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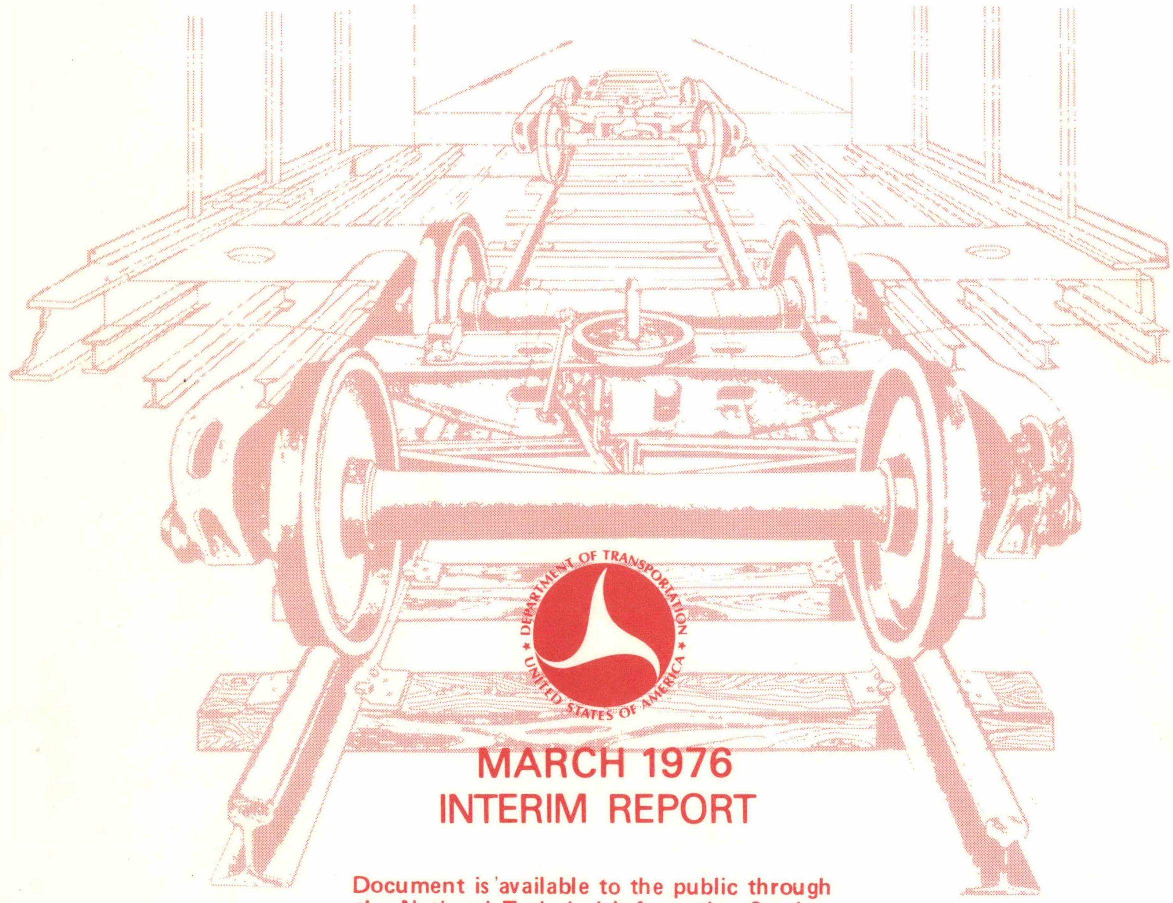
FREIGHT CAR TRUCK DESIGN OPTIMIZATION

Truck Economic Data Collection and Analysis

David April



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INTERIM REPORT

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03 - Rail Vehicles &
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See also Freight Car Truck Design Optimization, Methodology for a Comprehensive Study of Truck Economics, April 1975 (NTIS Accession No. PB 248 832/AS) to the extent that this report expands further on the economic analysis of freight car trucks.

16. Abstract

A first interim report covering the development of the TDOP economic methodology was published by the Federal Railroad Administration in April 1975. It contains the truck investment economic evaluation procedures intended for the use of the railroad industry and their suppliers.

The primary objective of the Truck Economic Data Collection and Analysis Program is to test the procedures for establishing the significant actual operating costs of existing Type I general purpose trucks. This second interim report covers the progress of the program. A generalized truck cost information system was designed for the collection and integration of truck economic data. The collection of test data for off-line truck maintenance costs was completed. Test data collection was initiated for on-line truck maintenance and other associated costs and operating conditions. Preparatory work was begun to develop the appropriate data analysis guidelines. A preliminary analysis of some of the test data clearly revealed the truck's reported off-line wear and failure cost performance.

Railroad companies and their suppliers are encouraged to consider adopting the tested procedures of the TDOP economic methodology. A progressive implementation of this methodology will provide them with the timely opportunity to develop a truck economic evaluation capability of their own.

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FREIGHT CAR TRUCK DESIGN OPTIMIZATION

Truck Economic Data Collection and Analysis

EXECUTIVE SUMMARY

I. Background: Economic Methodology Development

The initial economic analysis effort resulted in the development of a methodology for conducting a comprehensive study of truck economics. A first interim report covering the TDOP methodology was published by the Federal Railroad Administration in April 1975. It contains the economic evaluation procedures that the railroad industry and its suppliers may elect to use for making proposed investment decisions among alternative truck designs.

II. Progress: Truck Economic Data Collection and Analysis Program

The primary objective of this Program is to test the procedures for collecting and analyzing the significant actual operating costs of existing Type I general purpose trucks. This second interim report covers the progress of the program. A generalized truck cost information system was designed for the collection and integration of truck economic data. The collection of test data for off-line truck maintenance costs was completed. Test data collection was initiated for on-line truck maintenance costs; associated commodity losses, derailments, train and roadway costs; and the truck-related operating conditions. Preparatory work was begun to develop the appropriate data analysis guidelines. A preliminary analysis of some of the test data clearly revealed the truck's reported off-line wear and failure cost performance. The TDOP Truck Economic Model used as the guide for the data collection follows on the next page.

III. Future: Type I Truck Economic Data Base Use

The completion of this program is expected to result in tested procedures for the industry user to follow to establish his own truck economic data base. The future exploitation of the data base aided by the TDOP economic data analysis guidelines, being developed, should help the user determine the economic operating life cycles of his existing trucks. The life cycle data are useful for the truck comparative analysis and component replacement decisions. The data are also useful for the industry's engineering truck design improvement effort. Since the data being gathered include the truck's historical wear and failure cost performance, they can serve as guides for testing improvements for comparison with alternative design choices.

Truck Economic Model

Alternative Freight Car Truck Incremental Investment Evaluation

Truck Operating Conditions	Factor
Car Class	kind/number/builder
Commodity carried	type/weight
Average annual car miles.	empty/loaded
Average car age.	years
Roadway conditions	class/type
Other Conditions.	topographic/speed/ geographic/load/service

Truck Cash Flow Analysis	Amount Per Car Set
Net cash investment in improvements	
Initial investment in trucks	$________
Investment credits	________
Investment debits	________
Net cash invested	$________
Annual net cash benefits	
Existing truck operating cost	$________
Improved truck operating cost	________
Gross cash benefits	________
Other adjustments	________
Net cash benefits	$________
Return on Truck Investment Adjusted for Risk	
Present value of the net cash benefits	$________
Less net cash invested	________
Net present value	$________
Profitability index	________
Estimated savings	$________

- EXECUTIVE SUMMARY CONCLUDED -

FREIGHT CAR TRUCK DESIGN OPTIMIZATION

Truck Economic Data Collection and Analysis

Table of Contents

FREIGHT CAR TRUCK DESIGN OPTIMIZATION

Truck Economic Data Collection and Analysis

Management Summary

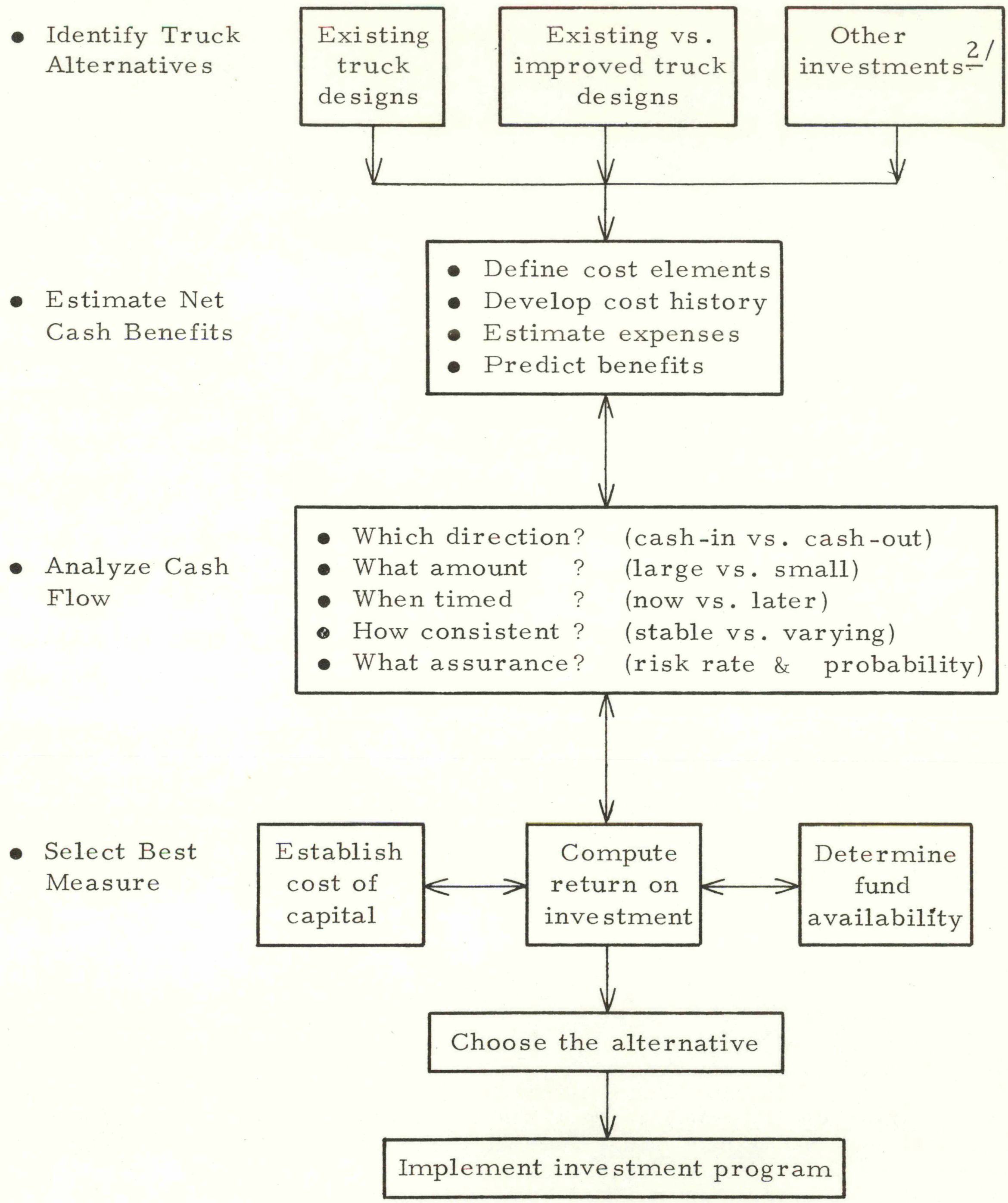
I. Background

A. Methodology development

The initial economic analysis of the Freight Car Truck Design Optimization Project (TDOP) resulted in the development of a methodology for conducting a comprehensive study of truck economics. This effort took the form of an Economic Analysis Plan, published by the Federal Railroad Administration in April 1975[1/]. The plan identifies the significant costs to be analyzed and contains the economic evaluation procedures to be used by the railroad industry and its suppliers to help make decisions among proposed investments in alternative truck designs (a summary of the procedure follows).

1/ See Freight Car Truck Design Optimization Methodology For A Comprehensive Study of Truck Economics, Federal Railroad Administration, OR&D Report No. 75-58, April 1975, available through the National Technical Information Service, Springfield VA 22161 (PB 248 832/AS).

1. Truck Economic Evaluation Procedure Summary



[2/] See Opportunity cost, page 4.

2. Organization sources

The methodology was prepared by the TDOP economic staff under the guidance of the TDOP management group and the railroad industry and its suppliers in cooperation with representatives of the Federal Railroad Administration's Office of Research and Development and the Association of American Railroads. Headquarters for this effort are located at the Southern Pacific Transportation Company in San Francisco, California.

3. Type I truck data sources

A brief Type I truck economic survey of available information was conducted during the initial economic analysis effort. Later, field trips were made to observe actual truck operations: truck maintenance practices, spare part inventories, truck maintenance facilities, roadway conditions, train handling, and operating cost accounting procedures. Available national, international, and local truck operating cost reports and economic studies were reviewed. Interviews were held to determine the availability of computer files containing relevant truck data and to determine other existing methods for evaluating truck economics. Available budgetary reports were analyzed.

4. Truck data selection[3/]

The truck data selected for economic analysis were the operating costs resulting from truck component service and wear and failure performance associated with the truck's operating conditions. Financial data requirements were selected and the cost data to be excluded from the study were established.

3/ See Appendix A: Truck Data Selection, for a listing of the types of data.

5. Use of the methodology

The methodology is to be used by the railroad industry and its suppliers to help evaluate investments and to help make decisions to assure economic investments in proposed improvements to existing trucks.[4/]

B. Opportunity cost

The opportunity cost and alternative investments other than in trucks also are to be considered. The opportunity cost is the cost to the industry of the other things that must be sacrificed to bring about a savings resulting from a truck investment, (i.e., the benefits and costs foregone by not investing in some other alternative, such as track or motive power or some entirely different product).

