the experiences of change in other regulated sectors (e.g., Civil Aeronautics Board) and also in the experiences of other countries, particularly Canada. The consequences of change are important issues that affect the decisions to lessen regulation; there will be more assurance in the adoption of policy if such consequences are identified and potential consequences are evaluated.

There is a much greater need for more intensive study on the cost of regulation both from the standpoint of resource allocation and from that of legislative and administrative cost/benefit requirements. In addition, the greater activity and responsibility of state and local regulatory agencies affect the number of regulations and consequent cost to railroads. There is a need for understanding of areas of exclusive or overlapping authority, conflict, and direction of the several government levels.

Another regulatory consideration is that of cost/benefit or loss. What are the positive and negative effects of regulatory actions on competing modes, e.g., of deregulation of air freight on surface freight forwarders, of barge-line user charges on railroads, and of oil pipeline divestiture?

Increasing emphasis on service and performance call for a reassessment of the concept of the common carrier. Governmental responsibility, both national and state, for additions and modifications to the level of service and extent of the network, together with the role of subsidies, must be defined and understood as public bodies play increasingly active roles.

#### Horizontal Regulation (Priority 1)

Governmental regulation that pertains to certain activities, regardless of the industry in which they take place (e.g., environment, antitrust), is here designated horizontal regulation. Activities subject to regulation of this sort have greatly increased in recent years. Some regulatory requirements have turned out to be in conflict with each other. Many requirements of this kind have resulted in greatly increased costs and in some aspects have generated substantial inefficiencies. Although an effort has been made to apply some regulatory requirements in the form of performance specification, much more needs to be done.

This problem is broader than transportation alone. Studies are needed into the effectiveness of many currently evolved regulatory requirements in achieving their goals. Better knowledge is needed of the consequences (positive and negative) of the form and substance of various types of such regulatory requirements. This applies particularly to regulation pertaining to safety and environmental factors.

The participation of the judicial branch of government and the increase of activity of state and local governments in the safety and environmental areas has also complicated the conduct and increased the cost of rail transport affairs. Studies in these areas should include the effects of these activities, possible trade-offs, and the need for their coordination and review.

Along with the changes that are beginning to occur (or may occur) as reforms are made in economic regulatory policy, across-the-board provisions of antitrust regulation may come into effect in the railroad industry. This could induce a series of new problems, such as operating distortions under an untried mixture of antitrust and traditional economic regulation and difficulties because provisions evolved for other types of business and industry may not be fully applicable to the transport function.

Such developments could have a profound effect on the ability of the industry to provide services by an interconnected transport network that needs a certain degree of coordination. Thoughtful and discerning study is needed to foresee the possible stifling adverse consequences of substituting antitrust regulation, in its present form, for the kind of economic regulation that has been practiced in the transportation industries for many decades.

#### Transport Demand and Commodity Flow (Priority 2)

Incompatibility between railroad data and data from other modes has led to partial and fragmentary approaches to transport planning and policy formulation and analysis. This is especially true in truck transportation, for which there is currently incomplete reporting of traffic patterns. While additional and higher-quality data are

needed for all modes, the necessary data on national and international commodity flow and transport demand can also be derived largely through more elegant aggregation-disaggregation and/or other techniques for transforming existing and supplemental data sources. Both shippers' and carriers' needs and resources should be considered in devising means that will provide better measures of existing (and more reliable forecasts of future) transport demand and commodity flow.

#### Restructuring of Planning Data (Priority 2)

There are considerable data concerning demographic trends; trends in production; estimates of future activities and locations of agriculture and the extractive, manufacturing, and service industries; indexes of economic conditions, resource availability, and social conditions; and trade as it is affected by changing economic and resource development or depletion in foreign countries. These conditions and trends all work to create the future environment for transportation and bear on the role of rail transport. Relatively little has been done to structure, interpret, and synthesize information from these data that would be useful for planning in the rail transport field.

#### Marketing Studies (Priority 3)

Although various marketing studies and shipper-behavior studies have been conducted in relation to rail transport, a critical evaluation of marketing techniques in other modes and fields, with a view to evolving a more aggressive approach to marketing railroad services, would appear to be worthwhile.

#### Production and Distribution of Energy Materials (Priority 3)

It is far from clear what changes will take place in the future production (including imports) of energy materials and what impact this and fuel substitutability and technology will have on the markets, traffic patterns, and distribution of such materials, and consequently on the character of their demand on the rail industry.

The transport of energy materials constitutes a very large portion of rail tonnage and revenue. It is therefore important that the rail industry examine potential shifts in the demand and flow of energy materials, including possible shifts between modes and the placing of greater demands on railroads. The possible developments of "new" transport technologies need to be studied, since new technological systems may profoundly affect commodities, including changes to their locations of supply and their movement and distribution.

#### PLANT AND EQUIPMENT

Seven of the original nine items have been retained. "Life-cycle design" has been dropped as a separate item and included in a new item—"track systems". "System design" has also been dropped as a separate item; it has been combined with "investment trade-offs" to form "trade-offs: way-and-structures investment versus equipment investment". Four other new items have been added—"train-fuel performance", "track strength research", "signal and traffic control", and "locomotive design". "Electrification" has been moved from "operations" into "plant and equipment". Four of the original items have been extensively rewritten. These are "trade-offs: way-and-structures investment versus equipment investment", "terminal and yard design", "on-board measurement" (which is now titled "measurement of



dynamic forces and detection of flaws"), and "car design". The 1975 study recommendations for "car design" were limited to integration into the train or yard system. The requirement to recognize shippers' needs in new car designs is an important addition. Although "locomotive design" is a new item, its addition recognizes not only a need but the fact that research is now under way. "Track strength" adds a new dimension to the research needs on track structure and, for the first time, includes the subgrade as a research item.

The priorities of "energy systems", "measurement of dynamic forces and flaw detection", and "component improvements" have been changed from 3 to 2.

#### Track Systems (Priority 1)

There is a strong need for research and development in life-cycle design to minimize the sum of discounted investment and lifetime maintenance costs. This research and development effort must take a total systems approach, with awareness of today's heavier loads, higher speeds, long-distance unit trains, and new knowledge and appreciation of the dynamic interaction between track and trains. It must include train performance research and both track maintenance and operations parameters and practices. The effort must also consider the ever-present need to maximize the use of available funds. Life-cycle costing should be an integral part of this research. Adequate provision for technology transfer is required.

#### Track Strength (Priority 1)

There is an urgent need to characterize and quantify the vertical and lateral strength of the track system and its components, including the rail, tie, and fastening system, as well as the system as a whole, including ballast and subgrade.

#### Train-Fuel Performance (Priority 1)

The current energy crisis requires that use of fuel should be minimized by exploring design improvements in terms of changing the physical configuration of equipment to reduce weight and drag, improving diesel-electric propulsion systems, and using fuel-saving devices. This research effort should extend to operating practices (e.g., better matching of power to trains, route optimization, on-board fuel monitoring, and train consistings).

#### Trade-Offs: Way-and-Structures Investment Versus Equipment Investment (Priority 1)

A number of aspects of car and track design are potentially able to improve utilization or reduce operating costs at an acceptable level of capital consumption. These need to be looked at, in various combinations, in terms of overall system improvement. This approach would include development of less specialized or more adaptable designs, of designs to improve ease of maintenance, and of design of maintenance techniques more appropriate to new equipment, plant, and operating conditions. The problems stemming from the adoption of heavier axle loadings have become well recognized, and considerable effort is going into technical analysis and solutions. There is also a growing understanding of the relationships between a range of equipment dynamics and the range of allowable track perturbations that can increase system reliability and safety while reducing maintenance. Development of such in-depth understanding must include overall cost/benefit relationships, as well as adequate means to characterize and quantify, in

usable terms, the dynamic interaction between equipment and track.

#### Energy Systems (Priority 2)

Changing energy costs may make feasible the use of alternative fuels or energy sources, such as liquified coal or methane, in addition to electrification. An in-depth study of all promising sources of energy and of the technology needed to use them should be made. Demonstrated technological solutions, supported by economic considerations, must be developed before any major decisions are made on the use of alternative energy sources. However, it is necessary to ensure that full attention is given to the widest possible range of plausible energy and energy-conversion systems, e.g., turbine, sterling engines.

#### Terminal and Yard Design (Priority 2)

There is a need for continued improvement in yard and terminal design, including environmental aspects related to noise and societal impact. Intermodal terminals are particularly important, since terminal design is a major factor in service and profitability. Selection of locations for yards and terminals, including future real property requirements, which are always critical, should improve with application of operations research techniques. This research effort must include a systems approach that addresses matters of flow, inspection, servicing, and maintenance of locomotives, cars, and even whole trains.

#### Measurement of Dynamic Forces and Flaw Detection (Priority 2)

Means of recording operating data, such as forces on couplers, in the locomotive cab, combined with methods of analysis and display, may have direct impact on improvements in safety and train handling and on maintenance needs. Wayside measurement of undue deviation in equipment and track performance is a direct necessity for safety of operation. Such measurements should include but not be limited to bearing temperature, worn or broken wheels, and overstressed track. Portable measurement systems to measure stresses and defects in rail, wheels, axles, and other key components may have direct impact on proper safety and maintenance of operation.

#### Component Improvements (Priority 2)

Deficiencies of various kinds in key equipment and track components should be identified. Developmental work should be aimed at making the most cost-effective changes or modifications (using the system design approach), bearing in mind the constraints of the industry's need for compatibility and interchangeability, as well as the new demands imposed by high-speed service. The increased volume of transportation of hazardous materials and the development of new hazardous materials and substances constitutes a serious problem. There is a need for development of track, equipment, and operating methods that will reduce the risk of accidents involving hazardous materials and substances.

#### Signals and Traffic Control (Priority 3)

Despite the exceptionally high reliability characteristics of the present signal and traffic control systems, there is a need for further development of solid-state systems to reduce both initial and maintenance costs in order to permit their economical extension to lower-density lines.



Further development is needed in systems that not only monitor train functions but detect failure modes without constant dispatcher surveillance. These will include wayside systems that monitor dynamic response and provide refined weighting techniques and train consist data.

#### Locomotive Design (Priority 3)

Overall locomotive designs need to be assessed from the standpoint of reliability, maintainability, life-cycle costs, and dynamic interaction with track structure. Attention should also be given to achievable levels of adhesion, since the effective utilization of locomotive power is constrained thereby.

#### Car Design (Priority 3)

Overall car designs that take into account reliability, maintainability, and life-cycle costs need to be assessed as part of a system—either a train or a yard movement—including dynamic interaction with the track system. The needs of the shippers and consignees as to car type and size must be redefined and clarified, particularly in regard to loading and unloading methodology as it relates to the sensitivity of finished products to vibration and shock and must include its increased loadability for back-haul movement. The standardization of brake, draft, and truck systems must be extended to hatches, doors, outlets, and load dividers in order to improve reliability and maintainability, as well as to reduce downtime and parts inventory.

Significant reductions in tare weight will demand careful design and selection of materials, as well as construction quality control and more extensive use of non-destructive inspection techniques. A critical element of each analysis is the cost/benefit of system compatibility.

#### Urban Facilities (Priority 3)

In the urban areas of the nation, there are many opportunities to consolidate tracks, yards, and other facilities in order to reduce costs, improve operations, eliminate some grade crossings, and aid in urban revitalization. There are also opportunities to improve both intermodal coordination and the rail network as a part of the national rail system. Studies are needed to assess opportunities and problems associated with railroad terminal and switching companies (e.g., to assess trade-offs between urban yard interchange and run-through trains to nonurban points). Funding sources and allocation methods should be reviewed for possible joint urban and railroad funding, especially where urban land conservation can be facilitated and traffic conflicts between rail and other transport modes can be substantially reduced.

#### Electrification (Priority 3)

Electrification provides an opportunity, where operating conditions justify it, to reduce operating costs, improve service, and conserve petroleum fuels. The technology of electrification has improved greatly in recent years, but there is still some work to be done, particularly in the area of electrical and electromagnetic interference. The greatest amount of research must be done on the institutional and economic problems that face electrification, particularly the problems of financing it and of inductive interference with other established nearby electrical systems. Continuing research is needed to determine whether electrification of specific lines is a good investment.

### OPERATIONS

Two new items have been added—"operating-service planning" and "line capacity". An overall operating plan for each railroad that aims for both better service and efficiency is considered essential. One original item—"electrification"—has been transferred to "plant and equipment". "Terminal management" has been moved from priority 3 to priority 1. The five remaining original items have all been amended.

#### Service Quality (Priority 1)

While there has been progress in measurement of service quality, there is a general agreement that existing measures of railroad service are incomplete and often inadequate. It is necessary to identify a more comprehensive group of measures of service quality that would satisfy both managements and users and to find means of making them operational.

This includes means of combining the measures of the several aspects of service quality into composite indicators. Studies of the value to shippers of different levels of service quality are a prerequisite to studies of demand elasticities that are called for under "management" research recommendations.

#### Equipment Utilization and Management (Priority 1)

A number of closely interrelated problems combine to make improvements in equipment utilization difficult. There is a need for techniques to level fluctuations and reduce imbalances in car loading demand (such as buffer storage for commodities, backhaul and peak-demand rates), for sizing of assigned car fleets, and for distribution and control methods that will reduce the length of car cycles and the percentage of empty time and/or mileage. Studies of improvements in interroad management mechanisms (car rental rates, rules and directives, etc.) are needed, specifically a means to match inspection and grading to car loading demand. Current work on car utilization by AAR needs to be augmented and accelerated. The car-cycle data base that has been developed should be enriched and fully exploited. Finally, the utilization and management of both motive power and cars is explicitly included in these recommendations.

#### Terminal Management (Priority 1)

Research and development in terminal management should be undertaken with an awareness of the factors noted in the discussions of terminal and yard design and of blocking and scheduling, as well as with an appreciation for the newly developed management information and control systems now becoming prevalent in the railroad industry. The research should explicitly consider means of effectively integrating car costs into terminal budgeting and control systems. Operations research techniques should be used to increase their effective capacity. Research should be done on the problems peculiar to terminals in which two or more companies operate. The opportunities for changes in yard operating practices should be assessed in light of the results of the labor-management terminal projects.

Terminal railroads and joint facilities were developed to facilitate car interchange in multiple-railroad terminals. Terminal railroads significantly affect car movements. Research into the effectiveness of these institutions and their management practices and incentives should be undertaken to determine whether alternatives can be developed that could contribute to improved car

utilization and operating efficiency.

#### Line Capacity (Priority 2)

Track capacity and train performance have been significantly improved over many years by advances in signaling and traffic control. The underlying philosophy and control logic have never changed, and they require complete reexamination and evaluation in the light of both today's operating environment and the knowledge and experience gained in other modes.

#### Blocking and Scheduling (Priority 2)

There is a need for continuing research and development in the blocking and scheduling of trains. Such research and development must be undertaken in full awareness of the changing patterns of service, the loss of short-haul freight traffic, the increased use of run-through freight trains and unit trains, the growing volume of TOFC and container-on-flat-car (COFC) traffic and its special needs, planned railroad mergers, and the possible future flexibility in work rules.

#### Operating-Service Planning (Priority 2)

In addition to research under the separate topics of "service quality", "equipment utilization and management", train operations ("blocking and scheduling"), and "terminal management", there is a strong need to study the interactions of these elements of the industry to achieve the best balance among them. This implies a planning framework to decide on trade-offs among the components of operating costs and between them and service quality. An overall plan for each railroad that aims for both efficiency and better service is considered the key.

#### Hazardous Materials (Priority 3)

In addition to improved equipment, the procedures for safer handling, shipping, control, and monitoring of the transport of hazardous materials (e.g., switching and classification) need further development. However, cost-benefit analysis should be employed in this area to ensure that the most cost-effective preventive measures are adopted to obtain the needed protection. Because of its peculiar problems, the transport of hazardous materials has been separated from the overall question of safety, which is discussed under general areas of research.

### MANAGEMENT

Out of the 11 original items, only two have been deleted—"indirect costs and benefits" and "demand pricing". Every one of the original set has been extensively rewritten. One new item has been added—"integration of information systems and management systems".

"Cost structures" was changed to "railroad costs" and rewritten to sharpen the research focus. "Sources of capital" was retitled "industry financial issues" and rewritten to reflect current questions. In addition, it was felt that the original item was not effective in presenting a researchable question.

Excess verbiage in the item "studies of human resources" was removed, but the item retains its focus on the labor market, behavioral science research, and railroad discipline systems. "Productivity" was expanded to include both human and capital resource productivity. "Training methods" was broadened to include analysis of supply, demand, and methodologies.

The title "information technology" was changed to

"data acquisition technology", and the section was rewritten to reflect current research needs and concerns in this fast-changing area.

#### Resource Productivity (Priority 1)

Improving the productivity of both human and capital resources offers great opportunities to lower costs and improve service. Productivity measures that adequately reflect both service quality and quantity and that permit the analysis of trade-offs between labor and capital should be developed. Although the greatest opportunities appear to be in operations, the research effort should cover all phases of railroad activity and should preferably be carried out with the active cooperation and participation of labor organizations.

New approaches are needed for the successful implementation and continuing support of programs that promote productivity but involve changes in working conditions. There is a need to examine and evaluate alternatives, such as joint labor-management participation in experiments with new work rules. Changes in railroad operations often require changes in labor agreements. New approaches are needed to improve the collective bargaining process when such changes are involved. Approaches such as labor participation in cooperative experimentation should be explored and evaluated.

Greater efforts need to be made in the area of technology transfer to enhance resource productivity.

#### Railroad Costs (Priority 1)

There is a continuing need for an improved understanding of railroad cost structures. The questions of economics of scale and density remain issues in pricing, investment, and regulatory policies. Assessing the impact of proposed changes in technology and operating practices on total costs also requires better cost information than is currently in hand; the indirect costs and benefits of such changes are also difficult to trace in existing costing systems. The design for data collection to support more competent costing systems poses a related set of technical problems that requires further research. Research is also needed in the area of transportation cost sensitivities.

