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Evaluation of the Transit Reliability Information Program

Richard A. Uher

Rail Systems Center Carnegie-Mellon University 4617 Winthrop Street Pittsburgh PA 15213

July 1982 Final Report

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PREFACE

This evaluation of the Transit Reliability Information Program was sponsored by Dr. Ross Adams and John Durham of the Urban Mass Transportation Administration, Technology Development and Deployment, Office of Research and Special Projects, as part of the independent assessment programs. Funding was provided by the UMTA Office of Safety and Product Qualification. The work was performed under the direction of the Transportation Systems Center (TSC). The Technical Monitor was Dr. Arthur S. Priver.

The Executive Summary was prepared by Barbara Zumwalt and John Durham of UMTA and Arthur Priver of TSC based on material primarily compiled and organized by the author, Professor Richard Uher.

The author wishes to thank all those individuals from the transit properties, the suppliers, Dynamics Research Corporation, the American Public Transit Association, and the U.S. Department of Transportation who provided data and assistance during this effort.

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1.0 EXECUTIVE SUMMARY

1.1 Background

This report presents an evaluation of the Transit Reliability Information Program (TRIP), which is designed to collect and analyze transit equipment reliability data on U.S. transit systems. Although TRIP will include bus and rail transit, this evaluation considers only the rail portion because the bus portion is not yet operational. The evaluation was conducted during May-December 1981, as an independent assessment of TRIP at the end of its experimental phase. The objectives of this evaluation are to: 1) determine how well TRIP achieves its stated objectives, 2) identify the costs and benefits of the program, and 3) make recommendations for improvement.

The TRIP program, begun in 1979, is financially supported by the Federal government. An industry-wide program, its principal thrust has been to establish a data bank (DB) for reliability related information on transit vehicles. Data are contributed voluntarily by transit properties. Its major goals are realized when data from the central repository are used to compare equipment performance among different transit systems in order to improve productivity and reduce cost at local property and/or industry levels. Principal participants (Table 1-1) in the program since its inception are thirteen rail transit properties; two vehicle suppliers; the American Public Transit Association (APTA); the Urban Mass Transportation Administration (UMTA); the Transportation Systems Center (TSC); and the Dynamics Research Corporation (DRC), the data base manager. Five rail system operators currently provide manpower support and data to DRC for inclusion in the data base. All participants serve on a liaison board overseeing this program.

TABLE 1.1 TRANSIT INDUSTRY MEMBERS OF TRIP LIAISON BOARD

RAIL SYSTEM OPERATORS

*BART - Bay Area Rapid Transit District (San Francisco)

*CTA - Chicago Transit Authority

GCRTA - Greater Cleveland Regional Transit Authority

MARTA - Metropolitan Atlanta Rapid Transit Authority

MBTA - Massachusetts Bay Transportation Authority (Boston)

MDCTA - Metropolitan Dade County Transportation Administration (Miami)

MTA-MD - Mass Transit Administration of Maryland (Baltimore)

*NYCTA - New York City Transit Authority

PAT - Port Authority of Allegheny County (Pittsburgh)

*PATCO - Port Authority Transit Corporation (Lindenwold Line)

PATH - Port Authority Trans-Hudson Corporation (New York)

SEPTA - Southeastern Pennsylvania Transportation Authority (Philadelphia)

*WMATA - Washington Metropolitan Area Transit Authority

EQUIPMENT SUPPLIERS

BUDD - The Budd Company

GE - General Electric Corporation

^{*}These rail system operators voluntarily contributed data and manpower support to the TRIP data base during the experimental phase.

1.2 Accomplishment of Program Objectives

The stated objectives of TRIP are:

- Amalgamate current reliability efforts within the transit industry and provide a focal point for a consolidated reliability effort;
- 2. Promote uniform reliability related definitions for the transit industry;
- 3. Provide a central repository for voluntary submittal of transit industry field failure data;
- 4. Provide means for periodic distribution of reliability data to potential users:
- 5. Provide uniform processing and analysis of reliability data;
- 6. Provide data for factual comparison of reliability between related equipments; and,
- 7. Provide substantive data for specifying new equipment procurements, justifying product improvement projects and supporting systems analysis programs.

A strict evaluation of TRIP based on these objectives is problematic because they have remained unchanged since the beginning of the program in 1979. In the interim, the basic intent of this program - to develop an industry-wide program that meets the real needs of operators for improved reliability information - has not been achieved because of the desire to keep data collection requirements imposed on the operators to a minimum. These conflicting goals have had a significant impact on the specific data included in the TRIP DB and resulted in data collected to date which are not strictly speaking "reliability data." Rather, TRIP data collection has focused on maintenance action data/replacement rates. True reliability data would include the failure mode of specific equipment. The DB does not include these data or data on maintainability and maintenance costs because transit operators do not have this type of information readily available in a consistent or useful form. As a result, the working

objectives of TRIP have undergone some evolution since their conception four years ago.