II. Truck Economic Data Collection and Analysis Program Summary[5/]

A. Introduction

The Truck Economic Data Collection and Analysis Program was designed to meet the objectives developed in the Economic Analysis Plan. The expected result of the Program is to provide the users with a tested methodology for their own individual implementation. The order of priority for testing the methodology is first to collect the actual test data for the significant operating costs of selected existing trucks (i.e., to establish the economic base line). The

4/ Corollary uses are to determine truck economic life cycles, measure truck operating cost performance, and compare the operating costs of existing designs.

5/ See Appendix B: Cost Data Collection and Analysis Test Procedure for Existing Trucks, for details.

second order of priority is to develop the estimated operating costs of proposed improvements to existing trucks. Finally, the evaluation and comparison of this information is made during the subsequent data analysis phase of the program.

B. Program status summary

1. Existing truck test data collection

a. Operating costs

The collection of test data for off-line truck maintenance to home cars has been completed for the present. The truck data were collected for one Southern Pacific Transportation Company 100-ton box car class of 99 cars, and one 70-ton flat car class of 64 cars. The test data include the complete daily recorded history of the repair cost for each truck component (car number; component and repair description and location; the reason for the repair and its cost; and the responsibility for the repair cost and the handling line). The collection of test data for on-line truck maintenance to home cars is in progress. Some of the existing field records giving evidence of truck maintenance activity (such as the backs of bad order cards) are being retrieved and reviewed. In addition, the costs of truck project maintenance costs are being gathered through the use of project cost estimates and project completion reports.

The collection of other associated operating cost test data is also in progress. Available freight claim report inquiry programs are being accessed to acquire car commodity loss and damage costs for analysis of truck-related causes.

For similar truck-cause analysis, the derailment costs are being gathered from available car retirement files, the FRA Rail Equipment Accident/Incident Report System, and the FRA-published Accident Bulletins. The collection of test data for truck-related train delay and lost car day costs was not initiated during this phase of the effort, but will be developed in a subsequent phase. The only category of the other track/train component costs being currently collected are the truck-related car component repair costs by means of the maintenance data acquisition effort noted above. In the future, Maintenance of Way and Maintenance of Equipment cost accounting and inspection reports are expected to help provide test data for the remaining truck-related roadway and locomotive costs.

b. Operating conditions

Lastly, the relevant truck-associated operating condition test data are being collected through available car movement and car specification files. These data include the commodity carried in the car; the average age of the car; the car's empty and loaded mileage; and the topographic, geographic, speed, load, and roadway conditions.

2. Truck test data analysis

The truck data analysis effort is being directed toward the preparation of guidelines for the effective use of the data base.

a. Exploitation of the truck economic data base

The natural result of the adoption and implementation of the TDOP economic procedures by the user should be the establishment of a readily available comprehensive truck economic data base. It can then be exploited by the user by means of an inquiry subsystem. Currently, the preliminary off-line truck maintenance data that has been already collected by TDOP is providing cost behavior information on inquiry. The data being analyzed reveal the truck wear patterns and failure frequencies over the car life. When the data are combined with all the other associated cost data and are supplemented by statistical analysis, they will provide a powerful tool for developing truck unit cost performance standards and truck component life cycles as measures to help improve upon truck utilization.

b. Truck economic operating life cycle modeling

Essential for the comparative analysis of truck components is the development of their economic operating life cycles. These cycles are also necessary for establishing the economic replacement interval to minimize the individual component cost per unit of measure (e.g., per year, per mile) associated with its replacement in kind. Preparatory work in this area has included the review and analysis of the similar modeling done by Battelle Columbus Laboratories, the Southern Pacific Transportation Company's Bureau of Transportation Research, Stanford University, and others.

c. Cash flow modeling

The cash flow analysis procedure is also in preparation. It will identify the appropriate financial data elements and their source and application. A preliminary cash flow analytical model is provided to demonstrate the method of calculating net present value adjusted for risk and probability of occurrence.

C. Conclusion

The initial testing of the Type I general purpose freight car truck economic evaluation procedures has resulted in the successful collection of useful preliminary data. The findings indicate, thus far, that existing truck cost and related performance data can be made available, and can be effectively used in an economically feasible way. The TDOP economic methodology emphasizes collecting and integrating the data that exist as opposed to establishing new data acquisition systems. For the most part, the existing data are not integrated, but lend themselves well to assimilation through the orderly process of a truck cost information system developed for that purpose. The preparatory work that was begun to develop the appropriate data analysis guidelines resulted in a preliminary analysis of some of the collected test data. The analysis clearly revealed the truck's reported off-line wear and failure cost-performance.

Railroad companies and their suppliers are encouraged to consider adopting the tested procedures of the TDOP economic methodology. A progressive implementation of this methodology will provide them with the timely opportunity to develop a truck economic evaluation capability of their own.

Truck Economic Data Collection and Analysis Program

Appendix A: Truck Data Selection

The truck data selected are listed in this appendix for reference purposes. The source, integration, and use of the data are shown in detail in Appendix B.

I. Type of data selected:

- A. Truck operating cost data
  - 1. Truck Maintenance
    - a. Truck component service, repairs, and replacements
      - (1) Costs (labor, material,[1/] overhead)
      - (2) Units of production (number of repairs)
      - (3) Off-line repairs
      - (4) On-line inspection and repairs:
        - (a) Running
        - (b) Heavy (shop)
  - 2. Freight damage payments
  - 3. Derailment costs
  - 4. Train delay costs
  - 5. Lost car day costs
  - 6. Associated train and roadway costs
- B. Truck operating condition data
  - 1. Car class description (kind, number, builder)
  - 2. Commodity carried (type, weight)
  - 3. Average annual car miles (empty, loaded)
  - 4. Average car age (years)
  - 5. Roadway conditions (class, type)

1/ Including inventory cost: direct cost and inventory carrying cost (see Appendix B, Section V, B, 3: Truck component inventory cost, page B-44).

B. Truck operating condition data (cont'd)

6. Other conditions

a. Topographic

b. Average speed

c. Geographic

d. Wheel load

e. Traffic service (unit trains, general service, type of locomotive)

C. Truck financial analysis data (for cash flow analysis)

1. Initial incremental investment in truck improvements [2/]

2. Current assets

3. Depreciation schedule

4. Taxes (income, use and investment credits)

5. Short/long term gains/losses

6. Cost of capital (risk factor)

7. Present value computatation factors

8. Price level factor (inflationary index)

9. Probability of occurrence (i.e., benefits and cost)

D. Truck operating life cycle data

1. Out-of-service time

2. Component population

3. Probability of occurrence of wear and failure cause and effect

4. Removed component's residual life

5. Unit cost measures (e.g., cost per mile, per year, loaded, empty)

E. Opportunity cost

1. Alternative investment

2. Other programs

[2/] The incremental investment analysis for proposed improvements to trucks would also include the benefits and costs resulting from any incremental investments that may be required by the improvement such as additional maintenance facilities.

F. Cost data exclusions

1. Costs incurred but not caused by trucks[3/]

   a. Storage facility costs

      (1) Insurance

      (2) Taxes

      (3) Transportation

      (4) Rent

      (5) Handling

      (6) Depreciation

      (7) Idle time

   b. Truck component repair costs

2. Obsolescence costs[4/]

   a. Capital

   b. Replacement

[3/] These are the storage costs incurred by the truck but not caused by the truck, due to such reasons as lack of freight, power shortage, work strike, labor and material shortage, lack of equipment and facilities; and the truck component repair costs due to, for example, non-truck related derailment costs.

[4/] A primary purpose of the TDOP engineering and economic research effort is to evaluate the normal operating performance characteristics of existing railroad freight car trucks and to determine through cost-benefit analysis the feasibility of improving truck performance by, for example, the mechanical modification of existing-type trucks. Obsolescence costs (which are costs to be considered in an analysis of the overall economic useful life of equipment) are beyond the scope of the TDOP economic research effort which is to evaluate benefits and costs of trucks under normal operating conditions. (However difficult it may be to establish a consensus of what normal operating conditions are, the focus of the economic analysis is on the cost behavior of trucks in operation.)

3. <u>Allocation of existing vs. future overhead</u>[5/]

a. General and administrative expenses

b. Other fixed costs

5/ In evaluating the economic impact of proposed incremental investments for proposed improvements to trucks, arbitrary allocations of existing overhead charges are to be avoided. The problems of solving the fair distribution (i.e., equity) of such charges must be kept separate from the problems of establishing the realistic economic effects of the proposed incremental investment. The problem is not to determine the proportion of the existing overhead charges (currently allocated to existing equipment) for allocation to the new investment. What is needed is a reliable prediction (i.e., cost estimate) of how future overhead charges will change if the investment is made compared with the investment not being made. This estimated change in overhead charges is not germane to existing overhead allocations.

Truck Economic Data Collection and Analysis Program

Appendix B:

Cost Data Collection and Analysis Test Procedure for Existing Trucks

Table of Contents

Subject	Page

Attachments:

Report formats for off-line maintenance test data:

Car Class B-100-33: Reports 1 through 4

Car Class F-70-65: Reports 1 through 4

I. Basic Principles

A. Utilizing existing data collection systems

1. Data from existing input documents

The TDOP economic data collection procedure emphasizes the use of existing input documents (with minor modifications in some cases) for the future development of the truck economic data base as opposed to establishing new systems. An example of this might be the use of bad order cards as one of the basic input documents for gathering the history of on-line truck maintenance to home cars. This is made possible in the case where railroads require their car inspectors to write the truck maintenance instructions on the back of the bad order card for the car repair employee to follow. Other similar source documents are available in the form of various local records at repair facilities which record the daily maintenance activities. These documents most often do not facilitate the orderly collection of cost information because the input data are not standardized, nor is there a standard format. In addition, the data are often incomplete. For example, the reason for the repair being made may be missing as well as the actual quantity of material used. Nevertheless, the basic data exist and can be developed to partially meet immediate needs. But minor modifications to the input documents can, in many instances, readily provide an economic solution for collecting more comprehensive data to meet future needs. One example might be pre-printing the back of the bad order card with a standardized coded set of repair instructions to be checked off when the repair is made.

2. Data from existing files

The procedure also emphasizes the use of existing output files for data collection. Examples are car movement files to determine track conditions over which the trucks operate; car specification files for truck configuration; and accident reports for derailment detail.

3. The economical data collection approach

The approach of using existing data collection methods is the most economical one to follow. It enables the individual user companies among the railroad industry and suppliers to develop their own truck data in an economically feasible way, as opposed to incurring expenses for new cost information systems whose benefits are difficult to quantify. The approach is supported, in part, by a preliminary data collection economic feasibility study conducted by the TDOP economic staff. The TDOP economic study has not been finalized, but the initial findings do reveal that a ratio of estimated "stand-alone" savings to cost of approximately 5 to 1 can be reasonably expected. The "stand-alone" estimated savings are not dependent on truck investment benefits. They are based on an early warning feature of the data collection procedure designed to detect defects in an early stage of incidence; an estimated reduction in the bad order ratio by scheduling maintenance for truck and other critical car components; and an estimated savings through better control of the cost of repairs to cars close to retirement.

B. Data quality assurance

1. Existing data problems[1/]

The results of the methodology study clearly indicated a pervasive need in the railroad industry for improved cost perform-

[1/] See FRA Report No. 75-58, Methodology For A Comprehensive Study of Truck Economics.

ance information for existing freight car trucks. While the industry does make use of investment evaluation procedures for rolling stock acquisitions such as for motive power and freight cars, the value of these procedures is impaired by the difficulty of acquiring the relevant and reliable operating cost information for existing comparable equipment.[2/] There appear to be no available investment evaluation procedures for freight car trucks alone.

Therefore, a serious imbalance exists between railroad industry truck cost performance data needs and present methods for acquiring that information. The present methods consist mainly of a variety of discrete data applications as opposed to systems data applications. [Discrete applications are found in many railroad cost accounting systems which have been set up to meet ICC regulatory cost reporting and internal budgetary control requirements. One existing example is an application that provides for the collection of actual labor time expended on home freight car repairs for the total car fleet as opposed to individual cars. In addition, the application does not provide for production count, such as the number of repairs made or the number of cars repaired. This discrete (or separate) application uncouples the reporting of the cost of production from the units of work completed. In effect, the discreteness of the application inhibits the establishment of such unit cost measures as truck costs per component per mile, and makes difficult the determination of the unit value received for each dollar spent.] In addition, there seems to be no significant development of

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2/ See subsection 2: Improving the reliability of the existing data, page B-7.

existing truck cost behavior history files and few query and response mechanisms. Nor does there appear to exist a capability for several users to be serviced out of a common data base in close time sequence, nor any methods of continuously and incrementally updating files.

2. Improving the reliability of the existing data

Basic data exist in a variety of non-integrated systems such as cost accounting systems, car movement files, accident reporting systems, car specification files, field records, the AAR car repair billing system, loss and damage reports, and bad order cards. Since the base data do exist, the industry needs little more new data. Mainly it needs to improve the reliability of the existing information by collecting and integrating the data (e.g., associating maintenance cost with the number of repairs, mileage, car age, commodities carried, and other operating conditions). The appropriate solution to collecting and integrating the existing data is through the development and use of a truck economic information system based predominantly on using existing systems. The current TDOP Type I truck economic analysis is in the process of testing the procedures for that system for the use of the railroad industry and its suppliers. Users who then adopt and implement these procedures will be provided with the capability to establish existing truck operating costs of any selected design as well as the related operating condition data. The procedures will also contain the relevant analytical methods for economic truck component operating life cycle determination. Simplicity of the overall system design for the data collection and analysis program will be effected by the use of a common code classification. It will have an expansion and contraction capability responsive to the user's need for more or less data. The system will maintain flexibility for the design of input and output report formats to accommodate a user's individual environmental work conditions. Lastly, it will include a data base inquiry subsystem for evaluating cost performance.

II. Truck Economic Model

A Truck Economic Model was developed to be used in evaluating alternative freight car truck incremental investments.[3/] The model is illustrated on page B-9.

III. Generalized Truck Cost Information System Structure

A generalized truck cost information system structure was developed to guide the collection and integration of the truck economic model data requirements. The structure is shown on page B-10, and is followed by an explanation of its major elements.

[3/] See Methodology For A Comprehensive Study of Truck Economics.