#### Accounting Methods (Priority 1)

Conventional accounting practice, together with past changes and future proposals, has profound implications for sound management and future corporate development. Research is necessary to determine the implications of these accounting practices, as well as the special problems posed by present and prospective tax laws, e.g., the role of betterment accounting, inflation, and other macroeconomic forces. Accounting systems that use computers for massive restructuring of accounts, performing such operations as reflecting inflation in inventories, are being developed on a proprietary basis within the financial community.

A balance is required between the desire for uniformity in general accounting data and the retention of useful practices that are particularly applicable to the railroad industry.

#### Demand and Marketing (Priority 2)

Continued examination is required of the bases for shippers' needs and choices of mode. This should lead to a generalized technique for estimating demand elasticity under alternative assumptions. One of the alternatives for which provision must be made is demand pricing that

is aimed at balancing directional, seasonal, or regional commodity flows. The development and acquisition of plant and equipment, the structuring of operating plans and coordinating agreements, and the implementation of marketing programs in a timely and effective manner all require development of this tool.

#### Management Processes (Priority 2)

In view of the changing organizational demands developing in the railroad industry, there is increasing concern over the adequacy of the industry's traditional functional and geographical organizational patterns. The feeling is growing within the industry that bridges must be built between the traditional functional components of the railroad's organization and between headquarters and field. However, there is not yet a consensus as to the direction that should be taken. At the very least, organizational alternatives should be examined that will contribute to the effectiveness of the railroad but that will preserve the core of the current structure. Asset management, matrix management, product and project management, and holding-company and profit-center management, as well as the basic issues of centralization versus decentralization, management information systems, and integrated decision making, all deserve substantial commitment of research effort.

#### Studies of Human Resources (Priority 2)

The railroad labor market is disaggregated by carrier, craft, and union. The ability of this industry in the future to attract, retain, and effectively utilize human resources requires a systematic study to understand the operation of the railroad labor market, to forecast changing demands, and to improve mobility of personnel between areas of specialization. A specific objective of such research should be to identify the changes in labor agreements and management practices necessary to increase labor mobility and provide greater employment security and to suggest cooperative approaches to eliminating rigidities in the market.

Behavioral research and practices in fields other than railroading should be imaginatively examined, and their adaptation to the railroad situation should be seriously considered. Some deeper understanding of workplace motivations, in terms of current life-styles and attitudes, is needed.

Railroads retain a uniquely paralegal approach to discipline. Its elimination is not possible, however, until some adequate and acceptable alternatives are devised. Research is needed into new systems of both motivation and discipline and their administration.

#### Training Requirements (Priority 2)

Anticipated demands for skilled craftspersons, supervisors, and managers in the industry emphasize the need for research leading to the development and implementation of improved training methods and programs. The research should acknowledge the varied sources of supply, both internal and external, and the additional needs for training and developing current employees. Research is needed on the economics of alternative training methodologies, on their effectiveness in meeting skill requirements, and on possibilities for multicarrier cooperative programs.

#### Data Acquisition Technology (Priority 2)

There is a continuing need for improved techniques of data acquisition and the development of automated data

acquisition technology that is capable of reliable performance in the typically hostile physical environment of railroad operations. Specifically, this need extends to such areas as an acceptable car identification system, a reliable wheel counter, a cost-effective locomotive fuel meter, unit work measurement, and countless other data acquisition problems.

#### Integration of Information Systems and Management Systems (Priority 2)

There is a need to continue the development of information systems interactively with the development of management systems, specifically the scope of responsibilities, the various line and staff relationships, and their cycles of planning, decision making, control, and evaluation, as well as the evaluations, measurements, and incentives of the individuals and operational units.

#### Industry Financial Issues (Priority 3)

There is a need for a better understanding of the railroad industry's financial structure and of how the formation of capital within the industry can proceed most efficiently and effectively. Capital flow analysis also needs further attention.

A number of special issues raise important questions, too—the widening gap between the financial circumstances of the various companies that constitute the industry; the growing involvement of new corporate entities, including nonrailroad companies, into the provision of railroad assets; the increasing assumption by public bodies of railroad ownership and operating responsibilities; the growing role of government as a lender of last resort; and the long-run financial implications of the Northeast railroad valuation case.

#### GENERAL PROBLEM AREAS

Three of the four original agenda items have been retained, although "safety" has been rewritten and "role of railroads in the economy" has been changed to "continuing role of railroads in economic development". "Data" has had new material added. "Cooperative research program management" has been changed in its intent and completely rewritten as "management of railroad research". The need for a cooperative research program was agreed to be less urgent than the need to be sure the limited research resources of the railroad industry are used on the most needed research and that the results of that research are disseminated and implemented.

Two new items were added—"railroads and national defense", both because defense needs have been somewhat neglected in studies of restructuring the rail industry and because, in view of the petroleum shortage, rail is expected to assume a larger role in future defense logistics planning, and "public enterprise: interfaces, interactions, and management", both because of the growing role of state governments in subsidizing and operating rail service and because of federally supported corporations, i.e., Amtrak and Conrail.

#### Safety (Priority 2)

Safety involves many concerns that require attention in the whole range of activities that produce transport service: planning, design, equipment, materials, operational methods, management attitudes, and human behavior. Because of the high visibility of many accidents, there will continue to be pressures of both anticipatory and reactive responses. Safety can generate large de-

mands for resources, even though expenditures to achieve other ends, e.g., pure economic efficiency, usually enhance safety.

Interactions between railroads and their environments, including the public (such as at railroad-highway grade crossings), require the joint attention of a number of organizations within and outside government.

The study committee recommends that the considerable research activity on safety in both industry and government (individually and jointly) that is already being pursued be actively continued. New safety research activities should be planned and conducted with knowledge and appreciation of existing research activities and the end products formulated to produce positive cost/beneficial results. Results for such research should provide an improved basis for decisions in safety-related actions, including regulatory initiatives. Safety research must be ahead of the rule makers, because performance safety standards should be actively pursued in all aspects of railroad equipment and track standards, including their interaction, and this requires much more knowledge on the part of government regulatory offices.

Economic impact is an unavoidable consideration of safety research; such considerations are major factors in investment decision making in support of safety objectives. This suggests that there may be viable alternatives to some areas of safety regulation. Means should be explored to achieve requisite safety levels by means of maximum reliance on the private-sector marketplace through such mediums as insurance and the profit motivation of industry managers.

#### Continuing Role of Railroads in Economic Development (Priority 2)

Planning by government and industry requires analysis of the railroads' role within the total transportation system, especially as it is related to the development of national and regional economies. The analytical models that are now available should be used to study possible shifts in the modal shares of the freight market and the need for new routes or increases in capacity of existing routes to handle new, redeveloped, or expanded sources of commodities (e.g., coal). This role must involve continuous monitoring of economic development and individual and collective interaction with railroads. One significant by-product will be the generation of data and insights necessary to inform both the public and public officials about the roles being played by the railroads in the national interest.

#### Data (Priority 2)

The lack of appropriate data for undertaking some of the kinds of research thought to be essential has been pointed out in all past critiques of railroad research. Although the lack of data seems especially to plague operations research and economic research, including research into financial and investment issues, it also spills over into important technological research and development issues. These data deficiencies seem to be problems of long standing. Although the U.S. railroad industry has provided more publicly recorded information on its finances, traffic, and operations over a longer period of time than any other industry, much of that information is not in suitable form for use in dealing with many questions of fundamental importance to the future of the railroads.

It seems clear that economic regulatory reform requires the collection and dissemination of data on the impact of reforms that are instituted, not only in the rail industry but in other modes as well. Otherwise it will

be impossible to cope intelligently with the changes.

To help improve rail efficiency and possibly induce cost reductions (recognizing the interdependencies present in the rail system), it is important to study means and costs of improving data interchanges and data sharing within the railroad community.

The lack of data on traffic flows, rates, and service characteristics of competing modes of freight transportation (particularly intercity trucking) is a major obstacle to understanding the present and prospective markets for rail transportation. This, in turn, affects planning for the future of the railroad industry in various ways. These inadequacies derive from long-standing industry practices and more recently from the inability of the federal government to organize an effective program of data collection in this area.

The problems here derive in part from the unworkability of a waybill sampling technique, such as that used for railroad traffic, to capture information on private and otherwise unregulated truck transportation. This is compensated for, but only in part, by the Census of Manufactured Goods Transportation, which is collected once every five years and leaves much to be desired in details on transportation charges or on the characteristics of the transportation provided. The use of the census data also suffers from disclosure problems that make it difficult in many cases to look at the transportation market in sufficient detail to understand the nature of the competitive interface between various modes and types of transportation services.

The sort of data collection that is required can, as a practical matter, be undertaken only by the federal government. Thus far, there has apparently been inadequate interest on the part of successive administrations to spend the public funds required to close these information gaps. This lack of interest stems from basic dependence on industry reporting and at least in part from the very long lead time involved in such efforts. Nevertheless, this inertia in regard to a fundamental form of research must be overcome if both the public and private decisions that turn on an adequate understanding of the intercity freight transportation market are ever to be made on a rational basis.

There is also a special requirement for external data on the costs of the various modes of intercity transportation. A number of crucial public and private policy decisions turn on better knowledge of what the various modes do well (or poorly) in an economic sense. Yet relatively little research has been done in this area and relatively little of the requisite cost data are in hand. It seems clear that there is much to be done on the development of improved data acquisition, storage, and retrieval capability in connection with railroad costing. Certainly, the cost of collecting sufficiently disaggregated data on railroad operations, railroad facilities, and railroad expenses has been an important obstacle to the development of better costing methods. But the need for more sophisticated and more efficient data collection procedures is apparent, and the cost should clearly be outweighed by the benefits to rail carriers and to the nation.

Beyond this critical need for internal costing data, there is a requirement for improved data for measuring the performance of the railroad system. This, in turn, gives rise to a need for research into improved systems for measuring carrier and modal performance. Without a clear definition of how best to measure railroad performance, it is not possible to specify data collection requirements with sufficient precision or to establish the parameters of the research into data collection techniques both in the aggregate and in detail. The data with which to measure service quality are partly in hand, but

they are not properly organized and are partly missing from present and past data collection programs.

The important internal data needs are for more functionally disaggregated data on operations and the use of assets. The need here is not for improved accounting systems per se (although there is such a need) but for improved data that can be analyzed on both a tactical and a strategic basis. Decisions requiring improved data inputs are many and involve technological developments whose economic usefulness is uncertain without an improved ability to assess that usefulness through the analysis of the appropriate data on past and present operations.

Research is required to ascertain the implications of the myriad rights-in-data issues that are now arising out of concepts for the use of carrier data by shippers who are competitors in their own marketplace. As more data are developed in support of rail planning, marketing, and operations, the pressure to solve rights-in-data issues will increase. The unrestricted public availability of individual railroad data could adversely affect railroad and shipper management prerogatives and decision making. This situation clearly requires careful study.

#### Public Enterprise: Interfaces, Interactions, and Management (Priority 3)

Research into the roles that federal, state, regional, and local public enterprises have with relation to railroads is needed to avoid wasteful, negative, or restrictive practices that do not result in net benefits and to balance the needs of both the public and the railroads. The subsidization and operation of rail service by the states and subsidy of Amtrak and Conrail by the federal government are the cases in point.

#### Management of Railroad Research (Priority 3)

A review of accomplishments since the 1975 study suggests that existing research resources may not always be deployed in the most effective way. Some of the work assigned a high priority in that study has not yet begun. Some has been done but not disseminated. Some has been disseminated but the results have not been adopted in practice.

There is continuing uncertainty about the role of government in relation to industry responsibility for the various areas of research. There is a continuing concern that railroad research may be underfunded in a number of critical areas. Thus, the whole question of how we manage railroad research and put its results to work seems in need of more thorough examination. For example, what is the proper mix of proactive and reactive research? What early-warning systems need to be established to ensure the relevance of railroad research? There is specific need to improve tracking of railroad-oriented research and development activities in other parts of the world to derive maximum benefits for U.S. railroads.

Research specifically directed at the diffusion of innovations in the railroad field is required. There is a sufficient body of recent railroad innovations to enable such research to be conducted at least on a case-study basis. Both hard and soft innovations need to be studied, with the latter illustrated by cost models that are developed by specific railroads but have relevance and value for the industry as a whole.

Managers of railroad research efforts must be especially aware of the need to establish the costs and benefits of the outcomes of their research, whether equipment or other. Many research projects are best done on a cooperative basis. Such cooperative efforts may involve any or all of the following in any number of combinations: railroads, shippers, railroad suppliers, unions, and government at various levels. The structuring and management of such programs require special approaches that can be identified only through a specific research management study.

#### Railroads and National Defense (Priority 3)

Railroads have performed effectively in prior national emergencies, whether they were occasioned by military or by natural events. Among the attributes demonstrated is the capability of rapid recovery from destructive forces. In view of the emerging shift to a greater reliance on railroad service in normal times, research should be undertaken to determine the capacity of railroads to meet future national emergencies, especially those arising from national defense requirements.

# Appendix A:

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Battelle Columbus Laboratories; 505 King Avenue; Columbus, Ohio; 43201; DOT-TSC-FRA-76-10; RR619/R-636ST  
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 Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
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Federal Railroad Administration; Northeast Corridor Project  
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ECONOMIC ANALYSIS

Loomis, AV  
Anyos, T

Stanford Research Institute; 333 Ravenswood Avenue; Menlo  
Park, California; 94025

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Maryland; 20760  
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White, DW  
Arnlund, RC  
Prause, RH

Battelle Columbus Laboratories; 505 King Avenue; Columbus,  
Ohio; 43201; TSC-744  
Bechtel, Incorporated; 15740 Shady Grove Road; Gaithersburg,  
Maryland; 20760  
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Intrm Rpt.: #FRA/ORD-78/2; Aug 78; 76 p.; 3 Fig.; 18 Tab.;  
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RESPONSE OF A RAIL-TIE STRUCTURE

Kerr, AD

Princeton University; Department of Civil Engineering;  
Princeton, New Jersey; 08540; 77-TR-8

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Tena Bernal, M  
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Robnett, QL  
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Illinois University, Urbana; Urbana, Illinois; 61801  
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Tayabji, SD

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Naval Construction Battalion Center; Civil Engineering  
Laboratory, Point Mugu; Port Hueneme, California; 93043  
Federal Highway Administration; Office of Research;  
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Salley, JR

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Mullin, T  
Tayabji, SD

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Association of American Railroads Technical Center; 3140 South  
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Jones, HN

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Federal Railroad Administration; 400 7th Street, SW;  
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Handbook; #FRA/ORD-77-30; Jun 77; 92 pp

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Wood, CD  
Mathis, RJ

Southwest Research Institute; Department of Engine and Vehicle  
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Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
United States Coast Guard; Office of Research and Development;  
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Office of Systems Development and Technology; 400 7th Street,  
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Newfell, AT

Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
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Mitre Corporation; 1820 Dolley Madison Boulevard; McLean, Virginia; 22101

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Hammit (Andrew G) Associates; 30813 Marne Drive; Rancho Palos Verde, California; 90274

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Hazel, M  
McGrath, T

Transportation Systems Center; Research and Special Programs Administration; Cambridge, Massachusetts; 02142

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Moon, AE  
Kiang, PL  
Siddigee, MW

Stanford Research Institute; 333 Ravenswood Avenue; Menlo Park, California; 94025; SRI-3983  
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Kaske, AD; Sperry Univac Defense Systems  
Phipps, PL; Sperry Univac Defense Systems

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Ensminger, D  
Meacham, HC  
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Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590  
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Press, M  
Kumar, S  
Seth, B  
Nailescu, S

Illinois Institute of Technology; Department of Mechanics; Chicago, Illinois; 60616  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590  
General Motors Corporation; Electro-Motive Division; La Grange, Illinois  
Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

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Paul, B

Pennsylvania University, Philadelphia; Department of Mechanical Engineering and Applied Mechanics; Philadelphia, Pennsylvania; 19104; MEAM Report 76-1  
Department of Transportation; Office of University Research; Washington, D.C.; 20590

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Kumar, S

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General Motors Corporation; Electro-Motive Division; La Grange, Illinois  
Association of American Railroads; 3140 South Federal Street; Chicago, Illinois; 60616  
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Tuten, JM  
Kadala, PS  
Law, EH

Clemson University; Department of Mechanical Engineering; Clemson, South Carolina; 29631  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Hashemi, J

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Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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 Cooperrider, NK

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 Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

Intrm Rpt.; #FRA/ORD-78/50; 15 Aug 78; 55 p.

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## USERS' MANUAL FOR PROGRAM FOR CALCULATION OF KALKER'S LINEAR CREEP COEFFICIENTS

Haque, I  
 Law, EH  
 Cooperrider, NK

Clemson University; Department of Mechanical Engineering; Clemson, South Carolina; 29631  
 Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590  
 Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

Tech Rpt.; #FRA/ORD-78/71; Mar 79; 36 p.; 3 Fig.; 2 Tab.; 9 Ref.; 3 App.