OBJECTIVES ACHIEVED

The first four objectives of TRIP have been achieved and will continue to be enhanced as the program develops. Success is demonstrated by the following accomplishments of TRIP to date:

- TRIP has successfully provided a forum for focusing reliability efforts within the transit industry. Attendance by transit properties at the periodic liaison board meetings has been consistent. At least 80 percent of the members have been present at each meeting. Transit operators and vehicle suppliers are enthusiastic about the program and its benefits. They desire expansion of the program to include other vehicle subsystems and more rail system operators. This high level of motivation and attitude toward improved reliability of transit equipment did not exist on an industry-wide basis before TRIP. The interest of the operators is significant also because they indirectly share some of the costs of TRIP and are willing to increase their contributions. These contributions to TRIP include in-house labor involved in preparing data input and reviewing the DB output. Operator estimates of the labor-hours devoted to TRIP range from 100 to 2400 hours per year, depending on the level of automated reporting.
- Promotion of uniform reliability definitions for the transit industry has
 been achieved on a working level, useful to rail system operators rather
 than the theoretical definitions previously developed by the Reliability,
 Availability, Maintainability, and Dependability Committee (RAMD) of APTA.

- The central repository for transit industry field failure data was established when the experimental data bank became operational in August 1979.

 The DB contains equipment failure information on three vehicle subsystems-propulsion, doors, and friction brakes. These subsystems were selected by the participating properties as representing three critical areas of concern. Other information necessary for construction of reliability data are also included. In addition to the five rail system operators who are voluntarily contributing input to the data bank shown in Table 1-1, GCRTA and MARTA desire to contribute data immediately. Most of the remaining thirteen rail properties who are participating in TRIP intend to contribute to the DB as soon as their newly procured cars are ready for service.
- Distribution of TRIP data to potential users is occurring through monthly distribution of maintenance action data on the three vehicle subsystems to contributing operators and the Federal Government. As of January 1982, these data were made available to the rest of the industry upon request. Although these are not strictly speaking "reliability data," it is relatively simple to develop from them unscheduled maintenance action rates, on which a comparison of subsystems and components can be made.

OBJECTIVES NOT ACHIEVED

The last three TRIP objectives have not yet been achieved. All three involve the <u>uniform analysis and comparison</u> of <u>reliability</u> data among properties. The desire to not burden the operators with additional data collection requirements is a major factor in the nonachievement of these objectives. The operators do not collect all the data necessary to accomplish them. In addition, comparison of equipment performance is dependent on the capability to properly characterize

relative equipment stress levels and operational environments among the properties which are to be compared. The depth to which this characterization is practical is now being evaluated by DRC, but has not yet been determined by TRIP.

Objective 7 is directly related to increasing rail transit productivity by both increasing system preformance and reducing cost under TRIP in its present configuration. As mentioned previously, maintainability and maintenance cost data are not included in the DB because the contributing operators do not currently collect these data in a consistent and useful manner. Thus, although the effect of reliability improvements on capital costs of new equipment and on system performance can be determined, the resulting change in maintenance cost and the change in maintainability as it relates to system performance cannot be estimated at this time.

1.3 Program Cost

A large percentage of the cost of TRIP to data (65%) was related to the development, establishment, and refinement of the TRIP DB. Since these costs will not recur, this analysis focuses on the operational cost of the data bank.

If the transit properties which have expressed the desire to voluntarily contribute failure information on all major sub-systems of the transit vehicle are included, thirteen properties would participate with an involvement of over 3,500 cars. With this level of participation, the annual operating cost for the DB is estimated at \$600,000-\$1,000,000 (1981 dollars). These costs include direct processing, error analysis and correction, output validity checks, system maintenance and update, report preparation, and supprot for special analysis studies.

Opportunities to reduce the operational cost of the DB exist:

- 1. Participants may generate their data in direct, computer readable format for input to the DB. This action is expected to reduce the data base management costs by 20-25% over that of hard copy submittal. With the increased tendency toward automation of failure reporting by transit properties, this cost reduction is likely to be realized.
- 2. The systems of the transit vehicle added to the DB may be limited to those with the highest failure rates and/or those whose failure rates have the highest potential for correction. This action will insure that a higher return on investment will be realized.

1.4 Program Benefits

The benefits that may be derived from TRIP depend on transit management's willingness and ability to use TRIP data as a management information tool in day-to-day operations and for long range system planning.

The benefits of TRIP can be divided into present and long run. It is not possible to quantify them at this time.