Truck Economic Model

Alternative Freight Car Truck Incremental Investment Evaluation

Truck Operating Conditions	Factor
Car class	kind/number/builder
Commodity	type/weight
Average annual car miles	empty/loaded
Average car age	years
Roadway conditions	class/type
Other conditions	topographic/geographic/speed/load/service

Truck Cash Flow Analysis	Amount Per Car Set
Net cash investment in improvements	
Initial investment in trucks	$____
Investment credits	____
Investment debits	____
Net cash invested	$____
Annual net cash benefits	
Existing truck operating cost	$____
Improved truck operating cost	____
Gross cash benefits	____
Other adjustments	____
Net cash benefits	$____

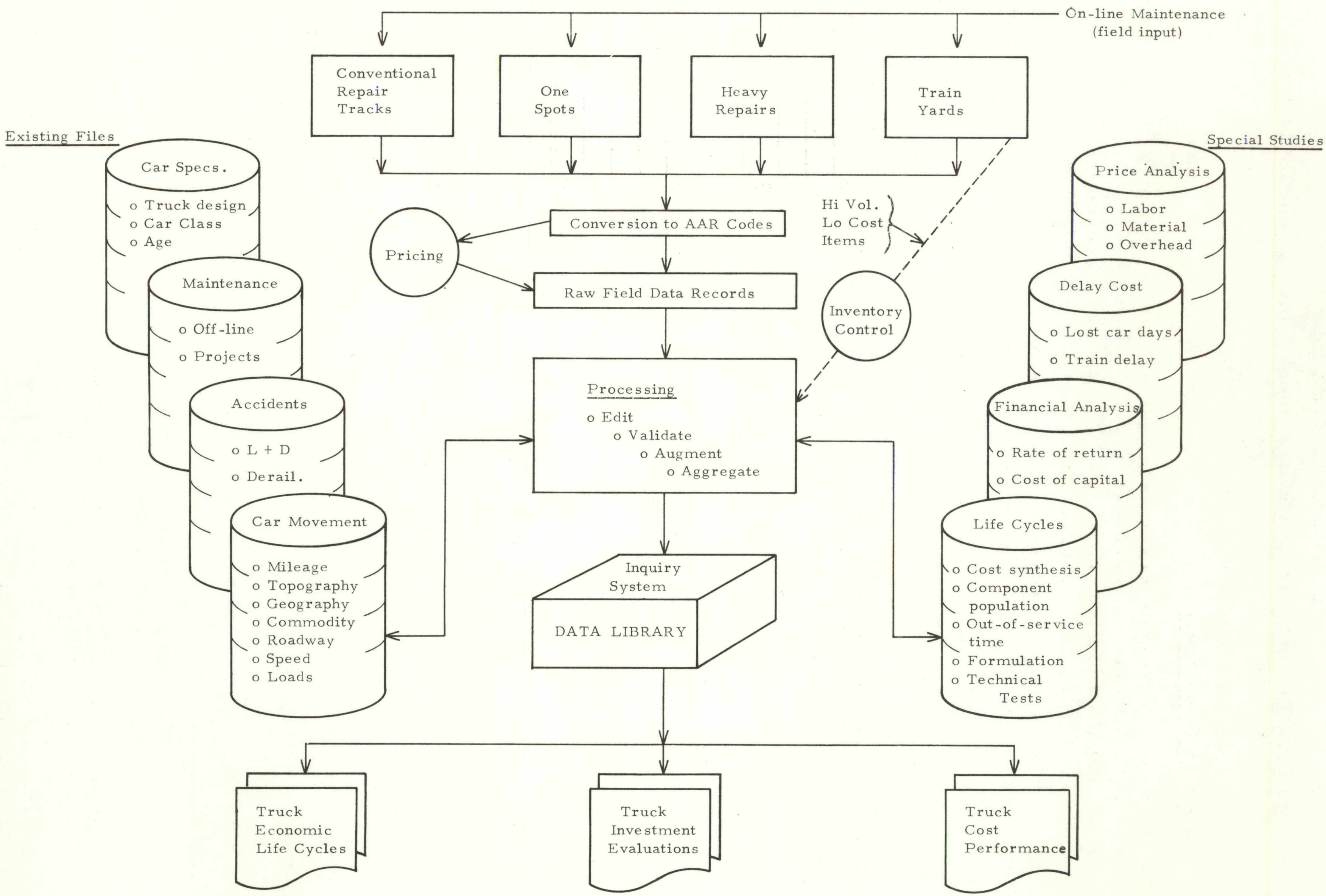
Return on Investment 4/	
Present value of the net cash benefits	$____
Less net cash invested	____
Net present value	$____
Profitability index 5/	____
Estimated total savings 6/	____

4/ Adjusted for risk and probability of occurrence. (See the detail model in Appendix B, pages B-46 through B-50.)

5/ Profitability index = The present value of the net cash benefits divided by the net cash invested.

6/ Estimated total savings based on truck population and time-phased implementation (replacing existing trucks with proposed improved trucks).

Truck Cost Information System Structure



A. On-line maintenance

1. Field input

The system is designed to have data collected for on-line maintenance to home cars by introducing a truck material application document to be filled out by field forces. Its introduction should not require additional clerical effort on the part of the field forces. It is proposed as a substitute (and more efficient medium) for current, similar truck maintenance record keeping, i.e., on the particular railroad where the economic methodology is being tested. (For a more detailed description of collecting on-line maintenance data, including the proposed document, its substitution and proposed industry-wide use, see Section IV, B, 2, page B-22: On-line maintenance.) An exception to using the proposed material application document at car repair facilities would be in the case of high volume low-cost truck component change-outs, such as brake shoes applied to trucks in the train yards (see the dotted line in the illustration). Because of their high volume, such components could create an undesirably heavy input paperwork burden. This burden can be overcome by using inventory control records (e.g., min/max purchase ordering) to account for the brake shoe applications in place of the material application document. This practice will invite cost accounting allocations that are not as accurate as the direct reporting of material. However, the practice does appear more economically justified without a serious distortion to the validity of the truck operating cost data.

2. Conversion to AAR codes and pricing

Depending on the work environment and the existing input methods of the users of this TDOP procedure, the material application document can either be pre-coded with AAR Car Repair Billing System codes or processed with a railroad's own codes and converted to AAR codes. During conversion, AAR standard labor and material repair prices can be applied by the same program. (NOTE: In those cases where users elect to use AAR codes on the field input document but have internal maintenance cost control needs for greater or lesser detail than provided by the AAR code classification, it is a relatively simple matter to expand or contract the codes for internal purposes.)

3. <u>Raw field data records</u>

The conversion routine will result in an "upstream" skeletal economic data base. It is expected to consist of the raw field data records for on-line maintenance work performed on truck components, other on-line truck-associated car component maintenance, and the maintenance cost in terms of AAR standard prices. While a more detailed description of the truck system awaits the completion of the testing of these procedures, there should be by-products available from this skeletal data base having significant potential that deserve comment. The raw field records carry data that can be retrieved in advance of the remaining processing required to develop the complete data library. The data can be retrieved "upstream" for periodic effective short term maintenance control purposes. The effectiveness rests in the capability of the system to provide the user with basic critical repair data on quick notice (i.e., 24-48 hour turn-around time). An example of this kind of critical data might be a suspected high frequency of a truck component defect under surveillance for a particular car series in sensitive commodity service.

Another example of the effective use of "upstream" reports is likely to be in cases where critical inventory shortages may exist. These would be rough inventory status report indicators with the potential to quickly reveal major surpluses or depletions by geographic repair location and therefore help address inventory imbalances.

B. Processing and file accession

The truck component raw field on-line data records next pass to the main processing stream for editing, validation, augmentation, and aggregation. An error system (not shown in the system structure illustration) includes the edit routine and validity checks for the orderly processing of unacceptable data. Augmentation and aggregation of the edited raw field on-line truck component maintenance records occur by the computer's accessing existing files and special study results and combining them with other truck-related operating data by individual car. The truck cost data record is then complete and becomes a part of the data library.

C. The data library and report generation

By means of a data base inquiry system, the library can be exploited to provide data to help make decisions relating to truck economic life cycles, truck investment evaluations, and truck cost performance. (For example, questioning the data base for thin flange causes of failure that apply to L1, R2, and L2, R1 change-outs. The data would be used to analyze diagonal wheel failure frequency distribution cost performance.)

IV. Progress of the Existing Truck Cost Data Collection Test Procedure

A description of the progress made in the actual collection of the truck component cost test data follows.

A. Car selection

Two classes of cars were selected to test the truck cost collection procedure.

1. Car class B-100-33 (SPTCo.)
    - 100-ton capacity box car, sliding sill, in general auto parts service, HC, 22 belt DF, nailable steel floor, 50K
    - AAR mechanical designation: XL
    - AAR car type code: A330
    - Date car class built: November 1972
    - Car builder: ACF
    - Car capacity: 176000 lb
    - Car numbers: SP 668000 - SP 668099 (excl. 668051) (99 cars)
    - Trucks: Barber stabilized with low profile side frames
    - Springs: D-5 (28 i.c. and 28 o.c.)
    - Wheels: CH 36
2. Car class F-70-65 (SPTCo.)
    - 55-ton capacity cushion Stac-Pac flat car used for hauling assembled automobiles
    - AAR mechanical designation: FA
    - AAR car type code: V191
    - Date class built: May 1973
    - Car builder: Pullman
    - Car capacity: 124000 lb
    - Car numbers: SP 517300 - SP 517363 (64 cars)
    - Trucks: Barber stabilized, low level
    - Springs: D-4 (20 i.c. and 20 o.c.)
    - Wheels: CB-28

3. Reason for the selection[7/]

- Truck cost information is more conveniently accessed by using SPTCo. cars as opposed to other railroad industry cars because SPTCo. is the prime contractor for the TDOP effort, and is making the data available for the economic analysis.
- Using car classes of a relatively small number of cars facilitates the manual handling of the truck cost data for procedural testing purposes and provides the opportunity to test the cost data for a 100% sample of the car class population.
- One car from each class was selected for TDOP technical testing.
- The ages of the car classes (2 to 3 years) provide the opportunity to analyze their cost performance under recent operating conditions.

B. Existing truck maintenance cost collection

1. Off-line maintenance (collection completed)

Off-line maintenance costs were selected as the first category of truck costs to collect because the information is more readily available than the other categories of truck costs. In addition, approximately 85% of the Class I railroads in the United States and Canada use this system (AAR Car Repair Billing System).[8/] Four fundamental report formats were developed to accumulate the relevant data.[9/]

7/ The methodology study published in April 1975 indicated that a special pilot study may be conducted with the Pacific Fruit Express Company, using their mechanical refrigerator cars with general purpose trucks. The initial pilot study findings showed that the relevant cost performance information was not readily available. (The physical measurements are still being planned.)

8/ Source: Association of American Railroads, Mechanical Division, Operations and Maintenance Department, 1920 L Street, N.W., Washington, D.C. 20036.

9/ Attached at the end of this Appendix B.

Report 1: Cumulative Truck Component Maintenance Cost for Car Class B-100-33 and F-70-65

This report has been prepared to allow for the accumulation of the total reported off-line truck component maintenance and repair costs for the selected car classes. (It also contains provision for accumulating reported on-line costs--currently in progress.) The data are presented in conformance with the AAR Car Repair Billing System code classification. While the dollar figures and the number of repairs are actual reported values, they are shown on the reports in this Appendix B for demonstration purposes only, not for data analysis.

IMPORTANT NOTE: THE ACTUAL VALUES SHOWN HAVE NOT BEEN SUBJECTED TO COMPLETE DATA ANALYSIS.[10/]

Page 1 of 2 of Report 1 shows only the reported truck off-line maintenance costs, as opposed to total reported car off-line maintenance costs. Separate subtotals are provided for the reported brake rigging equipment costs, for brake shoes, for all other truck costs.

Page 2 of 2 of Report 1 shows "Other Car Components." These are the other reported car off-line maintenance costs and are shown to demonstrate the capability of the system to collect such costs. They must be available so that a determination can be made (through data analysis) of which of these car component maintenance costs were truck-caused and which were not.

10/ This is important because detailed data analysis is still required to separate out truck costs charged to the truck but not caused by the truck, such as costs caused by non-truck-related derailments. (A preliminary analysis of wear and failure costs was made.)

The source for this information comes from the AAR Car Repair Billing System tape files located at the AAR headquarters in Washington, D.C. Users interested in acquiring the data must purchase their own individual company's car files. The monthly cost is nominal (approximately $2.00 for 1000 records - probably not more than $50.00 to $100.00).

NOTE: Users must also be subscribers to the AAR Car Repair Billing System to be able to make the purchase.

No special programming instructions are required here because the basic data of each billed maintenance transaction is on tape, and it is a relatively minor programming effort of approximately two man months to set up the appropriate data base interrogation files.

Report 2: Monthly Truck Component Maintenance Cost and Car Miles for Car Class B-100-33 and F-70-65

This report has been prepared to allow for the accumulation of reported period costs (by month, in this example). It also provides for accumulating empty and loaded mileage (not yet collected). Analysis of these data will include highlighting cost trends, identifying seasonal fluctuations, predicting period cost behavior, and establishing unit cost per mile standards.

The total reported costs of car off-line maintenance are shown calendarized in this report as opposed to truck costs alone or individual truck component costs to demonstrate the technique.

The source for these data is the same as for Report 1. All the billed car repair data are identified with the calendar date on which the repairs were made. It is a simple enough matter to have the data displayed over different periods (weekly, semi-monthly, quarterly) so that no special instructions are required here.

Report 3: Detail Truck Component Maintenance Cost for Car Class B-100-33 and F-70-65

This report has been prepared to allow for the accumulation of the reported daily off-line maintenance costs. It is this report that contains the initial economic data base. (The initial data base can be expanded to a full economic data base by accumulating and combining it with on-line maintenance; the other operating costs; the operating conditions under which the costs were incurred; and finally, the cash flow analytical data.)