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## WHEELS

02 153977

## FRICTION-CREEP AND WEAR STUDIES FOR STEEL WHEEL AND RAIL

Karamchandani, KC  
 Kumar, S  
 Sciammarella, CA  
 Seth, B  
 Naulescu, L

Illinois Institute of Technology; Department of Mechanics; Chicago, Illinois; 60616  
 Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
 General Motors Corporation; Electro-Motive Division; La Grange, Illinois  
 Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

Intrm Rpt.; #IIT-TRANS-75-1; May 75; 114 pp  
 #FRA/ORD-76-272

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03 151161

## ULTRASONIC DETECTION OF PLATE CRACKS IN RAILWAY WHEELS

Becker, FL

Battelle Memorial Institute/Pacific Northwest Labs; Battelle  
Boulevard, P.O. Box 999; Richland, Washington; 99352  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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FEASIBILITY OF FLAW DETECTION IN RAILROAD WHEELS USING  
ACOUSTIC SIGNATURES

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Finch, RD

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Houston University; Department of Mechanical Engineering;  
Houston, Texas; 77004  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.: #DOT-TSC-FRA-76-6; Oct 76; 206 p.; Figs.; Tabs.;  
27 Ref.; 5 App.  
#FRA/ORD-76/290

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FT-Contract; CN-DOT-FR-30002

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DOTL RP

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STRESS MEASUREMENTS IN RAILROAD WHEELS VIA THE BARKHAUSEN  
EFFECT

King, RR  
Barton, JR  
Perry, WD

Southwest Research Institute; 8500 Culebra Road, P.O. Drawer  
28510; San Antonio, Texas; 78284; DOT-TSC-FRA-76-32  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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WHEEL RESEARCH, VOLUME I. ELASTIC STRESS ANALYSIS, ELASTIC  
FINITE-ELEMENT STRESS ANALYSIS OF RAIL CAR WHEELS

Hopper, AT  
Johns, TG  
Sampath, SG  
Stoneisifer, RB  
Corliss, JM  
Davies, KB

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada

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03 152434

A COMPARISON OF THE STRESS LEVELS IN ONE- AND TWO-WEAR 36-  
IN. DIAMETER WHEELS UNDER SIMULATED SERVICE LOADS

Novak, GE; Del Engineering, Incorporated

Stone, DH; Association of American Railroads Technical Center;

American Society of Mechanical Engineers; 345 East 47th  
Street; New York, New York; 10017

Conf Paper; #Paper 77-RT-13; 30 Mar 77; 12 pp; 14 Fig.; 9  
Ref.

ORDER FROM:

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New York; 10017; DOTL RP

02 167061

WEAR STUDIES FOR STEEL WHEEL AND RAIL. I. MECHANISMS AND  
QUALITATIVE ANALYSIS

Krishna, R  
Kalpakjian, S  
Kumar, S

Illinois Institute of Technology; Department of Mechanics,  
Mechanical and Aerospace Eng; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 3140 South Federal Street;  
Chicago, Illinois; 60616  
General Motors Corporation; Electro-Motive Division; La  
Grange, Illinois

Intrm Rpt.: #IIT-TRANS-77-2 No. 7; Jun 77; 71 pp

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Association of American Railroads Technical Center; 3140 South  
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3 Ref.; 2 App.

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STRUCTURAL ADEQUACY OF FREIGHT CAR TRUCK CASTINGS AND WHEELS

Johnson, MR

IIT Research Institute; 10 West 35th Street; Chicago,  
Illinois; 60616  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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FRACTURE RESISTANCE AND FATIGUE CRACK GROWTH CHARACTERISTICS  
OF RAILROAD WHEELS AND AXLES

Carter, CS  
Caton, RG  
Guthrie, JL

Boeing Commercial Airplane Company; Commercial Airplane Group,  
P.O. Box 3707; Seattle, Washington; 98124  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.: #FRA/ORD-77/50; Nov 77; 138 p.; 71 Fig.; 25 Tab.;  
32 Ref.; 1 App.  
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## STRESS ANALYSIS OF THE SUMITOMO METAL IND. J-36 STEEL WHEEL

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Garg, VKAssociation of American Railroads Technical Center; 3140 South  
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#AAR Rpt R-325; Aug 78; 34 p.; Figs.; 2 Ref.

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STRESS ANALYSIS OF THE BETHLEHEM STEEL CORPORATION J-33  
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PREVENTION OF ROLLER BEARING-INITIATED BURNOFFS IN RAILROAD  
FREIGHT CAR JOURNALSAllen, GE  
Lucas, JR  
Tomlinson, FHSKF Industries, Incorporated; Technology Services Center, 1100  
First Avenue; King of Prussia, Pennsylvania; 19406  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142Final Rpt.; #FRA/ORD-78-16; Jan 79; 284 p.; Figs.; Tabs.; 8  
Ref.; 6 App.  
#DOT-TSC-FRA-79-5

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## TRUCKS

03 132965

## PROGRESS REPORT ON THE TRUCK DESIGN OPTIMIZATION PROJECT

Byrne, R; Southern Pacific Transportation Company

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

#FRA ORD 76-243; Oct 75; pp 59-64; 15 Fig.

## ORDER FROM:

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DOTL RP

03 132969

MODIFIED THREE-PIECE TRUCK REDUCES HUNTING AND IMPROVES  
CURVING - STATUS REPORT

Bullock, RL; Standard Car Truck Company

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

#FRA ORD 76-243; Oct 75; pp 85-92; 16 Fig.

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03 132968

## DESIGN SYSTEM APPROACH TO PROBLEM SOLVING

List, HA; Railway Engineering Associates, Incorporated

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

#FRA ORD 76-243; Oct 75; pp 79-84; 18 Fig.

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03 132967

## TRUCK DESIGN - A SYSTEMS APPROACH TO SOLVING PROBLEMS

Hawthorne, VT; Dresser Transportation Equipment Division

Federal Railroad Administration; 400 7th Street, SW;  
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#FRA ORD 76-243; Oct 75; pp 74-78; 9 Fig.

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## IMPROVED SUSPENSION FOR 100-TON CARS ON ROUGH TRACK

Love, RB; American Steel Foundries

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

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18 131621

FREIGHT CAR TRUCK OPTIMIZATION: TRUCK ECONOMIC DATA  
COLLECTION AND ANALYSIS

April, D

Southern Pacific Transportation Company; 1 Market Street; San  
Francisco, California; 94105; TOOP 75-2  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

Tech Rpt.; #FRA-ORD 75-58A; Mar 76; 86 pp

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## TRUCK AND CARBODY CHARACTERIZATION

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Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
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#R-186; 84 pp; 23 Fig.; 1 Tab.; 3 App.

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BOLSTER FATIGUE TEST DATAEvans, RA  
Johnson, MRAssociation of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616Res. Rpt.; #R-246; Sep 76; 114 pp; 65 Fig.; 4 Tab.; 5 Ref.; 2  
App.

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02 170095

## SUSPENSION DYNAMICS, VOLUME 1. TRUCK SUSPENSION

Korpics, FJ

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
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## LATERAL/VERTICAL MODEL, USER'S MANUAL

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Tse, YH  
Martin, GC

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#R-237; Feb 77; 74 pp; 5 Fig.; 4 Ref.; 2 App.

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TRUCKS FOR 100 MPH FREIGHT SERVICE:  
DESIGN-PERFORMANCE-SAFETY-RELIABILITY

Weber, HB; Midland-Ross Corporation

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

Conf Paper; #FRA/ORD-77/13; Jul 77; pp 128-137; 6 Fig.; 1  
Tab.

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## SUSPENSION DYNAMICS--VOLUME 2--TRUCK SUSPENSION

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Hussain, SMA

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION. VOLUME I. EXECUTIVE  
SUMMARY

Fay, GR  
Bang, AJ

Federal Railroad Administration; Office of Research and  
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FREIGHT CAR TRUCK DESIGN OPTIMIZATION. VOLUME II. PHASE I,  
FINAL REPORT

Southern Pacific Transportation Company; Technical Research  
and Development Group; San Francisco, California; 94105  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION PROJECT. VOLUME III.  
PHASE I. FREQUENCY DOMAIN MODEL

Southern Pacific Transportation Company; Technical Research  
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Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION. VOLUME IV. CRITIQUE  
OF FREQUENCY DOMAIN MODEL-SOLUTION TECHNIQUES

Sussman, NE

Mitre Corporation; 1820 Dolley Madison Boulevard; McLean,  
Virginia; 22101  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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#WP-12656

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DOTL RP

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION. VOLUME V. CRITIQUE OF  
FREQUENCY DOMAIN MODEL-EQUATIONS OF MOTION

Muhlenberg, JD

Mitre Corporation; 1820 Dolley Madison Boulevard; McLean,  
Virginia; 22101  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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#WP-11978

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION. VOLUME VI. CRITIQUE  
OF PHASE I. TEST SERIES RESULTS REPORTS

Muhlenberg, JD

Mitre Corporation; 1820 Dolley Madison Boulevard; McLean,  
Virginia; 22101  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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REPORT FOR TEST SERIES 1

Southern Pacific Transportation Company; Technical Research  
and Development Group; San Francisco, California; 94105  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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#TDOP-76-026

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REPORT FOR TEST SERIES 2 AND 5

Southern Pacific Transportation Company; Technical Research  
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Federal Railroad Administration; Office of Research and  
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TRUCK DESIGN OPTIMIZATION PROJECT (TDOP) PHASE II-PHASE I  
DATA EVALUATION AND ANALYSIS PLAN

Gibson, D

Wyle Laboratories; 4620 Edison Avenue; Colorado Springs,  
Colorado; 80915

#FRA/ORD-78/34; Sep 78; 27 p.; 13 Fig.  
#TDOP TR-01

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REPORT

Cappel, K

Wyle Laboratories; 4620 Edison Avenue; Colorado Springs,  
Colorado; 80915

Tech Rpt.; #FRA/ORD-78/53; Nov 78; 110 p.; 9 Fig.; 8 Tab.; 2  
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FREIGHT CAR COUPLER AND DRAFT GEAR

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CHARACTERIZATION OF DRAWGEAR SYSTEMS DURING COUPLER ANGLING

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
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#R-187; No Date; 73 pp; 43 Fig.; 2 App.

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FRACTURE ANALYSIS AND MATERIAL EVALUATION OF BUTTS FROM "F"  
COUPLERS CAST BEFORE MARCH 1970

Fleming, LD

Association of American Railroads Technical Center; 3140 South  
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Tech. Rpt.; #N. 8 (AAR N. R242); Oct 75; 138 pp; 113 Fig.; 2  
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STUDY OF "F" COUPLERS CAST BEFORE MARCH 1970

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FREIGHT DRAW GEAR SYSTEMS PAST-PRESENT-FUTURE

Hinson, AE; Southern Railway Company

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

Conf Paper; #FRA/ORD-77/13; Jul 77; pp 122-127; 13 Fig.

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ADVANCED COUPLING CONCEPTS PROJECT-PHASE I 1/2 REPORT  
INCLUDING GENERAL ECONOMIC MODEL

Punwani, SK

Eshelman, L; Kearney (AT) and Company, Incorporated

Association of American Railroads Technical Center; Safety  
Research and Applied Technology Division; Chicago, Illinois;  
60616

Final Rpt.; #AAR R-285; 01 Nov 77; 350 p.; Figs.; Tabs.; 7  
App.

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RAILROAD COUPLER SAFETY RESEARCH AND TEST PROJECT. STUDY OF  
THE FATIGUE LIFE CHARACTERISTICS OF CAST STEELS USED IN THE  
RAILROAD INDUSTRY

Morella, NA

Wallace, J

Maino, R

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COUPLING SYSTEM DESIGN OPTIMIZATION - A SURVEY AND  
ASSESSMENT OF AUTOMATIC COUPLING CONCEPTS FOR RAIL FREIGHT  
CARS. VOLUME I. EXECUTIVE SUMMARY

Nyquist, AE

Boydston, GD

Chanoux, JJ

Halagera, RT

Hall, RK

Kearney (AT) and Company, Incorporated; 100 South Wacker  
Drive; Chicago, Illinois; 60606

Transportation Systems Center; 55 Broadway; Cambridge,  
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Federal Railroad Administration; Office of Research and  
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COUPLING SYSTEM DESIGN OPTIMIZATION - A SURVEY AND  
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CARS. VOLUME II: TEXT AND APPENDICES

Nyquist, AE  
Boydston, GD  
Chanoux, JJ  
Halagera, RT  
Hall, RL

Kearney (AT) and Company, Incorporated; 100 South Wacker  
Drive; Chicago, Illinois; 60606  
Transportation Systems Center; 55 Broadway; Cambridge,  
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Final Rpt.: #DOT-TSC-FRA-77-30-II; May 78; 446 p.  
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INTERIM REPORT

Morella, NA  
Punwani, SK  
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Federal Railroad Administration; 400 7th Street, SW;  
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Railway Progress Institute; 801 North Fairfax Street;  
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Martin, GC

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Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
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Garg, VK  
Hawthorne, KL

Association of American Railroads Technical Center; 3140 South  
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Olson, LL

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Stone, DH; Association of American Railroads Technical Center; Pellini, WS

American Society of Mechanical Engineers; 345 East 47th Street; New York, New York; 10017

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Shelleman, CC  
Henderson, JP

Kearney (AT) and Company, Incorporated; 100 South Wacker Drive; Chicago, Illinois; 60606  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142

Final Rpt.; #DOT-TSC-FRA-78-1.I; Jun 78; 140 p.  
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Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
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Lundgren, JR  
Martin, GC

Association of American Railroads Technical Center; Research and Test Department, 3140 South Federal Street; Chicago, Illinois; 60616

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Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

Sep 76; 18 pp; Figs.; Tabs.

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#### TEST TRAIN PROGRAM NINTH PROGRESS REPORT

ENSCO, Incorporated; Engineering Test and Analysis Division; Alexandria, Virginia; 22303

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#### FACILITY FOR ACCELERATED SERVICE TESTING. THE FIRST EXPERIMENT

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#### TRAIN STABILITY

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#### QUASI-STATIC LATERAL TRAIN STABILITY MODEL. USER'S MANUAL

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MacMillan, RD  
Martin, GC

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
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## QUASI-STATIC LATERAL TRAIN STABILITY MODEL. PROGRAMMING MANUAL

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## QUASI-STATIC LATERAL TRAIN STABILITY MODEL

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Martin, GC

Association of American Railroads; Track Train Dynamics Program, 1920 L Street, NW; Washington, D.C.; 20036

Tech. Rpt.; #R-209; No Date; 65 pp 41 F; ig.; 1 App.

## ORDER FROM:

Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036; DOTL RP

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## USER'S MANUAL: DETAILED LONGITUDINAL TRAIN ACTION MODEL

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Plouffe, WE  
Ahmed, S  
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## MINIMUM TANGENT LENGTH BETWEEN REVERSE CURVES FOR SLOW SPEED

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Garg, VK

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## A DYNAMIC MODEL FOR LONGITUDINAL TRAIN ACTION

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Garg, VK

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

Thesis; #AAR Rpt R-297; Feb 78; 42 p.; 14 Fig.; 1 Tab.; 12 Ref.; 4 App.

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## EFFECTS OF SPIRAL LENGTH ON REVERSE CURVE NEGOTIATION WITH MINIMUM TANGENT LENGTH FOR SLOW SPEED OPERATION

Chang, EH  
Shum, KL  
Abbott, RA  
Singh, SP

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

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## NOISE ABATEMENT

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## STRUCTURAL VIBRATION NOISE ABATEMENT OF A LARGE DIESEL ENGINE

Varma, PK  
Kumar, SIllinois Institute of Technology; Department of Mechanics, Mechanical and Aerospace Eng; Chicago, Illinois; 60616  
General Motors Corporation; Electro-Motive Division; La Grange, Illinois  
Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590Interim Rpt.; #FRA/ORD-76/273; Jul 76; 100 pp  
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Southern Railway System; 99 Spring Street, SW; Atlanta, Georgia; 30303  
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Thompson, WI, III

Cambridge Systems Corporation; 545 Technology Square; Cambridge, Massachusetts; 02139

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Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Grant, WB  
Espeland, RH  
Hemp, TH

Office of Telecommunications; Institute for Telecommunication Sciences; Boulder, Colorado  
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# ELECTROMAGNETIC INTERFERENCE IMPACT ON RAILROAD CLASSIFICATION YARDS

Cracker, WF, Jr; Federal Railroad Administration  
Speh, PE; Electromagnetic Compatibility Analysis Center

Institute of Electrical and Electronics Engineers; 345 East 47th Street; New York, New York; 10017

Tech Pap.; #78CH1345-8 IA; 78; pp 18-21; 8 Fig.

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Long, LE

Transportation Systems Center; Research and Special Programs Administration; Cambridge, Massachusetts; 02142; DTS-733

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Federal Railroad Administration; Northeast Corridor Project; Washington, D.C.; 20590

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Pruitt, GK  
Miller, JT

ARINC Research Corporation; 2551 Riva Road; Annapolis, Maryland; 21401

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Smith, KR  
MacMillan, RD  
Martin, GC

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
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Hartmann, PW  
Martin, GCAssociation of American Railroads Technical Center; 3140 South  
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## LOCOMOTIVE MUFFLER FEASIBILITY STUDY

Donaldson Company, Incorporated; Product Engineering  
Department, P.O. Box 1299; Minneapolis, Minnesota; 55440

Sep 75; 38 pp; 25 Fig.

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Association of American Railroads Technical Center; 3140 South  
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## COMPARATIVE STUDY OF LOCOMOTIVE LATERAL STABILITY MODELS

Garg, VK; General Motors Corporation  
Mels, KD; General Motors CorporationFederal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

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LOCOMOTIVE CAB ENVIRONMENT & DEVELOPMENT OF CAB DESIGN  
ALTERNATIVESRobinson, J  
Piccione, D  
Lamers, GBoeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142; DOT-TSC-FRA-76-22-1Intrm Rpt.; #FRA/OR&D-76/275.1; Oct 76; 206 pp; Figs.; Tabs.;  
3 App.