PRESENT BENEFITS

TRIP's present benefits can be characterized as technical assistance opportunities currently accruing to specific portions of the transit industry. These benefits will continue to be realized in the long-term. Achievement of other potential short-term benefits (e.g., more efficient and effective maintenance planning and scheduling) has been constrained by the limited nature of the data collected in the experimental phase of TRIP.

• Improve internal management communication. The reports generated by the TRIP DB are used as unbiased management information tools on system reliability. For example, BART uses the reports to assure its general management and board of directors that system reliability compares favorably with other properties.

- Assist development of automated failure reporting systems. Successful development of the TRIP DB has encouraged development of automated reporting systems and provided technical assistance opportunities to transit operators who do so. CTA and WMATA are using TRIP while their failure reporting systems are being automated. Metropolitan Dade County Transportation Administration is using TRIP equipment and failure codes as a basis to develop its system, which reduced the overall development cost. BART has offered its internal, automated failure reporting system to any member of the rail transit community, free of charge. This kind of exchange has great potential for cost savings.
- Improve informal exchange. TRIP provides a forum by which the rail transit community is informally exchanging ideas on equipment reliability. This forum did not exists prior to TRIP. TRIP has provided a network of technical information exchange for such things as failure histories on special components being considered for purchase. Because of TRIP, the rail transit vehicle supply industry has been made aware of the high level of rail transit properties interest in reliable equipment. Through the periodic DB reports, equipment failures experienced by one property are visible to other properties.

LONG TERM BENEFITS

The potential long-term benefits of TRIP can substantially improve transit system productivity. If these benefits are achieved, the industry-wide savings from improved productivity will offset the operational costs of the TRIP DB. The degree to which these benefits are realized depends on whether the program can develop the capability to correctly compare reliability data among properties and transit management's willingness and ability to use this information to improve performance and reduce costs.

- Improve transit system performance. As the TRIP expands, basic failure data will exist in historical form for comparing functional systems (components) of the rail transit vehicle. These components will be of different technologies and suppliers and will operate in different environments. Such data can be useful in vehicle procurement, technology development, and new rail starts and extensions. Information which enhances procurement of highly reliable systems would tend to increase system performance.
- Reduce transit costs. Two potential long-term benefits which may result in measuable dollar savings are 1) reduced maintenance costs and 2) reduced rail car acquisitions. These benefits would result from wiser procurement decisions based on an analysis of TRIP data. Because of the length of car procurement cycles, neither of these benefits could be realized until the 1985-1990 time frame.

Maintenance cost reductions can be achieved through more efficient planning and scheduling, lower spare parts inventory, and improved equipment maintainability. Since maintainability and maintenance cost data are not included in the DB, the magnitude of the potential cost reduction cannot be measured at this time. A reduction in maintenance costs of 0.5% industry-wide would cover the cost of TRIP. Potential reductions in rail car acquisitions can be achieved if car availability is improved. If one less car per year industry-wide could be purchased, the cost of operating the DB could be matched. It should be noted, on the other hand, that increases in availability achieved through reliability improvements are likely to increase the capital cost of the vehicle (assuming the need to use more and/or more expensive components), so there may not necessarily be a direct correlation with reduced procurement costs.

- Assist equipment improvement by suppliers. The DB can provide objective service data on equipment failures. Suppliers may use these data for product improvement, comparative evaluation, and direction for strategy decisions. Suppliers can increase their participation in the program by direct contribution toward maintaining the DB and by a larger representation at the periodic meetings.
- Improve Federal Government management information. TRIP data can be used as a tool in the capital grant program. Review of equipment reliability data in processing capital grants can provide a measure of assurance that quality equipment is being purchased, used and maintained properly.

Objective service reliability data are valuable in research and development programs which are initiated and funded by the Federal government.

Through foreign technology exchange programs which use TRIP, world-wide technologies and equipments which may prove reliable in U.S. transit operation could be monitored. Success in this venture would require a substantial effort because of the lack of uniform world wide reliability definitions, the language barrier, and different operational philosophies.

1.5 Conclusions

TRIP is a worthwile program to the transit industry because it provides a structured forum for continued, cooperative emphasis on the urgency of improving equipment reliability. The periodic meetings and output reports are technical assistance tools for educating rail properties in practical applications of reliability analyses, encouraging rail properties to automated failure data reporting systems, and producing a network of technical information exchange. The high level of industry cooperation achieved as a direct result of TRIP is significant because it did not exist previously. Although theoretically the program is not necessary to achieve cooperative information exchange, previous efforts to do so were not successful.

The benefits of TRIP to date have been constrained by the limited data included in the experimental phase of the data base. This limited amount of data is directly attributable to the nature of the experimental phase (five operators and three equipment subsystems) and the practice of not requiring additional data collection efforts from participating operators. As the data are expanded the benefits should increase.