Column descriptions[11]

Columns 1 & 2: The data are sorted by car initial and number. (In essence, the report is a daily car repair history file, focusing on truck component maintenance.)

Column 3: The repair date is recorded by year, month and day.

Column 4: The SPLC, (Standard Point Location Code) provides the geographic location of the repair.[12]

Column 5: The removed job number code describes the removed component (or the labor attention only).

Column 6: The car location code provides the position on the car that that component occupies (in the example given in Report 3). However, this code has a variable use for different components which can be easily determined by using the field manual.

Column 7: The qualifier code distinguishes the type of component further (e.g., sometimes indicating the manufacturer). This code also has a variable use which must be determined by use of the field manual.

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[11] For a full description of the codes and their use, see the latest Field Manual. (The reference used here is: Field Manual of the AAR Interchange Rules, adopted by the Association of American Railroads, Mechanical Division, Operations and Maintenance Department, effective January 11, 1975, published by the Association of American Railroads, 1920 L Street, N.W., Washington, D.C. 20036.)

[12] See the latest Code Directory. (The reference used here is: Freight Station Accounting Code Directory, published by the Economics and Finance Department, AAR, Washington, D.C., 1974 edition.)

Column 8: The why made code provides the reason for the component repair. It is a singular use code.

Column 9: The quantity field code requires a special note of caution relative to interpreting the values in the field. It also has a variable use and can contain a value that is in terms of pounds of weight (e.g., center plates) or a value showing the component material quantity removed (e.g., wheels or axles). The code has other uses. Familiarity with the field manual resolves these differences. This variable use of the same code field is not as confusing as it appears when the data are analyzed at the daily transaction level, where each code describing the component repair activity is combined together on the same line of data, making the nature of the transaction clear.

Column 10: The applied condition code refers to the condition of the material applied (e.g., reconditioned) in place of the material removed.

NOTE: Report 3 calls for the details of the removed job code (component) and suppresses the applied component. The system has the capability of providing the details of both transactions for the user desiring to call for that data.

Column 11: The responsibility code identifies the agency (e.g., railroad, private car line) who bears the cost (responsibility) for the repair.

Column 12: The handling line code identifies the agency performing the repair.

Column 13: The AAR standard net price contains the cost of the repair to the responsible agent.

Sort and aggregation notes

These notes describe the order in which the user (in this case, the TDOP economic staff) desires to see the data displayed. The display in Report 3 is a basic one which provides a sequence of the car repair transactions from inception of the first reported repair by car number, making available to the user the car's entire reported off-line component maintenance history.

NOTE: The actual test data collected for Report 3 are not shown in the example provided at the end of this appendix because of space restrictions. The data are on file at the TDOP office.

Report 4: Causes of Truck Component Maintenance Cost for Car Class B-100-33 and F-70-65

This report has been prepared to allow for the accumulation of the reported causes of truck component off-line maintenance. These data, in conjunction with other related cost data, are useful for developing wear and failure frequency distributions for the determination of the economic operating life cycles of truck components. The life cycles are to be used for comparing component operating cost performance to help management make economic choices among competing truck designs. Other uses are for engineering truck design improvement analysis, and trouble-shooting (truck maintenance practices, early warning of truck components that might be experiencing defects).

Report 4 demonstrates the usefulness of the data base inquiry system. In this example, the interrogation request was made to screen out (suppress) car number, daily repair activity, and other test data not considered essential for a first look at the repair frequencies. The data are displayed by month to show trends, seasonal activity, peaks, and valleys. When these data are eventually associated in the overall truck cost information system with all the cost and operating condition data (e.g., track conditions, topography, load), they provide a powerful tool for developing an understanding of the truck's cost behavior in operation.

Column descriptions

Columns 1-4: The codes in these columns have already been described in the prior Report 3 comments. The arrangement of these codes is, however, different. The data presented in Report 4 focus on the wear and failure pattern of each truck component within the total car class. In the example given on the first line of the first four columns (of Report 4 for Car Class B-100-33) the coded data when decoded 13/ will read as follows:

13/ *Op. cit.*, Field Manual of the AAR Interchange Rules.

Column (1) Removed Job No. 3081: 36-in., 2 wear steel [wheel], 8-14 sixteenths [service metal remaining when the wheel was removed]

Column (2) Qualifier 01: J-36 wrot-steel [wheel]

Column (3) Why Made 60: Thin flange

Column (4) Car Location L1: B End, Left first [wheel]

The second line of information in the example under the Car Location Column (4) decodes to: B End, Right first [wheel]. The third line of data is a sub-total for the wheel set. The following lines of data repeat this sort and aggregation procedure. The rationale for this procedure is to provide data that will facilitate the comparison of the wear and failure experience (for a specific wheel and cause within a car class, by month) of the component. In this case, comparisons are readily available to be made for opposite wheels (e.g., L1 vs. R1, and L2 vs. R2); for wheel sets (e.g., L1, R1 vs. L2,R2) and for truck sets (e.g., L1, R1, L2, R2 vs. L3, R3, L4, R4). If required, the data could be requested and displayed by car number for greater detail. Further, the data are readily available in alternative combinations depending upon the experience pattern being analyzed, such as diagonal wheel repairs. (Caution: use Report 4 data in conjunction with Report 3 and other integrated data to analyze any component(s) total cause and effect - see Section V, A, 2: Data base inquiry subsystem, page B-41.)

Column 5, No. of repairs: This column of data provides the numerical frequency of the repairs.

Columns 6-10: These columns provide the breakdown of the AAR standard hours and prices.

NOTE: The actual test data collected for Report 4 are not shown in the example provided at the end of this Appendix because of space restrictions. The data are on file at the TDOP office.

B. Existing truck maintenance cost collection (Cont'd)

2. On-line maintenance

Based upon discussions with members of the railroad industry and its suppliers, there appear to exist little or no integrated historical data for on-line truck maintenance costs for home cars comparable to the off-line data. (The collection of test data for this category of cost is currently in progress.)

However, since the data are recorded on a variety of source documents (e.g., bad order cards and other field records), it is possible to reconstruct a general historical truck operating cost picture. By retrieving and reviewing the available field documentation, a determination can often be made of the components repaired and their date and location by car number. However, the documentation does not often provide a satisfactory level of detail for determining truck economic operating life cycles. For example, the reported data usually do not include the causes or frequencies of truck wear and failure. Further supplementation is required, such as estimating the repair labor hours utilized, the material quantities used, the failure cause, and other factors. The TDOP economic staff's experience in reconstructing some of these on-line maintenance costs with the data available reveals the need for a modernized, more simplified, cost collection procedure.

In proposing an improved procedure for reporting on-line maintenance activities, it is not appropriate that the design of the input format be standardized in this methodology. It is appropriate that the design remain flexible to accommodate the differences that exist among the users' own truck maintenance work practices and operating environments. With respect to the data content to be reported on the format, however, observing the following principles can be expected to dramatically improve the reliability of the existing data:

a. Uniformity

Introducing a common maintenance code classification helps assure homogeneity of the reported data, making practical its orderly processing. The AAR Car Repair Billing System's common maintenance code classification is reasonably appropriate for this purpose in the initial stages of establishing a data collection procedure. It is advantageous because it exists, the code price values (i.e., the standard cost of repairs) are updated frequently, the code has wide acceptability and use, and it provides the opportunity for data exchange among users at their election. It is a relatively simple matter for users to augment the code (i.e., to enlarge it to meet their own particular needs, internal to their own processing systems). Augmentation occurs, for example, when a user elects to add a field of data to his own internal truck repair input reporting requirements to allow for more detail for any one transaction. (This technique would facilitate the collection of detail to the level of actual part numbers for selected troublesome components for periods of time long enough to establish their behavior patterns.)

b. Compatability

Some users currently collect repair data not comprehensive enough to meet emerging needs (e.g., data for reliable economic operating life cycle determinations). At the same time, analysis of some of these data collection systems reveals they can be more economically retained and supplemented as opposed to discontinuing their use and designing new ones. Indeed, many of the maintenance repair system procedures reviewed are so firmly entrenched that to discontinue them could have serious undesirable repercussions on other parts of the user's organization that depend on the existing data. For example, some of the existing data collection systems, established for maintenance cost accounting purposes, are satisfactory to meet ICC cost reporting regulations, but unsatisfactory to meet the data requirements for determining component cost behavior. Unsatisfactory, because the input reporting procedures often do not require field forces to report, for example, the material applied when they repair freight cars. (Often there is no reporting at all of either labor or material for individual truck component repairs.) Where the discontinuance of such systems would cause undesirable economic effects (e.g., that may be due to re-training, re-programming and other similar costs) when compared with a new or revised system, then the individual users can elect to maintain and improve upon their existing maintenance code structure, and at the same time make it compatable with the AAR code structure. It is a relatively easy process to translate one code to another by means of internal conversion tables.

c. Simplification of field input reporting

Accuracy and economy of field input reporting for truck maintenance can be enhanced when the data are collected in a manner that is natural to the environment from which the data originate. An important rule to follow is for the user to avoid additional field input reporting that does not result in a clerical trade-off. Additional clerical work on the part of field forces can often be avoided by modifying similar existing reporting procedures. The introduction of a new or revised input reporting procedure should only be allowed when it can qualify as a more simplified, improved substitute for existing input reporting procedures in terms of accuracy, relevancy, form and content.

(NOTE: In the interest of collecting and using accurate and relevant data, it is desirable that field forces use the same input reporting medium to meet both payroll and on-line home car maintenance data collection requirements. But in every case observed by the TDOP economic staff, the two are kept separate. Some railroad industry personnel argue that the differing objectives of the two requirements justify their separation. However, industry personnel, whose companies do not currently collect maintenance data but are planning to, may find it worthwhile to examine the advantages and limitations of integrating both procedures.)

It is in the same interest that maintenance data collection procedures require field forces to report both labor and material through the same medium for the same repair function. This is most often not the case. Often, in practice, labor alone is reported, and then only at a high level of aggregation (i.e., labor is reported for freight car repairs for the entire fleet, as opposed to reporting repairs for the individual freight cars or the individual freight car components). The solution to acquiring labor utilization data combined with the material applied, for the detail level of individual freight car truck component repairs, may be economically resolved by using a pre-printed combination write-in and check-off format that is compatible with both the field personnel preparing the report and the computer processing procedure. An example of this comprehensive input reporting follows.

(1) <u>Comprehensive input reporting</u>

The document illustrated on the following page (AAR Car-Repair Billing - Original Record of Repairs) is an actual example of one being used by one railroad currently under study, for recording their repairs to foreign cars. This document is currently under revision by that railroad for purposes of further improving the data by requiring the field forces to record such things as wheel gage finger readings.

AAR CAR REPAIR BILLING - ORIGINAL RECORD OF REPAIRS

CS-2434-D

(1)	LOCATION (2-5)	DATE (6-11)	CAR INITIAL (12-15)	CAR NUMBER (16-21)	KIND(22)	REEL NO. / IMAGE NO (23-29)
2		19				

CONTROL NO (30-33)	DEFECT CARD →	COMPANY (34-37)	DATE (38-43)	INSPECTOR	(44-47) MNHR →	MAN HRS. (48-50)	(51)	(54-57) TMPR →	TEMP. REPAIRS (58-59)	(60-61)	PAGE____OF_____
			19								

PROJECT NUMBERS	PROJ (44-47) →	(48-53)	(54-59)	(60-65)	(66-71)	(72-77)

✓	RULE	ITEM REPAIRED	QTY (44-47)	APPLIED (48-51) JOB CODE	APPLIED (52-53) QLFR	REMOVED (54-57) JOB CODE	REMOVED (58-59) QLFR	WHY MADE CODE (60-61)	CONDITION OF MATERIAL (62)	LOCATION (63-72)	RESP (73-74)
	41	WHEEL	1						FFC 4, NOT FFC 5, OWN MTL 6	R 1 2 3 4	
	41	WHEEL	1						FFC 4, NOT FFC 5, OWN MTL 6	L 1 2 3 4	
	42-43	AXLE	1						NEW 1, SH 2, OWN MTL 6	1 2 3 4	
	41	LABOR	1					A/C REP (09)	LBR ATN (0)	1 2 3 4	
	41	WHEEL	1						FFC 4, NOT FFC 5, OWN MTL 6	R 1 2 3 4	
	41	WHEEL	1						FFC 4, NOT FFC 5, OWN MTL 6	L 1 2 3 4	
	42-43	AXLE	1						NEW 1, SH 2, OWN MTL 6	1 2 3 4	
	41	LABOR	1					A/C REP (09)	LBR ATN (0)	1 2 3 4	
	24	LUBRICATORS	8					WO 01, MISS 03, OBSOL 07, A/C REP 09	NEW (1)	(CS)	
	24	LUBRICATORS						WO 01, MISS 03, OBSOL 07, A/C REP 09	NEW (1)	R 1 2 3 4 L 1 2 3 4	
	24	LUBRICATORS						WO 01, MISS 03, OBSOL 07, A/C REP 09	NEW (1)	R 1 2 3 4 L 1 2 3 4	
	30	JOURNAL BRASS						WO 01, BRO 02, MISS 03, A/C REP 09	NEW (1)	R 1 2 3 4 L 1 2 3 4	
	30	JOURNAL BRASS						WO 01, BRO 02, MISS 03, A/C REP 09	NEW (1)	R 1 2 3 4 L 1 2 3 4	
	31	JOURNAL WEDGE						WO 01, MISS 03, BENT 05, A/C REP 09	NEW 1, SH 2	R 1 2 3 4 L 1 2 3 4	
	33	JOURNAL BOX LID						WO 01, BRO 02, MISS 03, BB REP 06	NEW (1)		
	33	JOURNAL BOX LID SEAL		2778		2778		WO 01, BRO 02, MISS 03	NEW (1)		
	33	JOURNAL BOX REAR SEAL		2786		2786		WO 01, BRO 02, MISS 03	NEW (1)		
	36	ROLLER BEARING	1						NEW 1, SH 2, REC 3, OWN MTL 6	R 1 2 3 4	
	36	ROLLER BEARING	1						NEW 1, SH 2, REC 3, OWN MTL 6	L 1 2 3 4	
	36	ROLLER BEARING	1						NEW 1, SH 2, REC 3, OWN MTL 6	R 1 2 3 4	
	36	ROLLER BEARING	1						NEW 1, SH 2, REC 3, OWN MTL 6	L 1 2 3 4	
	36	R.B. LUBRICANT FITTING		2868		2868		WO 01, BRO 02, MISS 03, OBSOL 07	NEW 1, SH 2	R 1 2 3 4 L 1 2 3 4	
	37	PEDESTAL ADAPTER NARROW, 11 IN. OR SMALLER		2870		2870		WO 01, BRO 02, MISS 03	NEW 1, SH 2	R 1 2 3 4 L 1 2 3 4	
	37	PEDESTAL ADAPTER NARROW 12 INCH		2874		2874		WO 01, BRO 02, MISS 03	NEW 1, SH 2	R 1 2 3 4 L 1 2 3 4	
	37	PEDESTAL FRAME KEY		2882		2882		WO 01, BRO 02, MISS 03	NEW 1, SH 2	R 1 2 3 4 L 1 2 3 4	