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MANUALRobinson, J  
Piccione, DBoeing Vertol Company; P.O. Box 16858; Philadelphia,  
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APPLICATION ANALYSIS

Robinson, J

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142; DOT-TSC-FRA-76-22-3Intrm Rpt.; #FRA/OR&D-76/275.3; Oct 76; 82 pp; Figs.; 8 Tab.;  
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DEVELOPMENT OF A SIMULATION METHODOLOGY FOR OPTIMIZING  
LOCOMOTIVE SUSPENSION SYSTEMSGarg, VK; Association of American Railroads Technical Center  
Hawthorne, KL; Association of American Railroads Technical  
Center  
Chang, EH; Association of American Railroads Technical Center;  
Hartmann, PW; Association of American Railroads Technical  
CenterAmerican Society of Mechanical Engineers; 345 East 47th  
Street; New York, New York; 10017Conf Paper; #Paper 77-RT-6; 30 Mar 77; 13 pp; 15 Fig.; 2 Tab.;  
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TECHNICAL DOCUMENTATIONSmith, KR; General Motors Corporation  
MacMillan, RD  
Martin, GCAssociation of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
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## LOCOMOTIVE TRUCK HUNTING MODEL. TECHNICAL DOCUMENTATION

Garg, VK  
Martin, GC  
Hartmann, PW  
Tolomei, JGAssociation of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
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Association of American Railroads Technical Center; 3140 South  
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## LOCOMOTIVE CAB DESIGN DEVELOPMENTS

Robinson, J; Boeing Vertol Company

Federal Railroad Administration; 400 7th Street, SW;  
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Conf Paper: #FRA/ORD-77/13; Jul 77; pp 33-44; 21 Fig.

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TRACKING & RIDE PERFORMANCE OF ELECTRO-MOTIVE 6-AXLE  
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Klinke, WR; General Motors Corporation  
Swenson, CA; General Motors Corporation

Federal Railroad Administration; 400 7th Street, SW;  
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Conf Paper: #FRA/ORD-77/13; Jul 77; pp 106-118; 17 Fig.; 10  
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Garg, VK

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Ref.; 4 App.

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LOCOMOTIVE DATA ACQUISITION PACKAGE. PHASE I, FINAL REPORT,  
OCTOBER 1977-JULY 1978

Kirsten, PA  
Abbott, RK  
Mullen, DR  
Turner, DB

California University, Berkeley; Lawrence Berkeley Laboratory;  
Berkeley, California; 94720  
Department of Energy; 1000 Independence Avenue, SW;  
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Sep 78; 122 p.

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Robinson, J

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142; 8-2792

Intrm Rpt.; #FRA/ORD-76/275.IV; Nov 78; 132 p.; 30 Fig.; 27  
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Tong, P  
Brantman, R  
Greif, R  
Mirabella, J

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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DiMasi, FP

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; 400 7th Street, SW;  
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DiMasi, FP

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; 400 7th Street, SW;  
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RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS. VOLUME III.  
TECHNICAL REPORT ADDENDUM

Bronowicki, A  
Hasselman, TK

Wiggins (JH) Company; 1650 South Pacific Coast Highway;  
Redondo Beach, California; 90277  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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RESPONSE ANALYSIS OF RAIL VEHICLE SYSTEMS. VOLUME IV.  
REVISED USER'S MANUAL

Bronowicki, A  
Hasselman, TK

Wiggins (JH) Company; 1650 South Pacific Coast Highway;  
Redondo Beach, California; 90277

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
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#FRA/ORD-75-22.IV

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Platin, BE  
Beaman, JJ  
Hedrick, JK  
Wormley, DN

Massachusetts Institute of Technology; Department of  
Mechanical Engineering; Cambridge, Massachusetts; 02139;  
DOT-TSC-FRA-76-13  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590

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12 Ref.; 7 App.

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Ahlbeck, DR  
Doyle, GR, Jr

Battelle Columbus Laboratories; 505 King Avenue; Columbus,  
Ohio; 43201  
Federal Railroad Administration; Office of Passenger Systems  
Research and Development; Washington, D.C.; 20590

Summary; #FRA/ORD-77/04; Nov 76; 73 pp

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# USER'S MANUAL. FREIGHT CAR HUNTING MODEL

Cheung, THW  
Garg, VK  
Martin, GC

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

#AAR R-251; Feb 77; 108 p.; 3 Fig.; 9 Ref.; 6 App.

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# INTERIM AAR GUIDELINES FOR FATIGUE ANALYSIS OF FREIGHT CARS, VOLUME 1

Przybylinski, P  
Halcomb, S

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
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# GENERAL MODELS FOR LATERAL STABILITY ANALYSES OF RAILWAY FREIGHT VEHICLES

Law, EH  
Hadden, JA  
Cooperrider, NK

Clemson University; Department of Mechanical Engineering;  
Clemson, South Carolina; 29631  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Arizona State University, Tempe; Department of Mechanical  
Engineering; Tempe, Arizona; 85281  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

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51 Ref.; 3 App.

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# FREIGHT CAR DYNAMICS--DEMONSTRATION TEST AND ANALYSIS. VOLUME I--FREE VIBRATION STUDY

Garg, VK  
Prasad, B  
Yau, JF

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Tech Rpt.: #R-280; Dec 77; 192 pp; 23 Ref.

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# AN INVESTIGATION OF TECHNIQUES FOR VALIDATION OF RAILCAR DYNAMIC ANALYSES

Fallon, WJ  
Cooperrider, NK  
Law, EH

Arizona State University, Tempe; Department of Mechanical  
Engineering; Tempe, Arizona; 85281  
Clemson University; Department of Mechanical Engineering;  
Clemson, South Carolina; 29631

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# FREIGHT CAR DYNAMICS-DEMONSTRATION TEST & ANALYSIS VOLUME II-FORCED VIBRATION, DYNAMIC STRESS ANALYSIS AND FATIGUE LIFE PREDICTION

Prasad, B  
Garg, VK  
Zarembski, AM  
Yau, JF

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

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# ELECTRIFICATION

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Rutishauser, H  
Kusko, A  
Barrett, M

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Kusko (Alexander) Incorporated; 161 Highland Avenue; Needham  
Heights, Massachusetts; 02194

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Carnegie-Mellon University; Transportation Research Institute; Pittsburgh, Pennsylvania; 15213  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Raposa, FL  
Spenny, CH

Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Speh, PE  
Griffin, S

Electromagnetic Compatibility Analysis Center; North Severn; Annapolis, Maryland; 21402  
IIT Research Institute; 10 West 35th Street; Chicago, Illinois; 60616  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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FRATE, VOLUME I: USER'S MANUAL

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Sussman, NE  
Anders, JR

Mitre Corporation; 1820 Dolley Madison Boulevard; McLean, Virginia; 22102

Tech Rpt.: #FRA/ORD-78/59; Sep 78; 97 p.; 14 Fig.; 12 Tab.  
#MTR 7889, VI

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Lawson, LJ  
Cook, LM

AiResearch Manufacturing Company; 2525 West 190th Street; Torrance, California; 90504  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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WAYSIDE ENERGY STORAGE STUDY. VOLUME II. DETAILED DESCRIPTION AND ANALYSIS

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Cook, LM

AiResearch Manufacturing Company; 2525 West 190th Street; Torrance, California; 90504  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Lawson, LJ  
Cook, LM

AiResearch Manufacturing Company; 2525 West 190th Street; Torrance, California; 90504  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Lawson, LJ  
Cook, LM

AiResearch Manufacturing Company; 2525 West 190th Street; Torrance, California; 90504  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

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Olson, LL

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Martland, CD  
Sussman, JM  
Phillip, CE

Massachusetts Institute of Technology; Transportation Systems Division; Cambridge, Massachusetts; 02139  
Federal Railroad Administration; Office of Policy and Program Development; Washington, D.C.; 20590

Final Rpt.; #FRA/OPPD-77/23; Nov 76; 141 pp  
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## RAIL FREIGHT SYSTEMS

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Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

Proceeding; #FRA/ORD-78/80; 78; 174 p.; Figs.; Tabs.  
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17 145590

MISSOURI PACIFIC'S COMPUTERIZED FREIGHT CAR SCHEDULING SYSTEM. STATE OF THE ART SURVEY: A COOPERATIVE EFFORT OF PRIVATE INDUSTRY AND GOVERNMENT

Shamberger, RC  
Sines, GS  
Dingle, AD

Missouri Pacific Railroad; Missouri Pacific Building, 210 North 13th Street; St Louis, Missouri; 63103  
Federal Railroad Administration; Office of Policy and Program Development; Washington, D.C.; 20590

#FRA/OPPD-76-5; Apr 76; 291 pp

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## MANUAL OF CAR UTILIZATION PRACTICES AND PROCEDURES

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#No. R-234; 80 Jun 76; 285 pp; Figs.; Tabs.; Refs.; 3 App.

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## PROCEEDINGS MANUAL. FREIGHT CAR UTILIZATION SEMINAR

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Proceeding; #AAR-R-253; Dec 76; 180 pp  
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Laughlin, MO  
Cetinich, J  
Ronsberg, V  
King, L

Association of American Railroads; Freight Car Utilization Research Demonstration Program; Washington, D.C.; 20036  
Peat, Marwick, Mitchell and Company; 1025 Connecticut Avenue, NW; Washington, D.C.; 20036  
PRC Railway Systems; 7600 Old Springhouse Road; McLean, Virginia; 22101

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ADD Systems; 2704 Easton Drive; Burlingame, California; 94010; Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; Office of Policy and Program Development; Washington, D.C.; 20590

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17 157698

## FREIGHT CAR UTILIZATION: DEFINITION, EVALUATION AND CONTROL. FINAL REPORT. TASK FORCE 2

Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036

Final Rpt.; #FRA/OPPD-77-6; 01 Mar 77; 23 pp; Tabs.; 3 App.  
#AAR-R-257

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National Technical Information Service; 5285 Port Royal Road; Springfield, Virginia; 22161; PB-267292/AS; DOTL NTIS

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## REPORT OF TASK FORCE FOUR: RECOMMENDED FREIGHT CAR MANAGEMENT AND CONTROL SYSTEMS OF THE FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION PROGRAM

Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; Office of Policy and Program Development; Washington, D.C.; 20590

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MISSOURI PACIFIC'S COMPUTERIZED FREIGHT CAR SCHEDULING  
SYSTEM FUNCTIONAL REQUIREMENTSMissouri Pacific Railroad Company; Missouri Pacific Building,  
210 North 13th Street; St Louis, Missouri; 63103  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

Final Rpt.; #FRA/OPPD-77/10; Jul 77; 149 pp

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MISSOURI PACIFIC'S COMPUTERIZED FREIGHT CAR SCHEDULING  
SYSTEM. SYSTEM PERFORMANCE MEASUREMENTMissouri Pacific Railroad Company; Missouri Pacific Building,  
210 North 13th Street; St Louis, Missouri; 63103  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

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FREIGHT CAR UTILIZATION AND RAILROAD RELIABILITY: CASE  
STUDIESAssociation of American Railroads; Freight Car Utilization  
Research and Demonstration Program; Washington, D.C.; 20036;  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590Final Rpt.; #FRA/OPPD-78/10; Oct 77; 398 pp  
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FREIGHT CAR DEMAND INFORMATION AND FORECASTING RESEARCH  
PROJECT. PHASE IIMinger, WK  
Hargrove, MBAssociation of American Railroads Technical Center; Research  
and Test Department; Chicago, Illinois; 60616  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

Final Rpt.; #FRA-OPPD-77/5; Nov 77; 82 pp

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FREIGHT CAR CLEARINGHOUSE EXPERIMENT: EVALUATION OF THE  
EXPANDED CLEARINGHOUSE

Dingle, AD

Association of American Railroads; Freight Car Utilization  
Research-Demonstration Program; Washington, D.C.; 20036  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590Final Rpt.; #FRA/OPPD-78-11; Jan 78; 114 pp  
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FREIGHT CAR UTILIZATION AND RAILROAD RELIABILITY: AN  
ASSIGNED FLEET MODEL. STUDIES IN RAILROAD OPERATIONS AND  
ECONOMICS. VOLUME 24

Assarabowski, RJ

Association of American Railroads; Freight Car Utilization  
Research-Demonstration Program; Washington, D.C.; 20036  
Massachusetts Institute of Technology; Center for  
Transportation Studies; Cambridge, Massachusetts; 02139  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590Final Rpt.; #AAR-R-286; Apr 78; 177 p.  
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APPLICATION OF AN INVENTORY MODEL TO THE RAILROAD EMPTY CAR  
DISTRIBUTION PROCESS. STUDIES IN RAILROAD OPERATIONS AND  
ECONOMICS. VOLUME 25

Philip, CE

Association of American Railroads; Freight Car Utilization  
Research-Demonstration Program; Washington, D.C.; 20036  
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Low, EM  
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Naval Weapons Support Center; Crane, Indiana  
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I--SPECIFICATIONS

Turpin Systems Company; 16611 Roscoe Place; Sepulveda,  
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Grumman Aerospace Corporation; Research Department; Bethpage,  
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RESEARCH LOCOMOTIVE AND TRAIN HANDLING EVALUATOR  
DEFINITION--CONCEPT 2. VOLUME II--ESTIMATED COSTS

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Buckwell, JJ, Jr

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75; 16 pp

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18 157670

## AN EXPLANATION OF RAILROAD ACCOUNTING

Brinner, HJ; Association of American Railroads

The Office; Office Publications Company; 1200 Summers Street;  
Stamford, Connecticut; 06904

V83 N1; Jan 76; pp 79-80

## ORDER FROM:

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Street, SW; Washington, D.C.; 20590  
Georgetown University; School of Business Administration;  
Washington, D.C.; 20007  
Transportation Research Forum; Washington, D.C. Chapter;  
Washington, D.C.  
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STATE-OF-THE-ART SURVEY

Peternick, J  
Fredrickson, V  
Pflugrad, A  
Rynders, B  
Wiersema, R

PRC Systems Sciences Company; 7600 Old Springhouse Road;  
McLean, Virginia; 22101  
Ford, Bacon and Davis, Incorporated; 11629 K Street, NW;  
Washington, D.C.; 20006  
Norfolk and Western Railway; 8 North Jefferson Street;  
Roanoke, Virginia; 24011  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

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## ACTIVITY DATA:

FT-Contract; CN-DOT-FR-741-5157

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RAILROAD OPERATIONS MODULAR PROCESSING SYSTEM: SYSTEM DESIGN  
SUMMARY

Ocean Data Systems, Incorporated; 6000 Executive Boulevard;  
Rockville, Maryland; 20852  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

#FRA/OPPD-78/15; Apr 78; 170 p.

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FT-Contract; CN-DOT-FR-65146

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## GENERAL

## SAFETY

## TRACK

01 131622

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Demuth, HP; ENSCO, Incorporated  
 Marine, RW; ENSCO, Incorporated  
 Mould, JC; Federal Railroad Administration

Institute of Electrical and Electronics Engineers; 345 East  
 47th Street; New York, New York; 10017

#C76 457-7 IA; 27 Jan 76; 8 pp; 14 Fig.

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## FATIGUE CRACK PROPAGATION IN RAIL STEELS

Fedderson, GE  
 Buchheit, RD  
 Broek, D

Battelle Columbus Laboratories; 505 King Avenue; Columbus,  
 Ohio; 43201  
 Transportation Systems Center; 55 Broadway; Cambridge,  
 Massachusetts; 02142  
 Federal Railroad Administration; Office of Research and  
 Development; Washington, D.C.; 20590

Intrm Rpt.; #DOT-TSC-PRA-77-3; Jun 77; 108 pp

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## THE REAL WORLD OF TRACK AS RELATED TO SAFETY

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 Gatton, CL; Louisville and Nashville Railroad Company

Federal Railroad Administration; 400 7th Street, SW;  
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Besuner, PS

Failure Analysis Associates; 750 Welch Road; Palo Alto,  
 California; 94304

Tech. Rpt.; #R-225; Oct 76; 135 pp; 23 Fig.; 3 Tab.; 31 Ref.;  
 2 App.

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FT-Contract; CN-FAA-75-1-1(B)

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## RAIL ANALYSIS. VOLUME 2: ENGINEERING COST-RISK ANALYSIS OF DEFECTIVE RAIL

Johnson, DP  
 Besuner, PM

Failure Analysis Associates; 750 Welch Road; Palo Alto,  
 California; 94304

Tech Rpt.; #P-265; Jun 78; 170 pp; Figs.; Tabs.; 47 Ref.; 8  
 App.

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## RAIL ANALYSIS. VOLUME 3: STATISTICAL ANALYSIS OF RAIL DEFECT DATA

Besuner, PM  
 Stone, DH  
 DeHerrera, MA  
 Schoeneberg, KW

Association of American Railroads Technical Center; 3140 South  
 Federal Street; Chicago, Illinois; 60616  
 Failure Analysis Associates; 750 Welch Road; Palo Alto,  
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## RAIL ANALYSIS. VOLUME 4: METALLURGICAL EXAMINATION OF RAILS WITH SERVICE-DEVELOPED DEFECTS

Sonon, DE  
 Pellegrino, JV  
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United States Steel Corporation; 125 Jamison Lane;  
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Res Rpt.; #R-300; Mar 78; 69 pp; Figs.; 7 Tab.; 13 Ref.; 3  
 App.

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## RAIL ANALYSIS. VOLUME 5: FATIGUE AND FRACTURE BEHAVIOR OF CARBON-STEEL RAILS

Barsom, JM  
 Inhof, EJ, Jr

United States Steel Corporation; 125 Jamison Lane;  
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## ANALYSIS OF FIVE RAIL FAILURES FOR CONRAIL

Park, YJ

Association of American Railroads Technical Center; 3140 South  
 Federal Street; Chicago, Illinois; 60616

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## TANK CARS

03 129154

## PHASE 05 REPORT ON HEAD SHIELD FATIGUE TESTS

Phillips, EA

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; AAR R-197

#RA-05-3-35; 10 Nov 75; 35 pp; 11 Fig.; 5 Tab.