✓	RULE	ITEM REPAIRED	QTY (44-47)	APPLIED (48-51) JOB CODE	APPLIED (52-53) QLFR	REMOVED (54-57) JOB CODE	REMOVED (58-59) QLFR	WHY MADE CODE (60-61)	CONDITION OF MATERIAL (62)	LOCATION (63-72)	RESP (73-74)
	73	A C I						BRO 02, MISS 03, ILLGBL 22, IN CRCT 23	NEW 1		
	74	COTTER OR SPLIT KEY		4400		4400		WO 01, BRO 02, MISS 03	NEW 1		
	74	BOLT, 12 IN. LONG OR LESS		4404		4404		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	BOLT, OVER 12 IN. LONG		4408		4408		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	BOLT, HIGH TENSILE		4412		4412		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	RIVET, LESS THAN 5/8 IN. DIA.		4416		4416		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	RIVET, TWO-PIECE LESS THAN 5/8 IN. DIA.		4424		4424		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	RIVET, TWO-PIECE 5/8 IN. DIA. OR OVER		4428		4428		WO 01, BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	74	NAILS (Per 1/10 LB)		4445		4445		BRO 02, MISS 03, A/C REP 09, D/REM 10, LOOSE 18	NEW 1		
	75	LABOR, FRT CAR (Per 1/10 hour)		4450		4450		BENT 05, A/C REP 09	LBR ATN 0		
	75	METAL END STRAIGHTENED HOUSE CAR		4464		4464		BENT 05, BLG OUT 14	LBR ATN 0		
	76	STRAIGHTEN OR FORGE WELD PART OFF CAR		4490		4490		BRO 02, BENT 05	RR & R 8		
	77	SEAL HOOK-PIN-WEDGE WITHOUT SECUREMENT		4500		4500		BRO 02, MISS 03, BENT 05	NEW 1, SH 2		
	77	DOOR HASP		4508		4508		BRO 02, MISS 03, BENT 05	NEW 1, SH 2		
	77	SIDE DOOR REPLACED		4536		4536		OUT GUIDE 17	LBR ATN 0		
	78	LUMBER (BOARD FEET)		4550		4550		BRO 02, MISS 03, D/REM 10, DCYD 26	NEW 1		
	79	HAND HOLD OR GRAB IRON		4580		4580		BRO 02, MISS 03, BENT 05, BB REP 06	NEW 1, RR & R 8		
	79	SILL STEP WITHOUT CENTER TREAD		4584		4584		BRO 02, MISS 03, BENT 05, BB REP 06	NEW 1, RR & R 8		
	79	LADDER TREAD		4592		4592		BRO 02, MISS 03, BENT 05, BB REP 06	NEW 1, RR & R 8		
	79	LADDER SECTION COMPLETE PER TREAD		4596		4596		BRO 02, MISS 03, BENT 05, BB REP 06	NEW 1, RR & R 8		
	82	TACK OR FILLET WELD		4800		4800		BRO 02, A/C REP 09	LBR ATN 0		
	82	BUTT JOINT WELD OVER 1/8 TO 1/2 INCH		4808		4808		WO 01, BRO 02, A/C REP 09	LBR ATN 0		
	82	BUTT JOINT WELD OVER 1/2 TO 1 INCH		4812		4812		WO 01, BRO 02, A/C REP 09	LBR ATN 0		
	82	WELD REMOVED (ANY SIZE)		4820		4820		A/C REP 09	LBR ATN 0		

QTY (44-47)	APPLIED (48-51) JOB CODE	APPLIED (52-53) QLFR	REMOVED (54-57) JOB CODE	REMOVED (58-79) QLFR	WHY MADE (60-61)	COND (62)	LOCATION (63-72)	RESP (73-74)	NET CHARGE (34-43)	DUP (44-53)	(54-57)	DESCRIPTION OF REPAIRS MADE (58-79)
											DESC	
											DESC	
											DESC	
											DESC	

This standardized, pre-printed, pre-coded combination write-in and check-off type format was developed by the railroad company because of its economic advantages. The standardized format helps to assure accuracy resulting in less clerical effort for screening, correcting, and recycling. (In addition, use of the format can result in less clerical effort to prepare when compared with prior methods which depended almost entirely on writing in longhand.) These features shift the clerical burden to the computer.

For these reasons, this procedure for recording foreign car repairs, or a similar modified one, appears well suited for many railroad companies and their suppliers to consider adopting for collecting on-line home car maintenance data. Because the AAR Car Repair Billing System is so widely used, no discussion is required here relative to the code structure or the format design which is apparent in the illustration provided. However, at least three unique features in the header of this repair input record add significantly to the value of its use for collecting home car repairs, and require comment.

(a) Provision for collecting actual labor utilization

This provision (see "Man Hrs." field in the header of the illustrated record, card columns 48-50,51) can provide the user with the capability of collecting actual truck repair labor utilization by individual car number. This is a significant step toward developing such workload scheduling and performance measures as standard truck repair labor hours per car based on the railroad's actual experience. This is a rougher measure than standard truck repair labor hours per truck component. However, when field forces have adjusted to this reporting requirement, greater levels of sophistication can be introduced to develop more refined standards. For example, it is a simple matter to reformat by shifting the "Man Hrs." field from the header of the format to its body. In that way, a space is provided for labor to be reported for each "item repaired."

(b) Provision for collecting temporary repair data

This provision (see "Temp. Repairs" field in the header of the illustrated record, car columns 58-59, 60-61) can provide the user with the capability to collect temporary repairs to trucks. It is this feature that can provide the user with the early warning truck defect data, referred to in this Appendix under Section I, A, 3, page B-5: The economical data collection approach.

(c) Provision for collecting truck project maintenance data

This provision (see "Project Numbers" fields, card columns 44-47, etc.) can provide the user with the capability of collecting data that report the completion of up to five different maintenance projects for any one car. Obviously, the input format does not enable the user to determine which project the components were changed out for, or whether they were changed out due to "normal" maintenance. (Currently these fields are not being used, but one plan is to require that the components recorded only apply to "normal" maintenance, and that the recording of the project numbers only apply to providing the user with notification that one or more projects have been completed.) However, a slight change in format would enable a user to collect the detail of components changed out for each of the projects and also for the "normal" maintenance performed on each car. This can be accomplished by restricting the use of the input document to one project per car for project reporting. Similarly, no project numbers would be reported on the same document that reported "normal" maintenance on the car. (Eventually, the actual labor utilized could also be reported: see above, "Provision for collecting actual labor utilization.")

The value of this format change becomes clear when maintenance project cost accounting procedures currently used by some railroads for many projects are understood. A car maintenance project differs from "normal" car maintenance by its uniqueness. The work performed on maintenance projects is usually a one-time effort as opposed to routine maintenance. The modification of the interiors of frieght cars to meet certain shipper's requirements for handling certain commodities is a widely known example of a "maintenance project." The modification of certain freight car trucks to test experimental changes in wheel configuration is another example. A "detail of estimate" is generally prepared by railroad personnel for such projects. The estimate contains instructions to field personnel for the work to be performed. A cost estimate is also made which distinguishes between capital and operating costs. Under some current project completion reporting the field forces are not always required to report the material applied. More often the labor used is reported alone and then not on completion reports. When general office personnel are notified that a project has been completed, the assumption is that it has been completed in accordance with the "detail of estimate." At that time, they credit the Maintenance of Equipment department operating expense (ICC account 314) with the capital cost estimate found in the "detail of estimate." In effect, in such cases, the actual cost of the project is not known, obviously restricting control over the operating budget. (And obviously the degree of accuracy of the "detail of estimate" may go unknown.)

This practice of not consistently collecting material applied and labor used on projects on the same input medium associated with truck components seriously impedes the determination of truck economic operating life cycles. There are other adverse side effects that are related to the control of material that deserve mention. For example, projects may be cancelled in a semi-completed state. Material may already be delivered to project sites prior to the cancellation. The project material may find its way back to inventory, or it may be inadvertently used for "normal" maintenance, or it may be left unused. Therefore, its disposition may be left to the exigencies of the moment, as opposed to disposition by management control, because of the lack of labor and material application data collection. The evidence in favor of collecting detail project data seems compelling enough to encourage companies within the industry to re-examine the economic feasibility of acquiring such data under their own maintenance conditions.

(2) Less detailed input reporting

As a minimum, railroad users could adopt a less detailed method of collecting maintenance data. An example could be to make use of the back of the bad order card to collect the data. A simplified example of the format might be as follows:

Back of the Bad Order Card

Car init. & no. __________ Date of bad order __________

Repair location __________ Date work completed _______

Truck Component					
AAR Code	Full Description	Needs Repair	Repair Made	Mat'l Qty.	AAR Repair Reason
XXX	Wheel, etc.	✓	✓	XXX	XXXX

NOTE: These input procedures can be used to collect maintenance data (including inspection time) at both running and heavy repair facilities.

C. Other operating costs

The collection of test data for the other truck-associated operating costs is currently in progress. These are the costs incurred for losses and damages to commodities (i.e., freight damage payments), derailments, and associated train and roadway costs.

The order of priority was to begin gathering the data by individual car number similar to the procedure used to collect the truck maintenance cost test data. Concurrently, the methods of collecting and integrating the data in the truck economic data base are being modified and standardized as a result of the test data acquisition findings. The last order of priority will be to analyze the data. (See subsection V, Data Analysis Progress, pages B-40 to B-50.)

1. Freight damage payments

The data for commodity losses and damages that result in freight damage payments are kept in considerable detail in railroad company files.[14/] In those cases where the files are computer-oriented, it is a relatively easy matter to access the data by car number. Manually-oriented data should, as a minimum, be cross-indexed to allow the same accessing capability. The minimum relevant test data available appear to be:

- Car initial(s) and number(s)
- Claimant identification
- Month and year in which the settled claim was entered into the statistics file
- Claim payment (money amount)
- Proportions of claim payment by incurring organization
- Commodity identification
- Carload - less than carload
- Billing road
- Origin city and state
- Shipper
- Destination road, city and state
- Consignee
- Cause - reason for claim[15/]

Although the causes of the commodity losses and damages are reported, the test data that have been collected indicate the

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14/ See also the latest issue of Rules of Order, Principles and Practices, Freight Claim Rules, Association of American Railroads, Freight Claim Division, Washington, D.C. 20036.

15/ Ibid., "Guide for Allocation to Causes and Commodities of Freight Claim Payments Charged to Loss and Damage Account" (page 92 of the 1974 Rules of Order publication, as amended at the 84th annual AAR session, June 10, 1975.)

causes are not refined sufficiently to identify whether or not they were due to truck operations. Determination of the truck-caused costs from the available records is further inhibited by the lack of a date and the specific location that would indicate when and where the loss occurred. While this area of cost is still under investigation, there are existing indicators that point to a partial resolution to meet immediate information needs. For example, more comprehensive data becomes available when the losses and damages were the result of an accident that must meet Federal Railroad Administration reporting requirements.[16] (Examination of one major railroad's input reporting procedure used to help comply with the FRA requirement, shows that it provides for the standardized collection of comprehensive accident data that identify the consist [i.e., train make-up]; damage to each car and its content; operational data, such as speed, time table direction, track and grade conditions; and other relevant information.) In cases where the commodity losses may not have been associated with an accident, then each car's freight damage report must be retrieved and analyzed separately. Based upon the TDOP test procedures that are currently in progress, a subsequent economic analysis report will describe the appropriate data acquisition methods to meet future truck economic data base needs for truck-related freight damage costs.

2. Derailment costs

The collection and integration of derailment costs by individual car appear to be readily available. A primary source for the test data was the accident reports mentioned in

16/ See Rail equipment Accident/Incident Report, Form FRA-F-6180-54 (8-74).

the previous section. Supporting test data were gathered from retirement history files (kept by railroads). These data are particularly helpful for subsequent cash flow analysis. They provide a pathway for the user to determine the undepreciated book value of a car that may have been retired early and sold at a book loss as scrap. Current Federal tax regulations, as they apply to railroads, prevent such a book loss from qualifying as an expense (and therefore as a tax shield). This is the case because car depreciation is based on a "pool" concept which provides an "allowance" for such book losses. However, a railroad having a comprehensive truck economic data base (which includes the book loss experience) would be in position to test that "allowance" by developing the actual economic operating life cycles of its own trucks. That is, the railroad's actual useful life cycle information, when compared with the useful life cycle bases that are included in current regulatory depreciation procedures should provide a meaningful measurement of the equity of those procedures.

A more important capability to develop is the capability to determine the causes of derailments. A wider and more comprehensive study is being carried out in that direction within the railroad industry compared with this study. An example is the government-industry research program on track/train dynamics. The published reports of that continuing program (such as the track-train dynamics report, Accident Investigation, copyrighted 1974) and other programs are being used as guides for the TDOP economic analysis effort. The contribution being aimed at by TDOP is to provide the industry with a procedure for determining the freight car truck's actual historical operating cost environment as another means for analyzing the conditions under which derailments occur. (See Section D: Operating conditions, page B-38.)

3. Train delay and lost car day costs

The collection of test data for truck-related train delay and lost car day costs were not initiated during this phase of the effort, but will be developed in a subsequent phase.

4. Other track/train component costs

The only category of the other track/train component cost test data being currently collected are the truck-related car component repair costs. (The progress of this effort is found in this appendix in Section IV, B, page B-15: Existing truck maintenance cost collection.) In the future, the Maintenance of Way and Maintenance of Equipment cost accounting and inspection reports are expected to help provide test data for the remaining truck-related roadway and locomotive component costs.

D. Operating conditions

Developing the capability to determine the actual operating cost of existing trucks is critical for the economic comparative analysis of competing existing trucks (or proposed improvements to them). Equally important is developing the capability to determine the conditions under which the trucks operate when incurring costs. The progress of collecting test data in this area follows:

1. Available car movement data

Many railroads maintain car movement systems containing records of empty-to-loaded-to-empty cycles. Some railroad personnel interviewed (e.g., Southern Railways, Canadian National, Trailer Train, Southern Pacific, FRA, AAR) indicate that some of these systems are computerized and provide a considerable degree of car movement detail. These systems trace detail car movements on-line.

Off-line car movement data are available (in less detail) from the Universal Machine Language Equipment Register (UMLER) and the Telerail Automated Information Network (TRAIN II) systems.

The objective here is to collect the on- and off-line car movement data and integrate them with the truck operating costs. Meeting that objective would provide significantly more complete and integrated truck operating condition data than now appear available. This capability should be developed slowly and gradually by potential railroad users because of the large volume of data involved and the need for familiarization with the data selection, acquisition, and integration procedures for truck economic evaluation purposes.

2. <u>Car movement test data</u>

Preliminary test data from one of the existing car movement systems have been collected and provide the following history (from inception of the system) by car initial and number:

- Geographic departure and arrival location by hour, day, month, and year and the loaded and empty mileage
- Commodity carried, gross weight, destination, consignee
- Traffic service (pool assignment)
- Bad order time (out-of-service)

Since geographic information has been provided, it next becomes possible to closely approximate the actual track grade and curvature conditions and the roadbed stability over which the truck operated. The available empty and loaded daily car miles provide the data for average annual mile calculations. The traffic service is available. The commodity carried is known (an important link to freight damage payments), as well as the weight for wheel load calculations. (These determinations and calculations have not yet been made because the test data collection program for operating conditions is still in progress.)

3. Car specification test data

Car class data related to the trucks being studied were readily available and were collected from "The Official Railway Equipment Register" for the class description, code designations, capacity, and the number of cars in the class.

The average car age in the car class will be determined from the equipment register noted above, adjusted for population attrition (e.g., retirements) and out-of-service time. (The analysis of population derivations and out-of-service time is currently in progress.)

The source of test data for average speed has not yet been determined. Consideration is being given to speed recorders versus manual recording and other methods such as train operation simulators (as used to determine average speeds under the Roadway Costing Contract DOT-FR-30028, TOPS On-Line Services, Inc., 50 California Street, San Francisco, CA 94111.)

V. Data Analysis Progress

The preparation of economic data analysis guidelines for industry consideration is currently in progress. These are the guidelines to be considered by the user for the effective exploitation of the truck economic data bases, and for the development of their truck economic operating life cycle and cash flow models.[17]

A. Exploitation of the truck economic data base

1. Size of the data base

It seems advantageous for potential users to consider limiting the size of the data base in the initial stages of implementation to, for example, poor truck component performers. A reasonable limiting factor would be for users to rely on professional experience with respect to judging which truck components are the poorest performers economically. This approach allows time for assimilating the procedures and making the inevitable adjustments to them as a preliminary step to expanding and refining them.

2. Data base inquiry subsystem

A data base inquiry subsystem can provide the appropriate means for retrieving the relevant information for data analysis. Examples of various data selections, sorts and aggregations using economic test data can be found in the body of the

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17/It is particularly important to stress to the potential user that these are guidelines. These are not exclusive data analysis techniques. One reason for stressing this point has to do with the physical and financial environmental differences that exist among companies within the industry. For example, the cost of capital is a significant variable to be considered in evaluating capital investments. However, methods of calculating that cost do not have the same degree of acceptability and application among potential users. The reason for that is due, in part, to such environmental differences as: ability to attract capital, productivity of capital, opportunities, and management skills. Another, and related, reason for stressing the idea of guidelines is that the theory and practice of economic quantitative analyses, as they apply to measuring the economic performance of physical operating assets (i.e., railroad rolling stock), appear so well established in the railroad industry as to preclude the preparation of detailed instructions for their selection and use. (These are the qualitative analysis techniques, for example, that may have use for economic truck component wear and failure cause and effect analysis such as frequency distributions of incidence; or may have use for economic risk analysis such as absolute and relative measures of dispersion: i.e., standard deviation, coefficient of variation.)

report formats at the end of this Appendix. Specific data retrieval requests are a function of the user's data analytical needs. Data base inquiry subsystem experimentation with the preliminary TDOP truck economic data base (i.e., for off-line maintenance) suggests that careful planning be given to the inquiry function. For example, wheel performance analyses that examine the reported wear and failure frequencies by cause and effect should not, perhaps, be restricted to the wheel data alone. In an actual case of a data base interrogation by one railroad for wheel cost performance, the significant data used were: (values not shown)

Wheel "X" Removal Data Retrieval

Column	Select	Sort	Aggregations
8	Wheel type X	Constant	
1 & 2	Car I.D.	Random	
3	Repair date	By car	
4	Location	"	
5	Position	"	
6	Mat'l qty.	"	Total whl. X
7	Repair cause	"	
9	Responsibility line	"	
10	Handling line	"	
11	Dollar amount	"	Total whl. X

These performance data do show wheel type X's wear and failure causes by car number. However, the conclusions to be drawn from these data, regarding the cost effect of the wheel removals, even assuming they represent the total type X wheel population over a significant time period, cannot be far-reaching. The reason is that the data were not integrated. While the reported causes are available for analysis, the total cost effect is not. The cost effect, for example, that becomes evident when any one of the wheel repairs is examined in relationship to all the truck and other car component repairs made on the same day, at the same location. It is in the requesting of the relevant combinations from a fully integrated data base that the greatest potential lies for establishing the truck's operating cost performance.

B. Truck economic life cycle modeling

The truck operating cost and operating condition data have been investigated more thoroughly than for other data elements required for a determination of truck economic operating life cycles, during the period covered by this report. The data analysis progress for the source and application of the following other data elements that require further investigation for the development of a realistic economic life cycle model is as follows:

1. Truck component population and out-of-service time

The cooperation of the railroad industry and its suppliers is quite essential for component population determination. Since the truck components do not make up an inseparable unit, there is an exponential difficulty in keeping track of their population sizes, movements, and conditions. Sources for at least population size may be available through railroad company material shipping and receiving records and suppliers' material sales records.

Similarly, industry cooperation seems essential for determining out-of-service time. This is especially critical for estimating the probability of wear and failure incidence (i.e., the causes of out-of-service time must be known to provide the means of separating them between truck and non-truck causes).

2. Probability of truck component wear and failure occurrence analysis

This element depends upon the completion of the test data collection and the establishment of the test data base which is expected to contain the incident experience for probability analysis. For example, the out-of-service time mentioned above is an essential element for estimating the probability of wear and failure occurrence.

3. Truck component inventory cost

The two major costs to be considered in developing inventory cost are direct costs of the components and the carrying costs:

a. Direct cost of component inventory
   (1) Manufacturer's cash delivered purchase price to user (new or used)
   (2) User's labor, material, and overhead cost to make (new or rebuild)

b. Component inventory carrying cost
   (1) Storage facilities
   (2) Insurance
   (3) Handling
   (4) Depreciation
   (5) Taxes
   (6) Transportation
   (7) Interest

4. Removed component's residual life

Truck and other components may be changed out due to truck performance and still be in useable condition. The accurate determination of components' residual life (and therefor the remaining economic value) presents a difficulty due to record keeping problems of maintaining surveillance over population size, movement, and condition (see Section I: Component Population and Out-of-service Time, page B-43).

This difficulty is overcome in the initial stages of this analysis by relying on the AAR standard price structure for car repair billing. The AAR price has an allowance for the residual life dollar value.

5. Unit cost measures

The development of unit cost measures also awaits the establishment of the completed test data base. They are a function of the user's comparative analysis needs. The approach taken in the test procedures will be first to establish the total cost of a truck per mile and then to expand and refine the measures. For example:

For a given track/train operating configuration

- Truck's total operating cost/mile/year/age group
- Truck's selected operating cost/mile/year/age group[18/]
- Truck's selected operating cost/empty mile/year/age group
- Truck's selected operating cost/loaded mile/year/age group
- Truck component's selected operating cost/mile/year/age group[19/]
- Truck component's selected operating cost/empty mile/year/age group
- Truck component's selected operating cost/loaded mile/year/age group

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18/ Selected operating costs such as: commodity loss and damage cost; or derailment cost; or lost car day cost per mile per year per age group.

19/ Truck component operating costs such as: the maintenance cost of 36-in. diameter, 2 wear, J-36 wrot-steel wheels with 8-14 sixteenths' service metal remaining when removed, per mile per year per age group.

C. Truck cash flow modeling

1. The cash flow data element determinants

a. Trucks that compete and have similar configurations

(1) Existing trucks

(2) Improved trucks

b. Truck operating conditions that are similar

(1) Car class description (kind, number, builder)

(2) Commodity carried (type, weight)

(3) Average annual car miles (empty, loaded)

(4) Average car age (years)

(5) Roadway conditions (class, type)

(6) Other conditions

(a) Topographic

(b) Average speed

(c) Geographic

(d) Wheel load

(e) Traffic service (unit trains, general service, type of locomotive)

c. Truck operating costs

(1) Maintenance

(2) Commodity loss and damage

(3) Derailment

(4) Train delay

(5) Lost car days

(6) Associated train and roadway components

d. Truck financial costs

(1) Net initial incremental cash investment in proposed improvements

(a) Manufactuers' cash delivered installed price (cash-out)

(b) Use taxes, e.g., sales tax (cash-out)

(c) Current assets, e.g., inventory (cash-out)

(d) Investment tax credits (cash-in)

(e) Capital gains or losses[20/] (cash-in)

(f) Scrap value (cash-in)

(2) The cost of capital

(a) Debt

(b) Equity

e. Rate of return computational factors

(1) Net initial incremental investment

(2) Annual gross cash benefits[21/] (cash-in)

20/ Long or short term capital gains or losses seem most unlikely for this type investment. However, there may be the possibility that existing trucks which may not be fully depreciated might be sold in favor of improved trucks. Depending on the slim chance that such sales would occur and have a high order of magnitude (say, 1000 trucks or more) then the additional possibility might exist that tax authorities would recommend the sales be handled in terms of capital gains or losses (see Section C, 2, page B-36: Derailment costs). In that case, sales of trucks in amounts greater than the undepreciated book value (however extremely unlikely) would result in capital gains. The capital gains after tax would result in a "cash-in" transaction which would serve to lower the initial incremental investment in improved trucks. Sales of trucks in amounts less than the undepreciated book value would result in a book loss. The loss would provide a tax shield and therefore result in a "cash-in" transaction. (The book loss is not visited on new investments for investment evaluation purposes, i.e., prior "unprofitable" decisions are not to burden future decisions anticipating profits.)

21/ Annual cash difference between actual operating costs of existing trucks and the estimated operating costs of improved trucks. (The benefits could be negative, i.e., a loss.)

e. Rate of return computational factors (cont'd)

(3) Depreciation schedule[22/]

(4) Federal income tax

(5) Probability of occurrence (i.e., benefits and cost)

(6) Inflationary index (price level factor)[23/]

(7) Present value tables

(8) Percent weighted average of the cost of capital[24/]

22/ Op. cit., Report No. FRA-OR & D 75-58, Appendix A, page 22, for depreciation calculations.

23/ A broad index would be the price deflator used by the government to bring costs up to date for the gross national product. "This GNP deflator rose 10.3% last year and 5.6% in 1973, and since 1958 it has climbed 84%." (See Wall Street Journal, November 12, 1975, page 36.)

24/ A cost of capital model is in preparation and will be presented in a subsequent report.