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PHASE 11 REPORT ON SPECIFICATIONS FOR THERMAL SHIELD  
SYSTEMS ON DOT 112A (114A) TANK CARS

Phillips, EA  
Skogsberg, AM

Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; AAR-R-196

#RA-11-7-34; 23 Jan 76; 109 pp; Figs.; Tabs.; Refs.

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Interrante, CG

National Bureau of Standards; 14th Between E Street and  
Constitution Avenue, NW; Washington, D.C.; 20234; NBSIR  
75-656  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #FRA.ORD-75-51; Jun 76; 160 pp; Figs.; Tabs.

## ACTIVITY DATA:

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MECHANICAL PROPERTIES OF AAR M128-69-B STEEL PLATE SAMPLES  
TAKEN FROM INSULATED FIRE TESTED TANK CAR RAX 202

Early, JG

National Bureau of Standards; 14th Between E Street and  
Constitution Avenue, NW; Washington, D.C.; 20234; NBSIR  
75-725  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #FRA/ORD-76-74; Jun 76; 82 pp; 25 Fig.; 3 Tab.;  
19 Ref.

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FT-Contract; CN-DOT-AR-40008

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Springfield, Virginia; 22161; PB-255907/8ST; DOTL NTIS

12 142509

EVALUATION OF RPI-AAR AND BRL TORCH FIRE TESTS OF TANK CAR  
INSULATIONS

Porter, RW

Association of American Railroads Technical Center; RPI-AAR  
Tank Car Safety Research and Test Project; Chicago,  
Illinois; 60616; AAR-R-244

Res. Rpt.; #RA-11-8-36; 09 Sep 76; 20 pp; 5 Ref.

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ELEVATED-TEMPERATURE MECHANICAL BEHAVIOR OF A  
CARBON-MANGANESE PRESSURE VESSEL STEEL

Early, JG

National Bureau of Standards; 14th Between E Street and  
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Final Rpt.; 77; 7 pp

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03 173371

PHASE 11 REPORT ON INSPECTIONS OF INSULATION-JACKET TYPE  
THERMAL SHIELDS ON TANK CARS IN ACCELERATED LIFE TESTS

Skogsberg, AM  
Phillips, EA

Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

Res Rpt.; #RA-11-9-39/AAR R-291; 13 Jan 78; 14 pp; 9 Fig.; 1  
App.

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03 188683

SELECTED TOPICS IN RAILROAD TANK CAR SAFETY RESEARCH VOLUME  
I: FATIGUE EVALUATION OF PROTOTYPE TANK CAR HEAD SHIELD

Johnson, MR

IIT Research Institute; 10 West 35th Street; Chicago,  
Illinois; 60616  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.; #FRA/ORD-78/32.I; Aug 78; 82 p.; 36 Fig.; 7 Tab.;  
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SELECTED TOPICS IN RAILROAD TANK CAR SAFETY RESEARCH VOLUME  
II: TEST PLAN FOR ACCELERATED LIFE TESTING OF THERMALLY  
SHIELDED TANK CARS

Johnson, MR  
Viergutz, OJ

IIT Research Institute; 10 West 35th Street; Chicago,  
Illinois; 60616  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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PHASE 09 FINAL REPORT ON BOTTOM FITTINGS PROTECTION TEST  
PROGRAM

Kunz, EL  
Olson, LL

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

Res Rpt.; #RA-09-4-41; 22 Dec 78; 44 p.  
#AAR Rpt. R-343

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# ADDENDUM TO PHASE 09 FINAL REPORT ON BOTTOM FITTINGS PROTECTION TEST PROGRAM

Kunz, EL  
Olson, LL

Association of American Railroads Technical Center; 3140 South  
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#AAR Rpt. R-364

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## CRASHWORTHINESS

03 137335

# STRUCTURAL ANALYSIS AND DESIGN FOR ENERGY ABSORPTION IN IMPACT

Lee, EH  
Mallett, RL

Stanford University; Department of Applied Mechanics;  
Stanford, California; 94305  
Department of Transportation; Office of University Research;  
Washington, D.C.; 20590

Final Rpt.; #SUDAM-75-15; Dec 75; 215 pp  
#DOT/TST-76/44

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# MECHANICS OF TRAIN COLLISION

Tong, P

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; 400 7th Street, SW;  
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Final Rpt.; #DOT-TSC-FRA-76-5; Apr 76; 74 pp  
#FRA/ORD-76/246

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# LOCOMOTIVE/CABOOSE CRASHWORTHINESS

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Transportation Systems Center; 55 Broadway; Cambridge,  
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# DYNAMIC SIMULATION OF FREIGHT CAR AND LADING DURING IMPACT

Kasbekar, PV

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

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App.

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Peters, DA  
Yin, SK

Washington University, St Louis; School of Engineering and

Applied Science; St Louis, Missouri; 63130  
Federal Railroad Administration; Office of Research and  
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Tech. Rpt.; #FRA/ORD-76-247; Jan 77; 65 pp

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Anderson, RL  
Cramer, PL

Ultrasystems, Incorporated; Dynamic Science Division, 1850  
West Pinnacle Peak Road; Phoenix, Arizona; 85027;  
DOT-TSC-FRA-76-7, I  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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Tab.; 1 App.

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# TRAIN-TO-TRAIN REAR END IMPACT TESTS--VOLUME II--IMPACT TEST SUMMARIES

Anderson, RL  
Cramer, PL

Ultrasystems, Incorporated; Dynamic Science Division, 1850  
West Pinnacle Peak Road; Phoenix, Arizona; 85027;  
DOT-TSC-FRA-76-7, II  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.; #FRA/ORD-76/303, II; 7703; 124 pp; 72 Fig.; 14  
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# TRAIN-TO-TRAIN REAR END IMPACT TESTS--VOLUME III--APPENDIX A: IMPACT TEST DATA-APPENDIX B: REPORT OF INVENTIONS

Anderson, RL  
Cramer, PL

Ultrasystems, Incorporated; Dynamic Science Division, 1850  
West Pinnacle Peak Road; Phoenix, Arizona; 85027;  
DOT-TSC-FRA-767, III  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

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# DYNAMIC SIMULATION OF FREIGHT CAR AND LADING DURING IMPACT

Kasbekar, PV; Association of American Railroads  
Garg, VK; Association of American Railroads  
Martin, GC; Association of American Railroads

American Society of Mechanical Engineers; 345 East 47th  
Street; New York, New York; 10017

Conf Paper; #Paper 77-RT-3; 30 Mar 77; 8 pp; 21 Fig.; 1 Tab.;  
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12 190536

RAIL SAFETY/EQUIPMENT CRASHWORTHINESS. VOLUME I. A SYSTEMS  
ANALYSIS OF INJURY MINIMIZATION IN RAIL SYSTEMS

Reilly, MJ  
Jines, RH  
Tanner, AE

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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GUIDE

Reilly, MJ  
Shefrin, J  
Patrick, LM

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Intrm Rpt.; #FRA/ORD-77/73. II; Jul 78; 99 p.  
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RAIL SAFETY/EQUIPMENT CRASHWORTHINESS. VOLUME III. PROPOSED  
ENGINEERING STANDARDS

Reilly, MJ

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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RAIL SAFETY/EQUIPMENT CRASHWORTHINESS. VOLUME IV. EXECUTIVE  
SUMMARY

Reilly, MJ

Boeing Vertol Company; P.O. Box 16858; Philadelphia,  
Pennsylvania; 19142  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

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PHASE 15 REPORT ON SWITCHYARD IMPACT TESTS

Schlink, LJ

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

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GRADE CROSSINGS

08 152457

INVESTIGATIONS OF RAILROAD-HIGHWAY GRADE CROSSING ACCIDENT  
DATA

Coleman, J  
Stewart, GR

Federal Highway Administration; Office of Research;  
Washington, D.C.; 20590

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STANDBY POWER FOR RAILROAD-HIGHWAY GRADE CROSSING  
WARNING-SYSTEMS

Holmstrom, FR

Lowell University Research Foundation; 450 Aiken Street;  
Lowell, Massachusetts; 01854; DOT-TSC-FRA-76-15;  
RR602/R6334T

Final Rpt.; #FRA-ORD/D-76-286; Sep 76; 26 pp; 4 Fig.; 1 App.

ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-589

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RAILROAD GRADE CROSSING PASSIVE SIGNING STUDY

Kozio, JS  
Mengert, PH

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Highway Administration; Office of Research;  
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Intrm Rpt.; #DOT-TSC-FHWA-76-1; Jan 77; 137 pp

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08 154800

POTENTIAL MEANS OF COST REDUCTION IN GRADE CROSSING  
AUTOMATIC GATE SYSTEMS. VOLUME I: OVERVIEW AND LOW COST  
RAILROAD/HIGHWAY GRADE CROSSING GATE SYSTEMS

St. Amant, A

MB Associates; P.O. Box 196; San Ramon, California; 94583  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.; #FRA/ORD-77/067.I; Feb 77; 90 pp

ACTIVITY DATA:

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AUTOMATIC GATE SYSTEMS. VOLUME II. IMPROVED GATE ARM  
CONCEPTS FOR RAILROAD/HIGHWAY GRADE CROSSINGS

Duttera, J  
Friedland, M

MB Associates; P.O. Box 196; San Ramon, California; 94583  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.; Feb 77; 66 pp

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PROCEEDINGS 1977 NATIONAL CONFERENCE ON RAILROAD-HIGHWAY  
CROSSING SAFETY HELD AT SALT LAKE CITY, UTAH ON AUGUST  
23-25, 1977

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
American Assn of State Hwy and Transp Officials; 444 North  
Capitol Street, NW; Washington, D.C.; 20001  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Federal Highway Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
National Transportation Safety Board; 800 Independence Avenue,  
SW, Federal Office Building 10A; Washington, D.C.; 20594

Aug 77; 134 p.

## ORDFR FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-293071/7ST

08 167399

INNOVATIVE CONCEPTS AND TECHNOLOGY FOR RAILROAD-HIGHWAY  
GRADE CROSSING MOTORIST WARNING SYSTEMS. VOLUME I. OVERVIEW  
AND CONCEPT GENERATION AND ANALYSIS

Raab, FH  
Brooker, MC  
Ryan, TE  
Waechter, JR

Cincinnati Electronics Corporation; Glendale-Milford Road;  
Cincinnati, Ohio  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-76-19.I; Sep 77; 209 pp  
#FRA/ORD-77/37.I

## ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-841-1

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08 167400

INNOVATIVE CONCEPTS AND TECHNOLOGY FOR RAILROAD-HIGHWAY  
GRADE CROSSING MOTORIST WARNING SYSTEMS. VOLUME II. THE  
GENERATION AND ANALYSIS OF ALTERNATIVE CONCEPTS

Peterson, DD  
Boyer, DS

Tracor Jitco, Incorporated; 1300 East Jefferson Street;  
Rockville, Maryland; 20852  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-76-19.II; Sep 77; 98 pp  
#FRA/ORD-77/37.II

## ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-842-2

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08 175477

POTENTIAL MEANS OF COST REDUCTION IN GRADE CROSSING  
MOTORIST-WARNING CONTROL EQUIPMENT. VOLUME I. OVERVIEW,  
TECHNOLOGY SURVEY AND RELAY ALTERNATIVES

DuVivier, CL  
Rogers, LM  
Sheffield, W  
Foster, HJ

Storch Engineers; 824 Boylston; Chestnut Hill, Massachusetts;  
02199  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-76-21-I; Dec 77; 178 pp  
#FRA/ORD-77/45-I

## ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-870

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Springfield, Virginia; 22161; PB-277946/0ST

08 175478

POTENTIAL MEANS OF COST REDUCTION IN GRADE CROSSING  
MOTORIST-WARNING CONTROL EQUIPMENT. VOLUME II. COMPARISON OF  
SOLID STATE AND RELAY DEVICES AND TECHNIQUES

Holmstrom, FR

Lowell University; Lowell University Research Foundation;  
Lowell, Massachusetts; 01854  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-76-21-II; Dec 77; 50 pp  
#FRA/ORD-77/45.II

## ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-589

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Springfield, Virginia; 22161; PB-277947/8ST

08 179112

A STUDY OF STATE PROGRAMS FOR RAIL-HIGHWAY GRADE CROSSING  
IMPROVEMENTS

Gertler, JB

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

Final Rpt.; #DOT-TSC-FRA-78-3; Feb 78; 174 pp; Tabs.; 7 Ref.;  
6 App.  
#FRA-OPPD-78-7

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-279774/AS; DOTL RP

08 197314

ANALYSIS OF NPRM STROBE LIGHTS ON LOCOMOTIVES

Priest, WC  
Knoblauch, K

IOCS, Incorporated; Waltham, Massachusetts; 02154  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

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FT-Contract; CN-DOT-FR-7-505226

## ORDER FROM:

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08 186108

RAILROAD GRADE CROSSING PASSIVE SIGNING STUDY

Kozio, JS, Jr  
Mengert, PH

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Highway Administration; Office of Research, 400 7th  
Street, SW; Washington, D.C.; 20590

Final Rpt.; #FHWA-RD-78- 34; Aug 78; 68 p.  
#DOT-TSC-FHWA-78-6

ORDER FROM:  
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08 191455

SUMMARY STATISTICS OF THE NATIONAL RAILROAD - HIGHWAY  
CROSSING INVENTORY FOR PUBLIC AT-GRADE CROSSINGS. SECOND  
EDITION. INVENTORY STATUS AS OF MAY 1978

Hitz, JS

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
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Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-78-19; Sep 78; 156 p.  
#FRA/OPPD-78/20

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12 136814

A COMPREHENSIVE RAILROAD SAFETY REPORT (INCLUDING AN  
ANALYSIS OF THE STATE PARTICIPATION PROGRAM)

Federal Railroad Administration; Office of Safety; Washington,  
D.C.; 20590

#FRA/RSS-7601; 17 Mar 76; 359p

ACTIVITY DATA:  
FT-Contract; CN-DOT-FR-53060

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12 147714

EVALUATION OF ACCIDENTS REPORTED ON FRA FORMS UNDER  
"CAUSE CODE NOT LISTED" CATEGORIES

Hawthorne, KL  
Popjoy, MA

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; Project S-003

Res. Rpt.; #R-222; Mar 76; 28 pp; 3 Tab.; 2 App.

ORDER FROM:  
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Federal Street; Chicago, Illinois; 60616; DOTL RP

12 139539

ANALYSIS OF NINE YEARS OF RAILROAD ACCIDENT DATA 1966-1974

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Taylor, CE

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

Res. Rpt.; #No. R-223; Apr 76; 136 pp; Figs.; Tabs.

ORDER FROM:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; DOTL RP

12 141582

AN OPERATIONAL DEMONSTRATION OF TRAILING END VISIBILITY  
ENHANCEMENT DEVICES FOR COMMUTER RAILROAD TRAINS

Englund, DB

Illinois Department of Transportation; 300 North State Street;  
Chicago, Illinois; 60610

Final Rpt.; #FRA-ORD-76-292; Jun 76; 129 pp; 12 Fig.; 5 Tab.;  
11 Ref.; 1 App.

ORDER FROM:  
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12 146295

DEVELOPMENT OF A MOBILE TREATMENT SYSTEM FOR HANDLING  
SPILLED HAZARDOUS MATERIALS  
FINAL REPT

Gupta, MK

Envirex, Incorporated; Environmental Sciences Division, 5103  
West Beloit Road; Milwaukee, Wisconsin; 53214;  
EPA-ROAP-21AVN-021  
Environmental Protection Agency; Office of Research and  
Development; Washington, D.C.; 20460

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ACTIVITY DATA:  
FT-Contract; CN-EPA-68-01-0099

ORDER FROM:  
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12 151169

TRANSPORTATION SYSTEM SAFETY METHODOLOGY

Horodniceanu, M  
Cantilli, EJ  
Shoeman, M  
Pignataro, LJ

Polytechnic Institute of New York; 333 Jay Street; Brooklyn,  
New York; 11201  
Department of Transportation; Office of University Research;  
Washington, D.C.; 20590

Final Rpt.; #TR-76-505; Nov 76; 147 pp  
#DOT/TST-77/17

ACTIVITY DATA:  
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Springfield, Virginia; 22161; PB-262793/3ST; DOTL NTIS

12 157700

ANALYSIS OF NINE YEARS OF RAILROAD PERSONNEL CASUALTY DATA

Shulman, AE

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

#R-252; Nov 76; 96 pp; 25 Fig.; Tabs.; 3 App.

ORDER FROM:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; DOTL RP

10 152663

TRAIN GENERATED AIR CONTAMINANTS IN THE TRAIN CREW'S WORKING  
ENVIRONMENT

Hobbs, JR  
Walter, RA  
Hard, T  
Devoe, DB

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142; DOT-TSC-FRA-76-34

Final Rpt.; #FRA/ORD-77/08; Feb 77; 52 pp

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National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-265355/AS; DOTL NTIS

07 155352

MAINTAINING ALERTNESS IN RAILROAD LOCOMOTIVE CREWS

Devoe, DB  
Abernethy, CN

Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-76-29; Mar 77; 68 pp; 4 Fig.; 4 Tab.;  
Refs.  
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Springfield, Virginia; 22161; PB-266273/2ST; DOTL NTIS

12 168782

## A SUMMARY OF ACCIDENTS RELATED TO NON-NUCLEAR ENERGY

Krickenberg, K  
Clifford, PMitre Corporation; 1820 Dolley Madison Boulevard; McLean,  
Virginia; 22101  
Environmental Protection Agency; Office of Research and  
Development, 401 M Street, SW; Washington, D.C.; 20460Exec Rpt.; #M76-88; May 77; 19 pp  
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## ACTIVITY DATA:

FT-Contract; CN-EPA-68-01-3188

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-271506/8ST

12 169279

## MANPOWER ANALYSIS IN TRANSPORTATION SAFETY

Bauer, CS  
Bowden, HM  
Colford, CA  
DeFilipps, PJ  
Dennis, JOFlorida Technological University; Transportation Systems  
Institute; Orlando, Florida; 32816  
Department of Transportation; Office of University Research,  
400 7th Street, SW; Washington, D.C.; 20590

Final Rpt.; #DOT/TST-77/40; May 77; 359 pp

## ACTIVITY DATA:

FT-Contract; CN-DOT-OS-40020

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-275445/5ST

24 163789

## PUTTING RESEARCH TO WORK FOR A SAFER RAILROAD

Lind, EF; Southern Pacific Transportation Company

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

Conf Paper; #FRA/ORD-77/13; Jul 77; pp 24-32

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
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## RAILROAD EMPLOYEE FATALITIES INVESTIGATED IN 1975

Federal Railroad Administration; Office of Safety; Washington,  
D.C.; 20590

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02 188060

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Garg, VK; Association of American Railroads Technical CenterAmerican Society of Mechanical Engineers; 345 East 47th  
Street; New York, New York; 10017Conf Paper; #78/WA/RT-3; 07 Jul 78; 8 p.; 10 Fig.; 3 Tab.; 2  
Ref.