2. Incremental investment evaluation calculation method[25]

a. Estimated net present value per car set

(1)	Net cash investment [item d (1), p. B-47]		$______
(2)	Annual net cash benefits		
	(a)	Gross cash benefits [item e (2), p. B-47]	$______
	(b)	Less: depreciation	______
	(c)	Gross cash benefits (before tax)	$______
	(d)	Less: Fed. Inc. Tax	______
	(e)	Accounting profit	______
	(f)	Net cash benefits (before recoveries [Line (d) minus (a)])	$______
	(g)	Plus: scrap value recovery	______
	(h)	Current asset recovery	______
	(i)	Net cash benefits (after recovery)	$______
(3)	Net present value of the benefits		
	(a)	Annual net cash benefits [Line (2), (i)]	$______
	(b)	Times: Prob. of occurrence factor	
	(c)	Net cash benefits adj. for prob.	$______
	(d)	Times: Inflationary index	
	(e)	Net cash benefits adjusted	$______
	(f)	Times: Present value factor	
	(g)	Present value of the benefits	$______
	(h)	Net present value per car set [Net investment (1) minus present value (3), (g)]	$______
	(i)	Profitability index [Present value (3), (g) ÷ net investment (1)]	$______

25/ In actual practice the calculations are based on time-phased estimates of the cash flow (i.e., benefits and costs) over the economic operating life of the trucks.

b. Estimated total annual savings

(1) Net present value per car set $__________

(2) Times: truck population ÷ 2

(3) Estimated total annual savings $__________

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REPORT 1

CUMULATIVE TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

31 Months from December 1972 through June 1975 (31 months from inception)

Car Numbers: SP668000 through SP668099 (excl. SP668051) 99 cars

Date Car Class Built:	Nov. '72	Class Description:	Box, HC, 22 Belt, D.F. Nail Stl. Flr, 50K
Car Builder(s):	ACF	AAR Mech. Designation:	XL
Car Capacity (lbs):	176000	AAR Car Type Code:	A330

Trucks: Barber stabilized with low profile side frames

Line	AAR Rules		Removed	Off-line Maintenance		On-Line Maintenance		Total Maintenance	
No.	No.	Name	Job Numbers	No. of Repairs	AAR Std. Net Price	No. of Repairs	AAR Std. Net Price	No. of Repairs	AAR Std. Net Price
1.	41	Wheels	3000 - 3180	60	$1873.88		$		$
2.	36	Roller Bearings	2800 - 2868	40	229.90				
3.	37	R.B. Adapters	2870 - 2882	17	35.86				
4.	26	R.B. Lube	2550 - 2552	3	27.54				
5.	43	Axles, R.B.	3250 - 3278	20					
6.	47	Bolsters	3500 - 3556, 3999	--	--				
7.	47	Center Pins	3560	3	51.15				
8.	47	Center Plates	3564						
9.	47	C.P. Liners	3568						
10.	47	Side Bearings	3572 - 3580, 3999						
11.	48	Side Frames	3700 - 3796, 3999						
12.	50	Springs	3900 - 3968, 3999						
13.	Total Lines 1 - 12			143	$2218.33		$		$
14.	6	Brake Beams	1640 - 1696, 1999	15	689.56				
15.	7	B.B. Hangers	1708	--	--				
16.	8	B.B. Brackets	1720 - 1724	--	--				
17.	9	B.B. Pins/Bolts	1740 - 1748	1	1.89				
18.	10	B.B. Supports	1764 - 1776	--	--				
19.	11	Levers, etc.	1792 - 1812	5	--				
20.	Total Lines 14 - 19			21	$ 691.45		$		$
21.	12	Brake Shoes	1828 - 1852	527	5792.70				
22.	Total Lines 13 + 20 + 21			691	$8702.48		$		$

REPORT 1 (Cont'd)

CUMULATIVE TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

OTHER CAR COMPONENTS [1/]

Line No.	AAR Rules No.	AAR Rules Name	Removed Job Numbers	Off-Line Maintenance No. of Repaird	Off-Line Maintenance AAR Atd. Net Price	On Line Maintenance No. of Repairs	On Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price
23.	3	IDT&S	1140 - 1144	96	684.65				
24.	4	Air Brakes & Parts	1160 - 1612	154	512.70				
25.	5	Air Brake Hose	1628	50	399.45				
26.	16	Couplers	2000 - 2160	49	823.75				
27.	53	Metal	4000 - 4020	1					
28.	69	Miscell. Material	4200 - 4244	8	105.35				
29.	70	Lightwt & Stencil	4300	16	592.32				
30.	73	Auto I.D.	4354 - 4368	5	10.63				
31.	74	Securement	4400 - 4445	103	233.26				
32.	75	Miscellaneous Labor	4450 - 4488	8	248.83				
33.	76	Straight - Forge	4490	15	73.82				
34.	79	Ladders	4580 - 4596	16	240.36				
35.	82	Welding	4800 - 4824	15	174.64				
36.	Sub-Total Lines 23 - 35			536	$4,099.76				
37.	72	Manufactured Material	1999	7	48.28				
38.	72	Manufactured Material	2999	58	2,308.10				
39.	72	Manufactured Material	3999	1	16.08				
40.	72	Manufactured Material	4999	1	10.50				
41.	Sub-Total Lines 37 - 40			67	2,382.96				
42.	Grand Total Lines 22 + 36 + 41			1294	$15,185.20				

[1/] These costs are grouped under Report 1 (i.e. under truck component maintenance) to demonstrate the capability of the economic procedure to accommodate total car component maintenance costs (required to isolate car costs caused by the truck but not charged to the truck).

Data analysis of the economic data base for off-line repairs (see Report 3, Daily Truck Component Maintenance Cost by Car Number for Car Class B-100-33) is required to separate out the non-truck-related costs in this grouping.

REPORT 2
MONTHLY TRUCK COMPONENT MAINTENANCE COST AND CAR MILES FOR CAR CLASS B-100-33
From Inception: 31 Months from December 1972 through June 1975
Car Numbers: SP668000 through SP668900 (excl. SP668051) 99 cars

Date Car Class Built: Nov. '72
Car Builder (s): ACF
Car Capacity (lbs): 176000
Trucks: Barber stabilized with low profile side frames

Class Description: Box, HC, 22 Belt, D.F. Nail Stl. Flr., 50K
AAR Mech. Designation: XL
AAR Car Type Code: A330

Calendar Months	Off-Line Maintenance No. of Repairs	Off-Line Maintenance AAR Std. Net Price	On-Line Maintenance No. of Repairs	On-Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price	Car Miles Empty	Car Miles Loaded	Car Miles Total
December 1972	28	$ 255.92		$		$			
January 1973	4	52.45							
February	5	16.08							
March	10	43.38							
April	10	106.33							
May	10	69.78							
June	17	124.16							
July	27	262.29							
August	49	351.92							
September	32	360.89							
October	65	913.42							
November	41	359.10							
December	39	529.95							
Total 1973	309	$3,189.75		$		$			
January 1974	35	$ 488.26		$		$			
February	44	430.10							
March	73	604.59							

REPORT 2 (Cont'd)
MONTHLY TRUCK COMPONENT MAINTENANCE COST AND CAR MILES FOR CAR CLASS B-100-33

Calendar Months	Off-line Maintenance No. of Repairs	Off-line Maintenance AAR Std. Net Price	On-line Maintenance No. of Repairs	On-line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price	Car Miles Empty	Car Miles Loaded	Car Miles Total
April 1974	74	2002.20							
May	55	420.49							
June	60	923.86							
July	62	814.49							
August	51	823.36							
September	58	746.82							
October	60	516.68							
November	54	711.98							
December	81	876.39							
Total 1974	707	$ 9359.22		$		$			
January 1975	41	524.99							
February	43	539.56							
March	85	317.70							
April	43	651.83							
May	20	231.94							
June	18	114.29							
Total 1975	250	$ 2380.31		$		$			
Grand Total 1/	1294	$ 15185.20		$		$			

1/ These totals cross balance with Report 1, line 42. They include total car component maintenance costs. See explanation: Report 1, page 2 of 2, footnote 1/

REPORT 3
DETAIL TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33
31 Months from December 1972 through June 1975 (31 months from inception)
Car Numbers: SP668000 through SP668099 (excl. SP668051) 99 cars

(Note: Off-line Repairs Only)

Date Car Class Built:	Nov. '72	Class Description:	Box, HC, 22 Belt, D.F. Nail Stl. Flt, 50K
Car Builder(s):	ACF	AAR Mech. Designation:	XL
Car Capacity (lbs.):	176000	AAR Car Type Code:	A330

Trucks: Barber stabilized with low profile side frames

(1)	(2)	(3)			(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Car		Repair Date				Removed					App'l			AAR Std.
Initial	Number	Yr.	Mo.	Day	SPLC	Job. No.	Cr. Lo.	Qlfr.	Wy Md.	Qty.	Cond.	RS	Hn. Ln.	Net Price
E.g.: SP	668000	74	07	01	689827	3081	L1	01	60	1	4	1	SSW	$ 164.09

Sort and Aggregation Notes;

Column (1) Car Initial : Hold constant or list alphabetically.
(2) Car Number : Ascending numerical order by car initial (if car initial is not constant).
(3) Repair Date : Ascending numerical order (year, month, day) for the same car number and car initial.
(4) Std. Point Loc. Code : Apply the value in the record.
(5) Removed Job No. : List according to the following table:
(6) Removed Car Location : List according to the following table:

(5)	(6)	Programmer Analyst (Reference Data Only) — AAR Rules	
Job Numbers 1/	Car Locations 2/	No.	Name
3000 - 3180	L1, R1 thru L4, R4	41	Wheels
2800 - 2868	L1, R1 thru L4, R4	36	Roller Bearings
2870 - 2882	L1, R1 thru L4, R4	37	R. B. Adapters
2550	None apply	26	R B. Lube - 4 wheel truck
2552	1, 2, 3, 4	26	R. B. Lube - wheel set
3250 - 3278	1, 2, 3, 4	43	Axles, R. B.
3500 - 3568	A, B	47	Bolsters, Cntr. Pl's, Pins, Liners
3572 - 3580	AL, AR, BL, BR	47	Side Bearings
3999	Rule 72 applies	47	Miscellaneous
3700 - 3796	*AL, AR, BL, BR*	*48*	*Side Frames*
3900 - 3968	None apply	50	Springs
1640 - 1696	1, 2, 3, 4	6	Brake Beams
1999	Rule 72 applies	6	Miscellaneous
1708 - 1852	None apply	7 - 12	See Report 1 for rule names

REPORT 3 (Cont'd)
DETAIL TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

Sort and Aggregation Notes - (Cont'd)

Column	(7)	Removed Qualifier :	Apply the value in the record.	
	(8)	Removed Why Made :	Apply the value in the record.	
	(9)	Removed Quantity :	Apply the value in the record.	(Some values will be in pounds of weight - i.e., Center Plates)
	(10)	Applied Condition :	Apply the value in the record.	
	(11)	Responsibility :	Apply the value in the record.	
	(12)	Handling Line :	Apply the value in the record.	(To include off-line, on-line and other organizations that performed maintenance)
	(13)	AAR Std. Net Price :	Apply the value in the record.	(Provide totals for each car number and initial and one grand total for all car numbers and initials. Provide grand totals for each rule number and one grand total for all rule numbers. Check against totals in Reports 1 and 2)

Footnotes:

1/ Job Numbers: Ascending numerical order for each repair date, for each car number, and car initial for each grouping of job numbers in the list.

2/ Car Locations: In the order shown for each job number, repair date, car number, and initial. Sort car location (2-digit, alpha-numeric code) on right-hand digit first (right justified).

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REPORT 4
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

31 Months from December 1972 through June 1975 (31 Months from Inception)
Car Numbers: SP668000 through SP668099 (excl. SP668051) 99 cars

(Note: Off-line Repairs Only)

Date Car Class Built:	Nov. '72	Class Description:	Box, HC 22 Belt, D F Nail Stl. Flt, 50K
Car Builder(s):	ACF	AAR Mech. Designation:	XL
Car Capacity (lbs.):	176000	AAR Car Type Code:	A330
Trucks: Barber stabilized with low profile side frames			

First Month: Dec. '72

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W.M.	Car Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
Example for Rule 41 - Wheels:									
3081	01	60	L1			$	$	$	$
			R1						
Total Car Loc. L + R1 (wheel set)						$	$	$	$
			L2						
			R2						
Total Car Loc. L + R2 (wheel set)						$	$	$	$
Total Car Loc. L + R1 + 2 (truck set)						$	$	$	$
(Repeat above entries for L + R3 + 4)									
Total Why Made 60 (car set)						$	$	$	$
(Repeat above entries for all Why Mades)									
Total Qualifier 01 (all Why Mades)						$	$	$	$
(Repeat above entries for all Qualifiers									
Total Job Number 3081 (all Qualifiers)						$	$	$	$

REPORT 4 (Cont'd)
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

First Month: Dec. '72 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W.M.	Car. Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
(Repeat above entries for Jobs 3000 - 3180)									
Total all Job No's. 3000 - 3180						$	$	$	$
(Repeat above entries for Rule 36 + 37)									
* * * *									
Example for Rule 26, R.B. Lube:									
2550	None	09	None						
	None	21	None						
	None	22	None						
Total Job No. 2550 (all Why Mades)						$	$	$	$
522	None	09	1			$	$	$	$
			2						
Total Car Loc. 1 + 2 (truck set)						$	$	$	$
			3			$	$	$	$
			4						
Total Car Loc. 3 + 4 (truck set)						$	$	$	$
Total Why Made 09 (car set)						$	$	$	$
(Repeat above entries for all Why Mades)									
Total Job No. 2552 (all Why Mades)						$	$	$	$

REPORT 4 (Cont'd)
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

First Month: Dec. '72 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W.M.	Car Loc.	No of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
(Repeat for Rule 43 - Axles)									
*	*	*	*						
Example for Rule 47 - Bolsters, etc.									
3524	None	01	A			$	$	$	$
			B	______	______	______	______	______	______
Total Why Made 01 (car set)				______	______	$ ______	$ ______	$ ______	$ ______
(Repeat for all Why Mades)				______	______	______	______	______	______
Total Job No. 3524 (all Why Mades)				______	______	$ ______	$ ______	$ ______	$ ______
(Repeat for all Jobs 3500 - 3568)									
*	*	*	*						
Example for truck Rule 47 - Side Bearings									
3572	None	01	AL			$	$	$	$
			AR	______	______	______	______	______	______
Total Car Loc. AL + AR (A-end)				______	______	$ ______	$ ______	$ ______	$ ______
			BL			$	$	$	$
			BR	______	______	______	______	______	______
Total Car Loc. BL + BR (B-end)				______	______	$ ______	$ ______	$ ______	$ ______
				______	______	______	______	______	______
Total Why Made 01 (car set)				______	______	$ ______	$ ______	$ ______	$ ______

REPORT 4 (Cont'd)

CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS B-100-33

First month: Dec. '72 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr	W.M.	Car Loc.	No. of Repairs	Labor Hours	Labor Hours	Material Price	Credit Price	Total Price
(Repeat for all Why Mades)				____	____	____	____	____	____
Total Job No. 3572 (all Why Mades)				____	____	$ ____	$ ____	$ ____	$ ____

(Repeat for all Jobs 3572 - 3580)

(Above examples provide the guide for all remaining truck rules, job numbers, qualifiers, and car location codes.)

Second Month: Jan. '73

(Repeat the first month's sort and aggregation procedure in each of the 31 months.)

31 Months' Cumulative: 12/72 - 6/75

(Repeat the month's sort and aggregation procedure for 31 months' cumulative.)