## ORDER FROM:

Engineering Societies Library; 345 East 47th Street; New York,  
New York; 10017; DOTL RP

12 190308

## SYSTEMS SAFETY ANALYSIS SUBCOMMITTEE. PHASE I FINAL REPORT

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

#AAR Rpt R-344; Oct 78; 50 p.; 24 Fig.; 14 Tab.; 1 App.

## ORDER FROM:

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; DOTL RP

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26 137424

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TRANSPORTATION RESEARCH INFORMATION SERVICES (TRISNET)  
REGIONAL CENTER IN INFORMATION TRANSFERGustave, JR  
Libman, A  
Jacobson, B  
Silva, J  
Roy, MNorthwestern University; Evanston; Transportation Center;  
Evanston, Illinois; 60201  
Department of Transportation; Office of University Research;  
Washington, D.C.; 20590

Final Rpt.; #DOT/TST/76/36; Oct 75; 39 pp

## ACTIVITY DATA:

FT-Contract; CN-DOT-OS-50090

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National Technical Information Service; 5285 Port Royal Road;  
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## MANAGEMENT OF RAILROAD RESEARCH

24 132970

ORE ORGANIZATION AND ITS STUDIES IN TRACK, SUSPENSION AND  
TRACK/TRAIN INTERFACE

Schrotberger, K; International Union of Railways

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

#FRA ORD 76-243; Oct 75; pp 93-102; 17 Fig.

## ORDER FROM:

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00 132976

HEAVY AXLE LOADS IN NATIONAL RAILWAYS OF MEXICO AND NEED FOR  
STRENGTHENING OF BRIDGES

Diaz, GR; National Railways of Mexico

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

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THROUGH U.S. BILATERAL AGREEMENTSRailroad Research Information Service; 2101 Constitution  
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## ACTIVITY DATA:

FT-Contract; CN-DOT-OS-40022

## ORDER FROM:

Railroad Research Information Service; 2101 Constitution  
Avenue, NW; Washington, D.C.; 20418

24 165083

TECHNICAL PROCEEDINGS OF THE INTERNATIONAL RAILROAD  
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JANUARY, 1977Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Proceeding; Jan 77; 62 pp; 93 Fig.; Refs.

## ORDER FROM:

Federal Railroad Administration; Technology Planning Officer,  
RRD-1, Office of R&D; Washington, D.C.; 20590; DOTL RP

01 167341

## U.S.-U.S.S.R. RAIL INSPECTION INFORMATION EXCHANGE

Becker, FL

Battelle Memorial Institute/Pacific Northwest Labs; Battelle  
Boulevard, P.O. Box 999; Richland, Washington; 99352  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

Final Rpt.; #DOT-TSC-FRA-77-6; Jun 77; 90 pp  
#FRA/ORD/77-35

## ACTIVITY DATA:

FT-Contract; CN-DOT-TSC-979

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-272612/3ST

03 179124

REPORT ON THE 5TH INTERNATIONAL WHEELSETS CONGRESS, TOKYO,  
JAPAN, 20-23 OCTOBER 1975

Bray, DE

Oklahoma University; School of Aerospace, Mechanical & Nuclear  
Engineering; Norman, Oklahoma; 73069

Spec Rpt.; #FRA/ORD-77/65; Oct 77; 17 pp; Figs.

## ACTIVITY DATA:

FT-Contract; CN-DOT-OS-40091

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
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04 196988

OBSERVATIONS BY U.S. RAILROAD DELEGATION OF SOVIET ELECTRIC  
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Spanton, DL; Editor

Federal Railroad Administration; Office of Freight Systems,  
RRD-10; Washington, D.C.; 20590

Final Rpt.; #FRA/ORD-79/16; Mar 79; 84 p.; 8 App.

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National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; DOTL NTIS

## RAILROADS AND NATIONAL DEFENSE

24 165090

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Interstate Commerce Commission; Rail Services Planning Office;  
Washington, D.C.; 20036

#Issue Paper 6; 12 Aug 77; 61 pp; 4 Fig.

## ORDER FROM:

Interstate Commerce Commission; Rail Services Planning Office;  
Washington, D.C.; 20036

## INDUSTRY OVERVIEWS

25 147680

NATIONAL TRANSPORTATION TRENDS AND CHOICES TO THE YEAR 2000

Coleman, WT, Jr

Office of the Secretary of Transportation; 400 7th Street, SW;  
Washington, D.C.; 20590

Army Corps of Engineers; Department of the Army, Forestal  
Building; Washington, D.C.; 20314  
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## ORDER FROM:

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Washington, D.C.; 20402; PB-282230/2ST  
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24 196985

THE U.S. RAILROADS: SOME ALTERNATIVES FOR IMPROVEMENT

Sussman, JM  
Martland, CD  
Juster, RD  
Kruger, JA  
Michaels, L  
Gray, R

Multisystems, Incorporated; 1050 Massachusetts Avenue;  
Cambridge, Massachusetts; 02138  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

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## ACTIVITY DATA:

FT-Contract; CN-DOT-FRA-757-5266

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-295793/AS; DOTL NTIS

24 196986

ORGANIZATION OF NEEDED PROGRAMS WITHIN THE NATIONAL RAIL TRANSPORTATION SYSTEM

Reebie, RS  
Robertson, AC

Reebie (Robert) and Associates, Incorporated; P.O. Box 1436,  
200 Railroad Avenue; Greenwich, Connecticut; 06830

Final Rpt.; #FRA-OPPD-79-3; Jan 79; 205 p.; Figs.; Tabs.; 10  
App.

## ACTIVITY DATA:

FT-Contract; CN-DOT-FRA-760-5271

## ORDER FROM:

National Technical Information Service; 5285 Port Royal Road;  
Springfield, Virginia; 22161; PB-297116/AS; DOTL NTIS

24 196930

THE RAILROAD SITUATION: A PERSPECTIVE ON THE PRESENT, PAST AND FUTURE OF THE RAILROAD INDUSTRY

Urba, CE  
Reebie, RS  
Liba, CJ  
Keale, MJ  
Isacowitz, DA  
Katz, JS  
Stone, PV  
Robertson, AC  
Singer, L

Reebie (Robert) and Associates, Incorporated; P.O. Box 1436,  
200 Railroad Avenue; Greenwich, Connecticut; 06830  
Federal Railroad Administration; Office of Policy and Program  
Development; Washington, D.C.; 20590

Final Rpt.; #FRA/OPPD-79-7; Mar 79; 500 p.; Figs.; Tabs.

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## Ongoing Research

### PLANNING

#### CORPORATE STRUCTURE OF RAILROAD INDUSTRY

24 159650

##### AMERICAN RAILWAY SYSTEM STUDY

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Policy and Program  
Development; 400 7th Street, SW; Washington, D.C.; 20590

INVESTIGATOR:  
Boone, JW; #(202) 426-9682  
Till, TA; #(202) 426-0382

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Completed; RD-Sep 79; SD-Aug 77

#### TRANSPORT DEMAND AND COMMODITY FLOW

24 179528

##### ECONOMIC ANALYSIS PROGRAM

PERFORMING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79

25 193783

##### PLANNING FOR REGIONAL ECONOMIC DEVELOPMENT

PERFORMING AGENCY:  
Massachusetts Institute of Technology; 77 Massachusetts  
Avenue; Cambridge, Massachusetts; 02139

INVESTIGATOR:  
Polenske, KR

FUNDING AGENCY:  
Economic Development Administration; 14th Between E Street and  
Constitution Avenue, NW; Washington, D.C.; 20231  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Apr 79; SD-Oct 76; DC-Mar 80 EST

### PLANT AND EQUIPMENT

#### TRACK SYSTEMS

01 188658

##### RAILROAD TRACK STRUCTURES RESEARCH

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Zaremski, AM; #(312) 567-3622

FUNDING AGENCY:  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Jan 79; DC-May 80 EST; TF-\$316190;  
FT-Contract; CN-DOT-TSC-1541

01 081797

##### INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 1--TRACK STRUCTURES

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Abbott, RA; #(312) 567-3616

FUNDING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jan 75; DC-78 Est

01 038974

##### CONTINUOUS MEASUREMENT OF DYNAMIC COMPLIANCE CHARACTERISTICS OF RAILROAD TRACK. PHASE 3

PERFORMING AGENCY:  
Battelle Memorial Institute; 505 King Avenue; Columbus, Ohio;  
43201

INVESTIGATOR:  
Kaiser, WD; #(614) 424-4505

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-May 73; DC-81; TF-\$345649;  
FT-Contract; CN-DOT-FR-30051; CT-CPFF

01 038973

##### RAILROAD TRACK STRUCTURES RESEARCH

PERFORMING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Illinois University, Urbana; Department of Civil Engineering;  
Urbana, Illinois; 61801

INVESTIGATOR:  
Zaremski, AM; #(312) 567-3622  
Thompson, MR; #(217) 333-3930

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-May 73; DC-Sep 79 EST; TF-\$823097;  
FT-Contract; CN-DOT-FR-30038; CT-CR

#### TRACK STRENGTH

01 170616

##### TRACK STRENGTH CHARACTERIZATION PROGRAM

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; K103

INVESTIGATOR:  
Zaremski, AM; #(312) 567-3622

FUNDING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jan 78

01 170783

##### DOCUMENTATION AND TESTING OF MULTI-LINEAR PORTION OF FINITE ELEMENT PROGRAM FOR ANALYSIS OF TRACK STRUCTURE

PERFORMING AGENCY:  
Canadian Institute of Guided Ground Transport; Queen's  
University; Kingston, Ontario K7L 3N6; Canada; PRO-822

INVESTIGATOR:  
Turke, DJ; #(613) 547-5714  
Raymond, GP

FUNDING AGENCY:  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Aug 77; DC-Aug 79 EST; TF-\$25150;  
FT-Contract; CN-D-500-372-3

## RAILS

01 099396

## ACOUSTICAL EMISSION MONITORING OF FIELD AND PLANT WELDS

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

## FUNDING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Aug 77

01 139163

## ENGINEERING ANALYSIS OF STRESS IN RAILS

## PERFORMING AGENCY:

Battelle Columbus Laboratories; 505 King Avenue; Columbus,  
Ohio; 43201

## INVESTIGATOR:

Sampath, S; #(614) 424-4597

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Transportation Systems Center; Office of Ground Systems; 55  
Broadway; Cambridge, Massachusetts; 02142

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jun 75; DC-May 79 EST; TF-\$429000;  
FT-Contract; CN-DOT-TSC-1038

01 099393

## PROGRAM FOR INVESTIGATION OF RAIL FAILURES

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

## FUNDING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
American Iron and Steel Institute; 150 East 42nd Street; New  
York, New York; 10017  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

## ACTIVITY DATA:

AS-Active; RD-Aug 77

## TIES

01 138568

## COOPERATIVE RESEARCH PROGRAM ON TIMBER CROSS TIE DEVELOPMENT

## PERFORMING AGENCY:

Forest Products Laboratory; P.O. Box 5130; Madison, Wisconsin;  
53705  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Geimer, RL; #(608) 257-2211  
Youngquist, JA

## FUNDING AGENCY:

Forest Products Laboratory; P.O. Box 5130; Madison, Wisconsin;  
53705  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-73

## BALLAST

00 179327

## RAILROAD BALLAST AND SUBGRADE REQUIREMENTS STUDY

## PERFORMING AGENCY:

Goldberg, Zoino, Dunncliff and Associates; 30 Tower Road;  
Newton Upper Falls, Massachusetts; 02164; DOT-TSC-1527

## INVESTIGATOR:

Simon, R; #(617) 244-4100

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 78; DC-Jan 80 EST; TF-\$326400;  
FT-Contract; CN-DOT-TSC-1527

01 196745

## SOIL AND BALLAST INVESTIGATION

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616; K104

## INVESTIGATOR:

So, W; #(312) 567-3599

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

## ACTIVITY DATA:

AS-Active; RD-Jul 79; SD-Jan 79

## MAINTENANCE-OF-WAY

01 188649

## MAINTENANCE-OF-WAY PLANNING PROGRAM

## PERFORMING AGENCY:

ENSCO, Incorporated; 2560 Huntington Avenue; Alexandria,  
Virginia; 22303; 437

## INVESTIGATOR:

Kenworthy, M; #(703) 960-8500

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jan 78; DC-Feb 80 EST; TF-\$362956;  
FT-Contract; CN-DOT-FR-64113

01 170618

## A THEORY FOR TRACK MAINTENANCE LIFE PREDICTION

## PERFORMING AGENCY:

State University of New York, Buffalo; Department of Civil  
Engineering; Buffalo, New York; 14214

## INVESTIGATOR:

Selig, ET; #(716) 831-3113

## FUNDING AGENCY:

Department of Transportation; Office of University Research,  
Res & Special Program Admin; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 77; DC-Oct 79 EST; FT-Contract;  
CN-DOT-OS-70058

01 188648

## MAINTENANCE-OF-WAY: TRACK LAYING SYSTEMS (TLS)

## PERFORMING AGENCY:

Unified Industries, Incorporated; 5400 Cherokee Avenue;  
Alexandria, Virginia; 22312

## INVESTIGATOR:

Cataldi, GR; #(703) 750-3282  
Elkheim, D  
Larsen, K

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and  
Development/Office of Freight Systems; Washington, D.C.;  
20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 78; DC-Mar 80 EST; TF-\$220000;  
FT-Contract; CN-DOT-FR-8046

01 188650

## MASTER PLAN FOR EVALUATION OF MAINTENANCE-OF-WAY EQUIPMENT

## PERFORMING AGENCY:

De Leuw, Cather and Company; 1201 Connecticut Avenue, NW;  
Washington, D.C.; 20036; DOT-FR-8028

## INVESTIGATOR:

Shipley, RL; #(202) 452-0860

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and  
Development/Office of Freight Systems; Washington, D.C.;  
20590

## ACTIVITY DATA:

AS-Completed; RD-Aug 79; SD-Mar 78; DC-Mar 79 EST; TF-\$158843;  
FT-Contract; CN-DOT-FR-8028



# TRADE-OFFS: WAY-AND STRUCTURE-INVESTMENT VERSUS EQUIPMENT INVESTMENT

03 170665

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS: PHASE III. TASK 4--FUTURE SYSTEM STUDIES

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Punwani, SK; #(312) 567-3601  
Sammon, JP; #(202) 293-4027

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-78; DC-80

## ENERGY SYSTEMS

16 196749

## ALTERNATE FUELS FOR MEDIUM-SPEED DIESEL ENGINES

PERFORMING AGENCY:  
Southwest Research Institute; Engine Research & Development, Dept of Engine & Vehicle Res; San Antonio, Texas; 78284; 11-5361

INVESTIGATOR:  
Storment, JO; #(512) 684-5111

FUNDING AGENCY:  
Department of Energy; Asst Secretary for Cons & Solar Appl, Off of Trans Programs; 20 Massachusetts Avenue, NW; Washington, D.C.; 20545  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590  
Association of American Railroads; Research and Test Department; Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Jul 79; SD-Jul 78; DC-Sep 79 EST; TF-\$472000;  
FT-Contract; CN-EM-78-C-01-4266

## TERMINAL AND YARD DESIGN

06 159656

## RAILROAD CLASSIFICATION YARD TECHNOLOGY: NEW CONCEPTS AND ADVANCED TECHNOLOGY IN FREIGHT CAR SPEED CONTROL

PERFORMING AGENCY:  
SRI International; 333 Ravenswood Avenue; Menlo Park, California; 94025

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Jul 78; DC-Oct 79 EST; TF-\$190000

21 170620

## RAILROAD CLASSIFICATION YARD DESIGN METHODOLOGY STUDY

PERFORMING AGENCY:  
SRI International; 333 Ravenswood Avenue; Menlo Park, California; 94025; 6364-1

INVESTIGATOR:  
Wong, PJ; #(415) 326-6200 X2104

FUNDING AGENCY:  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142  
Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Apr 77; DC-Oct 80 EST; TF-\$430000;  
FT-Contract; CN-DOT-TSC-1337

# MEASUREMENT OF DYNAMIC FORCES AND FLAW DETECTION

01 099394

## RAIL FLAW DETECTION SYSTEMS

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Aug 77

06 159657

## RAILROAD CAR PRESENCE DETECTION DEVICES

PERFORMING AGENCY:  
Shaker Research Corporation; Northway 10 Executive Park; Ballston Lake, New York; 12019.

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Sep 78; DC-Nov 79 EST; TF-\$210000

01 179330

## DEVELOPMENT OF DATA PROCESSING FOR AUTOMATIC RAIL FLAW DETECTION

PERFORMING AGENCY:  
Sperry Univac Computer Systems; 7801 Metro Parkway; St Paul, Minnesota; 55165; 01 160047

INVESTIGATOR:  
Phipps, PL; #(612) 456-4872

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Sep 78; TF-\$98773; FT-Contract; CN-DOT-FR-8180

17 188651

## LOCOMOTIVE DATA ACQUISITION PACKAGE (LDAP)

PERFORMING AGENCY:  
California University, Berkeley; Lawrence Berkeley Laboratory; Berkeley, California; 94720

INVESTIGATOR:  
Abbott, RK; #(415) 843-2740 X6450

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 77; DC-Jan 80 EST; TF-\$400000;  
FT-Contract; CN-AR-74348

03 138559

## VEHICLE INSPECTION

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Inspection, Detection and Testing Research Division; 400 7th Street, SW; Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 78; SD-Oct 76

01 059295

## TRACK GEOMETRY MEASUREMENT BY HIGH-RAIL VEHICLES

PERFORMING AGENCY:  
Iowa Department of Transportation; 800 Lincoln Way; Ames, Iowa; 50010

INVESTIGATOR:  
Sherfy, MA; #(515) 296-1222

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Jun 76; DC-Jul 79 EST; TF-\$273415;  
FT-Contract; CN-DOT-FR-64243; CT-CR

03 099439

#### HOT JOURNAL SENSOR AND LOCAL DERAILMENT DETECTOR

PERFORMING AGENCY:  
Naval Surface Weapons Center; White Oak Laboratory; Silver  
Spring, Maryland; 20910

INVESTIGATOR:  
O'Steen, JK

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Sep 79; FT-IA; CN-AR54162

21 170664

#### INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS: PHASE III. TASK 3--TRAIN OPERATION AIDS

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Ambrose, WG; # (312) 567-3649

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-78; DC-80

#### COMPONENT IMPROVEMENTS

#### CREEP AND ADHESION

02 170591

#### EXPERIMENTAL DETERMINATION OF COEFFICIENT OF ROLLING ADHESION IN RAIL TRACTION AND BRAKING

PERFORMING AGENCY:  
Virginia Polytechnic Institute & State University; Blacksburg,  
Virginia; 24061; 808440-1

INVESTIGATOR:  
Whitelaw, RL; # (703) 951-6801

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Feb 78; SD-Sep 76; DC-Aug 79 EST; TF-\$67000

02 081799

#### INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 2--WHEEL/RAIL

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Hawthorne, KL; # (312) 567-3584

FUNDING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-01 Jan 75; DC-78

02 099367

#### PILOT STUDY FOR THE CHARACTERIZATION AND REDUCTION OF WHEEL/RAIL LOADS

PERFORMING AGENCY:  
Battelle Memorial Institute; 505 King Avenue; Columbus, Ohio;  
43201

FUNDING AGENCY:  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jul 75; DC-Jul 79 EST; TF-\$583000;  
FT-Contract; CN-DOT-TSC-1051

#### WHEELS

03 099382

#### WHEEL RESEARCH PROGRAM

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Aug 76

#### TRUCKS

03 081798

#### INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 3--TRUCKS AND SUSPENSION

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Bullock, R

FUNDING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; Canada

ACTIVITY DATA:  
AS-Active; RD-Feb 79; SD-Jan 75; DC-Mar 79 EST

02 138469

#### TRUCK DESIGN OPTIMIZATION PROJECT, PHASE II

PERFORMING AGENCY:  
Wyle Laboratories; 4620 A Edison Street; Colorado Springs,  
Colorado; 80915

INVESTIGATOR:  
De Benedet, D; # (303) 697-4500  
Cappel, K

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 77; DC-Dec 80 EST; TF-\$2639100;  
FT-Contract; CN-DOT-FR-742-4277

03 081787

#### RAILROAD TRUCK SAFETY RESEARCH AND TEST PROJECT

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

INVESTIGATOR:  
Evans, RA; # (312) 567-3598

FUNDING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-73; TF-\$250000

02 188653

## REVIEW AND SUMMARY OF COMPUTER PROGRAMS FOR RAILWAY VEHICLE DYNAMICS

## PERFORMING AGENCY:

Virginia University; School of Engineering and Applied Science; Charlottesville, Virginia; 22904

## INVESTIGATOR:

Pilkey, WD; #(804) 924-3291  
Reid, RE

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Aug 78; DC-Sep 79 EST; FT-Contract; CN-DOT-FR-8076

## VEHICLE DYNAMICS

02 148358

## EXPERIMENTAL RESEARCH ON RAIL VEHICLE SAFETY USING DYNAMICALLY SCALED MODELS

## PERFORMING AGENCY:

Princeton University; Department of Aerospace and Mechanical Sciences; C230 Engineering Quadrangle; Princeton, New Jersey; 08540

## INVESTIGATOR:

Sweet, LM; #(609) 452-5305

## FUNDING AGENCY:

Department of Transportation; Office of University Research; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 78; SD-Jul 77; DC-Jun 79 EST; TF-\$203000; FT-Contract; CN-DOT-OS-60147

## FREIGHT CAR COUPLER AND DRAFT GEAR

03 081786

## RAILROAD COUPLER SAFETY RESEARCH AND TEST PROJECT

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314

## INVESTIGATOR:

Morella, NA; #(216) 229-3400

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-72

03 081801

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 5--COUPLERS, DRAFTGEAR, AND CUSHION UNITS

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Punwani, SK; #(312) 567-3601

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Feb 79; SD-Jan 75; DC-Mar 79 EST

05 157901

## SYSTEMS ENGINEERING FOR BRAKING AND COUPLING SYSTEM DESIGN

## PERFORMING AGENCY:

Bolt, Beranek and Newman, Incorporated; 50 Moulton Street; Cambridge, Massachusetts; 02138

## INVESTIGATOR:

Bender, EK; #(617) 491-1850

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Sep 78; DC-Jan 80 EST; TF-\$350000; FT-Contract; CN-DOT-FR-8091

## OTHER FREIGHT CAR COMPONENTS

03 081800

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 4--CAR STRUCTURES

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Zarembski, AM; #(312) 567-3622

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Feb 79; SD-Jan 75; DC-Mar 79 EST

05 081802

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS--PHASE II. TASK 6--BRAKE SYSTEM

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Misner, GR; #(312) 567-3587

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-01 Jan 75; DC-78

02 170594

## INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF RAIL FREIGHT ROLLING STOCK

## PERFORMING AGENCY:

Hammit (Andrew G) Associates; 30813 Marne Drive; Rancho Palos Verdes, California; 90274  
California Institute of Technology; 1201 East California Street; Pasadena, California; 91125  
Raines Engineering; 1225 North Lance Lane; Anaheim, California; 92806

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Completed; RD-Aug 79; SD-May 78; DC-May 79 EST; TF-\$110728; FT-Contract; CN-DOT-FR-8058

02 170595

## TRAIN RESISTANCE

## PERFORMING AGENCY:

Mitre Corporation; Metrek Division; 1820 Dolley Madison Boulevard; McLean, Virginia; 22101; 06.30.09.200

INVESTIGATOR:  
Muhlenberg, JD; # (703) 790-6692

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jan 77; DC-Jun 80 EST; FT- 30000;

04 099377

FLYWHEEL ENERGY STORAGE SWITCHER (FESS) SYSTEM ENGINEERING

PERFORMING AGENCY:  
Garrett Corporation; 2525 West 190th Street; Torrance,  
California; 90509

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Completed; RD-Aug 79; SD-Sep 77; TF-\$428000; FT-Contract;  
CN-DOT-FR-74247; CT-CPFF

#### TESTING

02 139178

FACILITY FOR ACCELERATED SERVICE TESTING (FAST)

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jan 76

01 139165

COLLECTION AND ANALYSIS OF TEST DATA

PERFORMING AGENCY:  
Portland Cement Association; 5420 Old Orchard Road; Skokie,  
Illinois; 60076

INVESTIGATOR:  
Colley, BE; # (312) 966-6200

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Completed; RD-Aug 79; SD-Jul 71; FT-Contract;  
CN-DOT-TSC-FR-90043

02 160409

LADING DAMAGE PARAMETERS

PERFORMING AGENCY:  
Rutgers University, New Brunswick; Packaging Science and  
Engineering; Piscataway, New Jersey; 08854

INVESTIGATOR:  
Morrow, D; # (201) 932-3679  
Richardson, G  
Vinatoru, M

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development/Office of Freight Systems; Washington, D.C.;  
20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 77; DC-Aug 79 EST; TF-\$125000;  
FT-Contract; CN-DOT-FR-767-4323; CT-CC

17 160402

FAST DATA MANAGEMENT AND ANALYSIS

PERFORMING AGENCY:  
Association Of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 77; DC-Mar 79 EST; TF-\$728307

02 058263

ROLL DYNAMICS UNIT/VIBRATION TEST UNIT FOR U.S. DEPARTMENT  
OF TRANSPORTATION RAIL DYNAMICS LABORATORY

PERFORMING AGENCY:  
Wyle Laboratories; 4620 A Edison Street; Colorado Springs,  
Colorado; 80915

INVESTIGATOR:  
De Benedet, D; # (303) 597-4500

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jul 75; DC-Oct 79 EST; TF-\$10414451;  
FT-Contract; CN-DOT-FR-64200

01 099369

OPERATION OF TEST TRACK AND RAIL INSPECTION EQUIPMENT

PERFORMING AGENCY:  
Transportation Systems Center; 55 Broadway; Cambridge,  
Massachusetts; 02142

FUNDING AGENCY:  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Mar 74; FT-In-House

#### SIGNALS AND TRAFFIC CONTROL

06 138529

TRACK CIRCUIT RESEARCH PROJECT

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
Patel, S; # (312) 567-3618

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 75

06 160400

EVALUATION OF SIGNAL/CONTROL SYSTEM EQUIPMENT AND TECHNOLOGY

PERFORMING AGENCY:  
STV, Incorporated; Pottstown, Pennsylvania; 19464

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-30 Sep 77; DC-Apr 79 EST; TF-\$538294;  
FT-Contract; CN-DOT-FR-773-4236; CT-CPFF

#### LOCOMOTIVE DESIGN

04 179335

ASSESSMENT OF THE PROSPECTS FOR A NEW ENGINE FOR PASSENGER  
AND FREIGHT RAIL SYSTEMS

PERFORMING AGENCY:  
Spriggs, (JO); 9903 Thornwood Road; Kensington, Maryland;  
20795

INVESTIGATOR:  
Spriggs, JO; # (301) 946-3527

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-78; DC-79

04 196748

DUAL-MODE LOCOMOTIVE (DML) SYSTEM ENGINEERING STUDY

PERFORMING AGENCY:  
06.40.00.000

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research & Development, Freight Service Division; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Proposed; RD-Jul 79; SD-Nov 79; DC-Sep 80 EST; TF-\$125000; FT-Contract; CN-RFP-DOT-FR-4462

10 179325

## LOCOMOTIVE IN-CAB NOISE RESEARCH

## PERFORMING AGENCY:

National Bureau of Standards; Gaithersburg, Maryland; 20760; 7353432

## INVESTIGATOR:

Kilmer, RD; #(301) 921-3783

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW, RRD-33; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Sep 76; DC-May 80 EST; FT-Contract; CN-IAG-AR-T4269

02 099390

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS. PHASE II. TASK 10--SPECIAL PROJECT, LOCOMOTIVES

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Garg, VK; #(312) 567-3596

## FUNDING AGENCY:

Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Feb 79; DC-79 Est

## CAR DESIGN

02 059427

## FREIGHT CAR DYNAMICS RESEARCH PROGRAM

## PERFORMING AGENCY:

Clemson University; Clemson, South Carolina; 29631

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-26 Nov 73; DC-Oct 79 EST; TF-\$313787; FT-Contract; CN-DOT-OS-40018; CT-CR

02 188663

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS: PHASE III, TASK 5--ADVANCED FREIGHT CAR RESEARCH

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Manos, WF; #(312) 567-3585

## FUNDING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jan 79; DC-81

03 059420

## PERFORMANCE EVALUATION OF LIGHTWEIGHT INTERMODAL FLAT CARS

## PERFORMING AGENCY:

Atchison, Topeka and Santa Fe Railway; 80 East Jackson Boulevard; Chicago, Illinois; 60604  
ENSCO, Incorporated; 5408-A Port Royal Road; Springfield, Virginia; 22151

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Completed; RD-Sep 79; SD-Aug 76; TF-\$750000; FT-Contract; CN-DOT-FR-65218  
FT-Contract; CN-DOT-FR-64113

02 170663

## INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK TRAIN DYNAMICS: PHASE III. TASK 2--ADVANCED DESIGN METHODOLOGY DEVELOPMENT

## PERFORMING AGENCY:

Association of American Railroads Technical Center; 3140 South Federal Street; Chicago, Illinois; 60616

## INVESTIGATOR:

Hamilton, AB; #(312) 567-3649

## FUNDING AGENCY:

Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street; Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A 2R3; Canada

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-78; DC-80

## ELECTRIFICATION

04 058270

## ELECTRIFICATION AND ELECTRIC TRACTION

## PERFORMING AGENCY:

Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142

## INVESTIGATOR:

Raposa, FL; Manager, Electric Power Systems Group; #617-494-2031

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; CN-PPA-RR-05

16 148321

## ENERGY MANAGEMENT FOR ELECTRIC POWERED TRANSPORTATION SYSTEMS

## PERFORMING AGENCY:

Carnegie-Mellon University; Department of Mechanical Engineering; Frew Avenue and Margaret Morrison; Pittsburgh, Pennsylvania; 15213

## INVESTIGATOR:

Uher, RA; #(412) 578-2960

## FUNDING AGENCY:

Department of Transportation; Office of University Research; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 78; SD-Jul 76; DC-Sep 78 EST; TF-\$170840; FT-Contract; CN-DOT-OS-60129

13 170609

## PARAMETRIC STUDIES FOR RAILROAD ELECTRIFICATION AND TRACTION

## PERFORMING AGENCY:

Jet Propulsion Laboratory; 4800 Oak Grove Drive; Pasadena, California; 91103

## INVESTIGATOR:

Macie, TW; #(213) 354-4432

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Feb 78; SD-01 Oct 77; DC-Oct 78 EST;  
FT-Contract; CN-DOT-AR-30006

## OPERATIONS

## EQUIPMENT UTILIZATION AND MANAGEMENT

21 185236

## FREIGHT CAR UTILIZATION STUDY

## PERFORMING AGENCY:

Massachusetts Institute of Technology; 77 Massachusetts  
Avenue; Cambridge, Massachusetts; 02139

## INVESTIGATOR:

Sussman, JM; # (617) 253-5326  
Martland, CD

## FUNDING AGENCY:

Association of American Railroads; Freight Car Utilization  
Program; 1920 L Street, NW; Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 77; DC-Jul 80 EST; TF-\$500000

17 159625

FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION  
PROGRAM-STRUCTURING ORGANIZATIONAL CONTROL MECHANISMS

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

French, PW; # (202) 293-4165  
Muehlke, RV

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Jul 77; DC-Dec 80 EST; TF-\$55000;  
FT-Contract; CN-DOT-FR-771-5279

21 159626

FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION PROGRAM  
UTILIZATION AND SERVICE RELIABILITY IMPACTS OF OPERATING  
PLANS

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

French, PW; # (202) 293-4165  
Muehlke, RV

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Jul 77; DC-Dec 80 EST; TF-\$185000;  
FT-Contract; CN-DOT-FR-771-5279

21 159627

FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION PROGRAM.  
CAR CYCLE ANALYSIS

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

French, PW; # (202) 293-4165  
Muehlke, RV

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Jul 77; DC-Dec 80 EST; TF-\$60000;  
FT-Contract; CN-DOT-FR-771-5279

17 159628

FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION  
PROGRAM-INDUSTRYWIDE FREIGHT CAR MANAGEMENT

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

French, PW; # (202) 293-4165  
Muehlke, RV

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Jul 77; DC-Dec 80 EST; TF-\$100000;  
FT-Contract; CN-DOT-FR-771-5279

24 159629

FREIGHT CAR UTILIZATION RESEARCH-DEMONSTRATION PROGRAM.  
EMPTY CAR DISTRIBUTION

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

French, PW; # (202) 293-4165  
Muehlke, RV

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Jul 77; DC-Dec 80 EST; TF-\$15000;  
FT-Contract; CN-DOT-FR-771-5279

03 159630

FREIGHT CAR UTILIZATION RESEARCH PROGRAM - PHASE II, TASK 6.  
UTILIZATION IMPACTS OF FREIGHT CAR DESIGN AND SERVICEABILITY

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Feb 78; SD-Jul 77; DC-Sep 77 EST; TF-\$92500; FT-  
92500

17 138526

MISSOURI PACIFIC'S COMPUTERIZED FREIGHT CAR SCHEDULING  
SYSTEM

## PERFORMING AGENCY:

Missouri Pacific Railroad Company; Missouri Pacific Building,  
210 North 13th Street; St Louis, Missouri; 63103

## INVESTIGATOR:

Sines, GS

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Feb 79; SD-Nov 75; DC-Aug 79 EST; TF-\$5500000;  
FT-Contract; CN-DOT-FR-65139

## MANAGEMENT

## RESOURCE PRODUCTIVITY

21 138527

## CHICAGO TERMINAL PROJECT

## PERFORMING AGENCY:

Federal Railroad Administration; Task Force on Rail Trans of  
Labor/Management Committee; 400 7th Street, SW; Washington,  
D.C.; 20590

## INVESTIGATOR:

Adamson, E  
McGuire, T

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railroad Labor Organizations

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 76; DC-Dec 80 EST; TF-\$495000

21 188662

## BUFFALO TERMINAL PROJECT

## PERFORMING AGENCY:

Conrail Task Force on Rail Transportation; 824 Ohio Street;  
Buffalo, New York; 14203