Sort and Aggregation Notes:

Column (1)	Removed Job No.	:	See Report 1, Lines 1 - 22, for the order of listing job numbers and aggregation totals.
(2)	Removed Qualifier	:	Ascending numerical order followed by alphabetical order.
(3)	Removed Why Made	:	Ascending numerical order.
(4)	Removed Car Location	:	See Report 3, Page 2 of 3, for the order of listing car location codes.
(5)	No. of Repairs	:	See examples above for totals. Some totals are a mixture of elements, but are useful for cross checks and balances.
(6)	through (10)	:	Source: AAR Car Repair Billing (pricing program and the Billing Regulation Price Matrices).

REPORT 1
CUMULATIVE TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65
26 Months from May 1973 through June 1975 (26 months from inception)
Car Numbers: SP517300 through SP517363 (64 cars)

Date Car Class Built: May '73
Car Builder(s): Pullman
Car Capacity (lbs): 124000
Trucks: Barber stabilized, low level

Class Description: Stac Pac - Flat F.M. Draft Gear
AAR Mech. Designation: FA
AAR Car Type Code: V191

Line No.	AAR Rules No.	AAR Rules Name	Removed Job Numbers	Off-Line Maintenance No. of Repairs	Off-Line Maintenance AAR Std. Net Price	On-Line Maintenance No. of Repairs	On-Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price
1.	41	Wheels	3000 - 3180	3	$393.94				
2.	36	Roller Bearings	2800 - 2868	6	61.19				
3.	37	R. B. Adapters	2870 - 2882						
4.	26	R. B. Lube	2550 - 2552	1					
5.	43	Axles, R. B.	3250 - 3278	1					
6.	47	Bolsters	3500 - 3556 - 3999	2	27.63				
7.	47	Center Pins	3560						
8.	47	Center Plates	3564						
9.	47	C. P. Liners	3568						
10.	47	Side Bearings	3570 - 3580 - 3999						
11.	48	Side Frames	3700 - 3796 - 3999						
12.	50	Springs	3900 - 3968 - 3999						
13.	Total Lines 1 - 12			13	$482.76				
14.	6	Brake Beams	1640 - 1696 - 1999						
15.	7	B. B. Hangers	1708						
16.	8	B. B. Brackets	1720 - 1724						
17.	9	B. B. Pins/Bolts	1740 - 1748						
18.	10	B. B. Supports	1764 - 1776						
19.	11	Levers, etc.	1792 - 1812						
20.	Total Lines 14 - 19								
21.	12	Brake Shoes	1828 - 1852	141	1,507.03				
22.	Total Lines 13 + 20 + 21			154	$1,989.79				

REPORT 1 (Cont'd)
CUMULATIVE TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65

OTHER CAR COMPONENTS 1/

Line No.	AAR Rules No.	AAR Rules Name	Removed Job Numbers	Off-Line Maintenance No. of Repairs	Off-Line Maintenance AAR Atd. Net Price	On-Line Maintenance No. of Repairs	On-Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price
23.	3	IDT&S	1140 - 1144	22	185.12				
24.	4	Air Brakes & Parts	1160 - 1612	35	222.54				
25.	5	Air Brake Hose	1628	15	153.35				
26.	16	Couplers	2000 - 2160	4	25.39				
27.	73	Auto I.D.	4354 - 4368	1	2.00				
28.	74	Securement	4400 - 4445	12	23.37				
29.	82	Welding	4800 - 4824	8	13.02				
30.	Sub-Total Lines 23 - 29			97	624.79				
31.	Grand Total Lines 22 - 30			251	$2,614.58				

1/ These costs are grouped under Report 1 (i.e., under truck component maintenance) to demonstrate the capability of the economic procedure to accommodate total car component maintenance costs (required to isolate car costs caused by the truck but not charged to the truck). Data analysis of the economic data base for off-line repairs (see Report 3, Daily Truck Component Maintenance Cost by Car Number for Car Class F-70-65) is required to separate out the non-truck-related costs in this grouping.

REPORT 2

MONTHLY TRUCK COMPONENT MAINTENANCE COST AND CAR MILES FOR CAR CLASS F-70-65
From Inception: 26 Months from May 1973 through June 1975
Car Numbers SP517300 through SP517363 (64 cars)

Date Car Class Built: May '73
Car Builder(s): Pullman
Car Capacity (lbs): 124000
Trucks: Barber stabilized, low level

Class Description: Stac Pac - Flat FM Draft Gear
AAR Mech. Designation: FA
AAR Car Type Code: V191

Calendar Months	Off-Line Maintenance No. of Repairs	Off-Line Maintenance AAR Std. Net Price	On-Line Maintenance No. of Repairs	On-Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price	Car Miles Empty	Car Miles Loaded	Car Miles Total
May 1973									
June									
July									
August	1	5.82							
September	1	5.82							
October	6	86.10							
November	3	20.55							
December	1	5.82							
Sub-Total '73	12	124.11							
January 1974	2	11.18							
February									
March	4	28.56							
April	7	43.78							
May	4	35.74							
June	14	126.82							
July	31	213.59							
August	5	26.75							
September	9	48.48							
October	34	623.80							
November	24	218.38							
December	36	279.36							
Sub-Total '74	170	$1,656.44							

REPORT 2 (Cont'd)
MONTHLY TRUCK COMPONENT MAINTENANCE COST AND CAR MILES FOR CAR CLASS F-70-65

Calendar Months	Off-Line Maintenance No. of Repairs	Off-Line Maintenance AAR Std. Net Price	On-Line Maintenance No. of Repairs	On-Line Maintenance AAR Std. Net Price	Total Maintenance No. of Repairs	Total Maintenance AAR Std. Net Price	Car Miles Empty	Car Miles Loaded	Car Miles Total
January '75	18	$ 247.49		$		$			
February	21	208.52							
March	13	141.52							
April	15	219.29							
May									
June	2	17.21							
Sub-Total '75	69	834.03		$		$			
Grand Total[1/]	251	$2,614.58		$		$			

[1/] These totals cross balance with Report 1, line 31. They include total car component maintenance costs. See explanation: Report 1, page 2 of 2, footnote 1/.

REPORT 3
DETAIL TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65

26 Months from May 1973 through June 1975 (26 months from inception)
Car Numbers: SP517300 through SP517363 (64 cars)

(Note: Off-line Repairs Only)

Date Car Class Built:	May '73	Class Description:	Stac Pac - Flat F.M. Draft Gear
Car Builder(s):	Pullman	AAR Mech. Designation:	FA
Car Capacity (lbs.) :	124000	AAR Car Type Code:	V191
Trucks: Barber stabilized, low level			

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Car		Repair Date		Removed					App'l			AAR Std.
Initial	Number	Yr. Mo. Day	SPLC	Job. No.	Cr. Lo.	Qlfr.	Wy Md.	Qty.	Cond.	RS	Hn. Ln.	Net Price
E.g.: SP	517300	74 07 01	689827	2081	L1	01	60	1	4	1	SSW	$ 164.09

Sort and Aggregation Notes:

Col. (1) Car Initial : Hold constant or list alphabetically.
(2) Car Number : Ascending numerical order by car initial (if car initial is not constant).
(3) Repair Date : Ascending numerical order (year, month, day) for the same car number and car initial.
(4) Std. Point Loc. Code : Apply the value in the record.
(5) Removed Job No. : List according to the following table:
(6) Removed Car Location : List according to the following table:

(5)	(6)	Programmer Analyst (Reference Data Only) AAR Rules	
Job Numbers 1/	Car Locations 2/	No.	Name
3000 - 3180	L1, R1 thru L4, R4	41	Wheels
2800 - 2868	L1, R1 thru L4, R4	36	Roller Bearings
2870 - 2882	L1, R1 thru L4, R4	37	R. B. Adapters
2550	None apply	26	R. B. Lube - 4 wheel truck
2552	1, 2, 3, 4	26	R. B. Lube - wheel set
3250 - 3278	1, 2, 3, 4	43	Axles, R. B.
3500 - 3568	A B	47	Bolsters, Cntr. Pl's, Pins, Liners
3572 - 3580	AL, AR, BL, BR	47	Side Bearings
3999	Rule 72 applies	47	Miscellaneous
3700 - 3796	AL, AR, BL, BR	48	Side Frames
3900 - 3968	None apply	50	Springs
1640 - 1696	1, 2, 3, 4	6	Brake Beams
1999	Rule 72 applies	6	Miscellaneous
1708 - 1852	None apply	7 - 12	See Report 1 for rule names

Sort and Aggregation Notes - (Cont'd)

Col. (7) Removed Qualifier	:	Apply the value in the record.	
(8) Removed Why Made	:	Apply the value in the record.	
(9) Removed Quantity	:	Apply the value in the record.	(Some values will be in pounds of weight - i.e., Center Plates.)
(10) Applied Condition	:	Apply the value in the record.	
(11) Responsibility	:	Apply the value in the record.	
(12) Handling Line	:	Apply the value in the record.	(To include off-line, on-line and other organizations that performed maintenance.)
(13) AAR Std. Net Price	:	Apply the value in the record.	(Provide totals for each car number and initial and one grand total for all car numbers and initials. Provide grand totals for each rule number and one grand total for all rule numbers. Check against totals in Reports 1 and 2.)

Footnotes:

1/ Job Numbers: Ascending numerical order for each repair date, for each car number, and car initial for each grouping of job numbers in the list.

2/ Car Locations: In the order shown for each job number, repair date, car number, and initial. Sort car location (2-digit, alpha-numeric code) on right-hand digit first (right justified).

REPORT 4
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65
26 Months from May 1973 through June 1975 (26 months from inception)
Car Numbers: SP517300 through SP517363 (64 cars)

(Note: Off-line Repairs Only)

Date Car Class Built:	May '73
Car Builder(s):	Pullman
Car Capacity (lbs.):	124000
Trucks:	Barber stabilized, low level
Class Description:	Stac Pac. - Flat F M. Draft Gear
AAR Mech. Designation:	FA
AAR Car Type Code:	V191

First Month: May '73

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W.M.	Car Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
Example for Rule 41 - Wheels:									
3000	01	03	L1			$	$	$	$
			R1						
Total Car Loc. L + R1 (wheel set)						$	$	$	$
			L2			$	$	$	$
			R2						
Total Car Loc. L + R2 (wheel Set)						$	$	$	$
Total Car Loc. L + R1 (truck set)						$	$	$	$
(Repeat Why Made 03 (car set)									
Total Why Made 03 (car set)						$	$	$	$
(Repeat above entries for all Why Mades)									
Total Qualifier 01 (all Why Mades)						$	$	$	$
(Repeat above entries for all Qualifiers)									
Total Job Number 3000 (all Qualifiers)						$	$	$	$

REPORT 4 (Cont'd)
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65

First Month: May '73 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W. M.	Car Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
(Repeat above entries for Jobs 3000 - 3180)									
Total all Job No.'s 300 - 3180						$	$	$	$
(Repeat above entries for Rule 36 + 37)									
*	*	*	*						
Example for Rule 26, R.B. Lube:									
2550	None	09	None						
	None	21	None						
	None	22	None						
Total Job No. 2550 (all Why Mades)						$	$	$	$
522	None	09	1			$	$	$	$
			2						
Total Car Loc. 1 + 2 (truck set)						$	$	$	$
			3			$	$	$	$
			4						
Total Car Loc. 3 + 4 (truck set)						$	$	$	$
Total Why Made 09 (car set)						$	$	$	$
(Repeat above entries for all Why Mades)									
Total Job No. 2552 (all Why Mades						$	$	$	$

REPORT 4 (Cont'd)
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65

First Month: May '73 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job						AAR Standard			
No.	Qlfr.	W.M.	Car Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
(repeat for Rule 43 - Axles)									
*	*	*	*						
Example for Rule 47 - Bolsters, etc.									
3524	None	01	A B	____	____	$ ____	$ ____	$ ____	$ ____
				____	____	$ ____	$ ____	$ ____	$ ____
(Repeat for all Why Made's)				____	____	____	____	____	____
Total Job No. 3524 (all Why Mades)				____	____	$ ____	$ ____	$ ____	$ ____
(Repeat for all Jobs 3500 - 3568)									
*	*	*	*						
Example for truck Rule 47 - Side Bearings									
3572	None	01	AL AR	____	____	____	____	____	____
Total Car Loc. AL + AR (A-end)				____	____	$ ____	$ ____	$ ____	$ ____
			BL BR	____	____	____	____	____	____
Total Car Loc. BL + BR (B-end)				____	____	$ ____	$ ____	$ ____	$ ____
				____	____	____	____	____	____
Total Why Made (car set)				____	____	$ ____	$ ____	$ ____	$ ____

REPORT 4 (Cont'd)
CAUSES OF TRUCK COMPONENT MAINTENANCE COST FOR CAR CLASS F-70-65

First Month: May '73 (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removed Job					AAR Standard				
No.	Qlfr.	W. M.	Car Loc.	No. of Repairs	Labor Hours	Labor Price	Material Price	Credit Price	Total Price
(Repeat for all Why Mades)				___	___	___	___	___	___
Total Job No. 3572 (all Why Mades)				___	___	$ ___	$ ___	$ ___	$ ___

(Repeat for all Jobs 3572 - 3580)

(Above examples provide the guide for all remaining truck rules, job numbers, qualifiers, and car location codes.)

Second Month: June '73

(Repeat the first month's sort and aggregation procedure in each of the 26 months.)

26 Months' Cumulative: 5/73 - 6/75

(Repeat the month's sort and aggregation procedure for 26 month's cumulative.)

Sort and Aggregation Notes:

Column (1) Removed Job No. : See Report 1, Lines 1 - 22, for the order of listing job numbers and aggregation totals.
(2) Removed Qualifier : Ascending numerical order followed by alphabetical order.
(3) Removed Why Made : Ascending numerical order.
(4) Removed Car Location : See Report 3, Page 2 of 3, for the order of listing car location codes.
(5) No. of Repairs : See examples above for totals. Some totals are a mixture of elements, but are useful for cross checks and balances.
(6) through (10) : Source: AAR Car Repair Billing (pricing program and the Billing Regulation Price Matrices).

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Freight Car Truck Design Optimization, Truck Economic Data Collection and Analysis, 1976
US DOT, FRA, D April