## INVESTIGATOR:

Bethge, C; #(716) 856-5940  
Morey, J

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
State Government of New York; Albany, New York  
Consolidated Rail Corporation; 1434 Six Penn Center Plaza;  
Philadelphia, Pennsylvania; 19104  
Railroad Labor Unions

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 78; DC-Dec 79 EST; TF-\$200000;  
FT-Contract; CN-DOT-FR-8186

21 170622

## ST. LOUIS TERMINAL PROJECT

## PERFORMING AGENCY:

Federal Railroad Administration; Task Force on Rail Trans of  
Labor/Management Committee; Washington, D.C.; 20590

## FUNDING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railroad Labor Organizations

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-May 76; DC-Dec 80 EST; TF-\$300000;  
FT-Contract; CN-75232

21 157598

## HOUSTON TERMINAL PROJECT

## PERFORMING AGENCY:

Federal Railroad Administration; Task Force on Rail Trans of  
Labor/Management Committee; Washington, D.C.; 20590

## INVESTIGATOR:

Joiner, D; #(713) 224-3662  
Dessens, F; #(713) 224-3662

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railroad Labor Unions

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Aug 77; DC-Dec 80 EST; TF-\$195000;  
FT-Contract; CN-DOT-FR-75244; CT-CC

21 196742

## CHICAGO INTERMODAL TERMINAL ROADWAY PROJECT

## PERFORMING AGENCY:

Barton-Aschman Associates, Incorporated; 820 Davis Street;  
Evanston, Illinois; 60201  
Kearney (AT) and Company, Incorporated; 100 South Wacker  
Drive; Chicago, Illinois; 60606  
Murphy Engineering Incorporated; 224 South Michigan Avenue;  
Chicago, Illinois; 60604  
Ripley Mead; Chicago, Illinois

## INVESTIGATOR:

Powells, M; #(312) 491-1000  
Davidson, W  
Hartigan, M

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Jul 79; SD-Sep 78; DC-Dec 79 EST; TF-\$250000;  
FT-Contract; CN-DOT-FR-8156

21 159653

## INTERMODAL SYSTEM DEMONSTRATION

## PERFORMING AGENCY:

Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

## INVESTIGATOR:

Minger, WK; #(202) 293-5323

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Feb 79; SD-77; DC-80 Est; TF-\$1300000

21 160398

## SYSTEMS ENGINEERING FOR INTERMODAL FREIGHT SYSTEMS-PHASE 1

## PERFORMING AGENCY:

Kearney (AT) and Company Incorporated; 1800 M Street, NW;  
Washington, D.C.; 20036  
Peat, Marwick, Mitchell and Company; 1025 Connecticut Avenue,  
NW; Washington, D.C.; 20036

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-Aug 77; DC-80 Est; TF-\$500000;  
FT-Contract; CN-DOT-FR-749-4273; CT-FPP  
FT-Contract; CN-DOT-FR-748-4336; CT-FPP

22 138481

## RAIL WHEAT TRANSPORT EFFICIENCY STUDY

## PERFORMING AGENCY:

Texas Transportation Institute; Texas Transportation  
Institute; Texas A&M University; College Station, Texas;  
77843

## INVESTIGATOR:

Bridges, S; #(713) 845-5814

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Apr 76; DC-Oct 79 EST; TF-\$630000;  
FT-Contract; CN-DOT-FR-65104

## RAILROAD COSTS

18 177624

## COSTING OF RAIL SERVICE

## PERFORMING AGENCY:

Northwestern University; Evanston; Transportation Center;  
Leverone Hall, 2001 Sheridan Road; Evanston, Illinois;  
60201; 425

## INVESTIGATOR:

Daugherty, AF; #(312) 492-5183  
Turnquist, M

## FUNDING AGENCY:

Department of Transportation; Office of University Research,  
RM 9413, Nassif Bldg; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-01 Sep 77; DC-Oct 80 EST; TF-\$123996;  
FT-Contract; CN-DOT-OS-70061

18 129724

## FREIGHT CAR AND LOCOMOTIVE COSTING

## PERFORMING AGENCY:

Peat, Marwick, Mitchell and Company; 1025 Connecticut Avenue,  
NW; Washington, D.C.; 20036  
Southern Railway System; 920 15th Street, NW; Washington,  
D.C.; 20005  
Reebie (Robert) and Associates, Incorporated; P.O. Box 1436,  
200 Railroad Avenue; Greenwich, Connecticut; 06830

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Inactive; RD-Sep 79; SD-30 Jun 75; TF-\$485021; FT-Contract;  
CN-DOT-FR-55055

18 129729

## RAILROAD YARD OPERATIONS COSTING METHODOLOGY

## PERFORMING AGENCY:

Haskins and Sells; 2500 Three Girard Plaza; Philadelphia, Pennsylvania; 19102  
Seaboard Coast Line Railroad; 500 Water Street; Jacksonville, Florida; 33202  
Whitten (Herbert O) and Associates; 7203 Poplar Street; Annandale, Virginia; 22003

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Inactive; RD-Sep 79; SD-30 Jun 76; TF-\$482299; FT-Contract; CN-DOT-FR-65135

18 138514

## GENERAL AND ADMINISTRATIVE SERVICES COSTING METHODOLOGY

## PERFORMING AGENCY:

Price Waterhouse and Company; 1 Federal Street; Boston, Massachusetts; 02110

## INVESTIGATOR:

Scanlan, J

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 78; DC-Dec 77 EST; FT-Contract; CN-DOT-FR-5167

## HUMAN RESOURCES STUDIES

17 148350

## EMPLOYEE INFORMATION SYSTEM. PHASE I

## PERFORMING AGENCY:

Booz-Allen Applied Research, Incorporated; 4733 Bethesda Avenue; Bethesda, Maryland; 20014

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Completed; RD-Aug 79; SD-Sep 76; DC-May 77 EST; TF-\$69768; FT-Contract; CN-DOT-FR-T5164

07 148352

## ALCOHOL AND DRUG ABUSE PROGRAMS IN THE RAIL INDUSTRY: PHASE II

## PERFORMING AGENCY:

University Research Corporation; 5530 Wisconsin Avenue; Chevy Chase, Maryland; 20015

## INVESTIGATOR:

Mannelo, T; (301) 524-3936

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Transportation Systems Center; 55 Broadway; Cambridge, Massachusetts; 02142

## ACTIVITY DATA:

AS-Active; RD-Aug 79; SD-Jul 77; DC-Dec 79 EST

07 170590

## CONFERENCES ON RAILROAD PERSONNEL DEVELOPMENT/ASSISTANCE

## FUNDING AGENCY:

Federal Railroad Administration; Office of Policy and Program Development; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 78; SD-Apr 75

## INTEGRATION OF MANAGEMENT INFORMATION SYSTEMS AND MANAGEMENT SYSTEMS

17 196741

## INTERMODAL MANAGEMENT INFORMATION SYSTEM PHASE II AND III

## PERFORMING AGENCY:

PRC Systems Sciences Company; 7600 Old Springhouse Road; McLean, Virginia; 22101

## INVESTIGATOR:

Peternick, J; (202) 893-1800  
Fredrickson, V  
Pflugrad, A  
Rynders, B

## FUNDING AGENCY:

Federal Railroad Administration; Office of Research and Development; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Jul 79; SD-Sep 77; DC-80; TF-\$1100000; FT-Contract; CN-DOT-FR-741-5157

17 159631

## RAILROAD OPERATIONS MODULAR PROCESSING SYSTEMS (ROMPS)

## PERFORMING AGENCY:

Ocean Data Systems Incorporated; 6000 Executive Boulevard; Rockville, Maryland; 20852

## INVESTIGATOR:

Bochner, A; (301) 881-3031

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590  
Association of American Railroads; 1920 L Street, NW; Washington, D.C.; 20036

## ACTIVITY DATA:

AS-Active; RD-Feb 79; SD-17 Jul 76; DC-Aug 79 EST; TF-\$700000;

## GENERAL

## SAFETY

## HUMAN FACTORS

07 049659

## HUMAN FACTORS IN RAILROAD OPERATIONS

## PERFORMING AGENCY:

Federal Railroad Administration; Office of Rail Safety Research; Washington, D.C.; 20590

## INVESTIGATOR:

Devoe, DB

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Aug 77

## GRADE CROSSING

08 159654

## GRADE CROSSING SAFETY

## PERFORMING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## FUNDING AGENCY:

Federal Railroad Administration; 400 7th Street, SW; Washington, D.C.; 20590

## ACTIVITY DATA:

AS-Active; RD-Sep 79; SD-77; TF-\$800000

08 049658

## RAIL SAFETY/GRADE CROSSINGS PROTECTION

## PERFORMING AGENCY:

Federal Railroad Administration; Office of Rail Safety Research; Washington, D.C.; 20590



INVESTIGATOR:  
Hopkins, JB; # (617) 494-2023

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 77

# TANK CAR

12 099436

RAILROAD TANK CAR SAFETY RESEARCH AND TEST PROJECT. PHASE  
1 - ACCIDENT DATA COLLECTION

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-70

12 099424

RAILROAD TANK CAR SAFETY RESEARCH AND TEST PROJECT. PHASE  
2 - ACCIDENT DATA ANALYSIS

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-70

26 099429

RAILROAD TANK CAR SAFETY RESEARCH AND TEST PROJECT, PHASE  
4 - LITERATURE REVIEW

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-70

12 099428

RAILROAD TANK CAR SAFETY RESEARCH AND TEST PROJECT. PHASE  
6 - SAFETY VALVE DISCHARGE CAPACITY

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-70

03 099426

RAILROAD TANK CAR SAFETY RESEARCH AND TEST PROJECT. PHASE  
9 - DESIGN STUDY-TANKS AND ATTACHMENTS

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314

ACTIVITY DATA:  
AS-Active; RD-Aug 79

12 138567

# SAFETY VALVE STUDY

PERFORMING AGENCY:  
Maryland University, College Park; College Park, Maryland;  
20742

INVESTIGATOR:  
Sallet, DW; # (301) 454-4216 Ext 4

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jun 76; DC-Feb 80 EST; PT-Contract;  
CN-DOT-FR-64181

09 058267

METALLURGICAL TESTS AND ANALYSIS FOR HAZARDOUS MATERIAL  
RAILROAD TANK CARS

PERFORMING AGENCY:  
National Bureau of Standards; Institute for Materials,  
Metallurgy Division; Washington, D.C.; 20234

INVESTIGATOR:  
Interrante, CG; #301-921-2997

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Sep 73; DC-Sep 79 EST; CN-AR-40008

# MISCELLANEOUS

12 099392

# LOCOMOTIVE CAB SAFETY

PERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

FUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railroad Labor Organizations

ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-73

12 099389

# RAIL VEHICLE SAFETY RESEARCH PROGRAM

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 77

09 138558

# SAFETY LIFE-CYCLE TESTING

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Inspection,  
Detection and Testing Research Division; 400 7th Street, SW;  
Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Oct 77

03 138565

# ROLLING STOCK SAFETY

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590

FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590

ACTIVITY DATA:  
AS-Active; RD-Aug 77; SD-Jul 76

05 159634

DESIGN AND FABRICATION OF A WAYSIDE BRAKE INSPECTION SYSTEM  
FOR RAILROAD VEHICLESPERFORMING AGENCY:  
Novatek Incorporated; 79R Terrace Hall Avenue; Burlington,  
MassachusettsINVESTIGATOR:  
Spaulding, D; #(617) 272-6230FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Jan 77; DC-Jun 79 EST; TF-\$77753;  
FT-Contract; CN-DOT-TSC-1323

01 138561

## AUTOMATED TRACK INSPECTION, SYSTEM DEVELOPMENT

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Inspection,  
Detection and Testing Research Division; 400 7th Street, SW;  
Washington, D.C.; 20590FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jul 75

01 138560

## TRACK INSPECTION AND TESTING

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Inspection,  
Detection and Testing Research Division; 400 7th Street, SW;  
Washington, D.C.; 20590FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jul 75

09 138557

## IMPROVED INSPECTION, DETECTION AND TESTING RESEARCH

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Inspection,  
Detection and Testing Research Division; 400 7th Street, SW;  
Washington, D.C.; 20590FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jul 75

01 099378

## IMPROVED INSPECTION, DETECTION AND TESTING RESEARCH

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Rail Safety  
Research; Washington, D.C.; 20590FUNDING AGENCY:  
Federal Railroad Administration; Office of Research and  
Development; Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Feb 78; TF-\$6245000

01 138563

## TRACK ACCIDENT REDUCTION RESEARCH SUBPROGRAM

PERFORMING AGENCY:  
Federal Railroad Administration; Improved Track Structures  
Research Division; 400 7th Street, SW; Washington, D.C.;  
20590FUNDING AGENCY:  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 78; SD-Jul 75

12 188661

## RAIL SAFETY INFORMATION SYSTEM

PERFORMING AGENCY:  
Federal Railroad Administration; Office of Safety, Reports and  
Analysis Division; Washington, D.C.; 20590FUNDING AGENCY:  
Federal Railroad Administration; Office of Safety, Reports and  
Analysis Division; Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 79

## PUBLIC ENTERPRISE: INTERFACES, INTERACTIONS, AND MANAGEMENT

25 185242

THE DEVELOPMENT OF DECISION CRITERIA FOR RAIL USAGE IN  
ARKANSASPERFORMING AGENCY:  
Arkansas State University; Department of Business  
Administration & Economics; State University, Arkansas;  
72467INVESTIGATOR:  
Kaminarides, J; #(501) 972-3037FUNDING AGENCY:  
Arkansas State Highway & Transportation Department; 9500 New  
Benton Highway, P.O. BOX 2261; Little Rock, Arkansas; 72203;  
Federal Highway Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590ACTIVITY DATA:  
AS-Completed; RD-Aug 79; SD-Feb 78; DC-Mar 79 EST; TF-\$29651

25 188665

## STATE RAIL PROGRAM EVALUATION

PERFORMING AGENCY:  
Ernst and Ernst; 1225 Connecticut Avenue, NW; Washington,  
D.C.; 20036INVESTIGATOR:  
Tyndall, GR; #(202) 862-6000  
Taggart, RE  
Swartz, DJ  
Walker, NFUNDING AGENCY:  
Department of Transportation; Office of Procurement;  
Washington, D.C.; 20590  
Federal Railroad Administration; Office of State Assistance  
Programs; Washington, D.C.; 20590ACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-Sep 78; DC-Oct 79 EST; TF-\$134000;  
FT-Contract; CN-DOT-FR-8211

## MANAGEMENT OF RAILROAD RESEARCH

07 170662

INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON TRACK  
TRAIN DYNAMICS: PHASE III. TASK 1--TTD TECHNOLOGY SHARING  
AND IMPLEMENTATIONPERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616INVESTIGATOR:  
Zotti, RF; #(312) 567-3585  
Miller, CJFUNDING AGENCY:  
Association of American Railroads; 1920 L Street, NW;  
Washington, D.C.; 20036  
Federal Railroad Administration; 400 7th Street, SW;  
Washington, D.C.; 20590  
Railway Progress Institute; 801 North Fairfax Street;  
Alexandria, Virginia; 22314  
Transport Canada Research and Development Centre; 1000  
Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
2R3; CanadaACTIVITY DATA:  
AS-Active; RD-Aug 79; SD-78; DC-80

02 081803

INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON  
TRACK TRAIN DYNAMICS--PHASE II. TASK 7--TEST MANAGEMENTPERFORMING AGENCY:  
Association of American Railroads Technical Center; 3140 South  
Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
 Darien, NJ; #(312) 567-3621

FUNDING AGENCY:  
 Association of American Railroads Technical Center; 3140 South  
 Federal Street; Chicago, Illinois; 60616  
 Federal Railroad Administration; 400 7th Street, SW;  
 Washington, D.C.; 20590  
 Railway Progress Institute; 801 North Fairfax Street;  
 Alexandria, Virginia; 22314  
 Transport Canada Research and Development Centre; 1000  
 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
 2R3; Canada

ACTIVITY DATA:  
 AS-Active; RD-Feb 79; SD-Jan 75; DC-Mar 79 EST

02 081805

INTERNATIONAL GOVERNMENT-INDUSTRY RESEARCH PROGRAM ON  
 TRACK TRAIN DYNAMICS--PHASE II. TASK 8--PROGRAM ANALYSIS

PERFORMING AGENCY:  
 Association of American Railroads Technical Center; 3140 South  
 Federal Street; Chicago, Illinois; 60616

INVESTIGATOR:  
 McGovern, WR; #(312) 567-3617

FUNDING AGENCY:  
 Association of American Railroads Technical Center; 3140 South  
 Federal Street; Chicago, Illinois; 60616

Federal Railroad Administration; 400 7th Street, SW;  
 Washington, D.C.; 20590  
 Railway Progress Institute; 801 North Fairfax Street;  
 Alexandria, Virginia; 22314  
 Transport Canada Research and Development Centre; 1000  
 Sherbrooke Street, West, P.O. Box 549; Montreal, Quebec H3A  
 2R3; Canada

ACTIVITY DATA:  
 AS-Active; RD-Feb 79; SD-Jan 75; DC-Mar 79 EST

24 082106

IOWA RAILROAD STUDY

PERFORMING AGENCY:  
 Iowa State University, Ames; Ames, Iowa; 50011;  
 415-40-30-09-1929

INVESTIGATOR:  
 Baumel, CP

FUNDING AGENCY:  
 Iowa State Highway Commission; Lincoln Way, Highway Commission  
 Building; Ames, Iowa; 50010; RS-I-DOT-55045  
 Federal Railroad Administration; 400 7th Street, SW;  
 Washington, D.C.; 20590

ACTIVITY DATA:  
 AS-Active; RD-Feb 79; SD-Oct 74; TF-\$257000; FT-Contract;  
 CN-DOT-FR-55045

TRANSPORTATION RESEARCH BOARD  
National Academy of Sciences  
2101 Constitution Avenue, N.W., Washington, D.C. 20418

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