The present technical assistance benefits will continue to accrue over the next two to three years as properties continue to automate their failure reporting systems and the number of participants and subsystems increase. Additional short-term benefits such as more cost-effective maintenance planning and scheduling could be achieved if the types of data collected in the program are expanded. The present benefits alone will tend to improve equipment reliability.

The potential long-term benefits of TRIP can substantially enhance transit system productivity by improving performance and reducing costs. If these benefits are achieved, the operating costs of TRIP will be offset. However, achievement of these long-term benefits hinges upon three critical factors:

- Expansion of the data currently collected by the DB so that maintainability, productivity, and cost savings can be measured,
- The ability to properly characterize the equipment stress levels and operating environments so equipment performance among suppliers can be compared, and
- Transit management's willingness and ability to use this information.

Although TRIP is benefical to the transit industry, it is the consensus of the transit properties involved that operation of the DB must continue to be federally financed. They simply cannot afford to pay for the operation of the data base. To ease the financial burden and stretch DRC's resources, the transit operators are extremely willing to substantially increase their manpower contributions to data base operations. For example, the operators have volunteered

to undertake management tasks related to expansion of the generic parts list so the number of vehicle subsystems and operators included in the data base can be increased.

1.6 Recommendations

It is recommended that TRIP remain funded for two more years to continue to meet its stated objectives. Several opportunities for improvements were identified during the evaluation which would substantially strengthen TRIP in terms of meeting these objectives.

- 1. Factual comparisons of reliability between related equipments on different transit systems depend on proper characterization of the relative equipment stress levels and operational environments among the transit properties. An <u>immediate</u> study should be undertaken to determine the depth required in such a characterization and its resulting credibility. The results of this study will determine the degree to which the longterm benefits of the program can be achieved.
- 2. More emphasis should be placed on encouraging transit operators to develop and use their own automated failure reporting and assessment systems. These systems should be developed and built to easily interface with the DB operation.
- 3. Maintainability and maintenance cost data should be included in the DB where it is practical to do so. Lack of these data limits the ability of the program to provide substantive data for specifying new equipment procurements, justifying product improvement projects, and supporting systems analysis programs.
- 4. The ability to use TRIP to increase transit productivity and save dollars ultimately depends on the degree to which the general management of each property is aware of and believes in the program's capabilities. A low

level of general management support is eqivalent to no support. General management seminars should be conducted to stress and demonstrate the use of TRIP to improve transit productivity.

2.0 INTRODUCTION

This report presents an evaluation of the Transit Reliability Information Program (TRIP), which is designed to collect and analyze transit equipment reliability data on U.S. transit systems. Although the TRIP will include bus and rail transit, this evaluation considers only the rail portion because the bus portion is not yet operational. The evaluation was conducted during May 1981 through February 1982, as an independent assessment of TRIP at the end of its experimental phase. It was commissioned by the Office of Socio-Economic and Special Projects of the Urban Mass Transportation Administration (UMTA), of the U.S. Department of Transportation (DOT), and was technically and administratively managed by the Transportation System Center (TSC).

2.1 Evaluation Plan

The objectives of this evaluation are:

- 1. to determine how well TRIP achieves its stated goals,
- 2. to identify the costs and benefits of the program, and
- 3. to make recommendations for improvement.

In order to achieve these objectives, a program plan was established. This plan consisted of the following tasks, all of which were executed during the period May 1981 through February 1982:

1. Review of the documents which were generated during the program. This review also included attendance at the TRIP Liaison Board Meetings #11 (held at the Transportation Systems Center (TSC), Cambridge, Massachusetts, May 6-7, 1981), #12 (held at the Washington Metropolitan Area Transit Authority (WMATA), Washington, D.C., September 2-3, 1981), and #13 (held at the American Public Transit Association (APTA), Washington, D.C., January 11, 1982). Attendance at meeting #13 was to present the preliminary results of this evaluation to the Liaison Board.

- 2. Interviews of program participants, which included members of the rail transit community, suppliers, consultants and the DOT. These included:
- personal and letter interviews with representatives of the five transit properties which are active participants in the experimental Data Bank (DB),
- letter interviews with representatives of transit properties which are on the TRIP Liaison Board, but are not active participants in the DB. There are eight properties in this category,
- letter interviews with rail carbuilders who are supplying U.S. transit properties,
- personal interviews with the TSC project manager and the UMTA sponsor of the TRIP.
- a personal interview with the Dynamics Research Corporation (DRC), the contractor selected by the TSC to operate the experimental DB, and
- a personal interview with personnel at Booz-Allen & Hamilton (BAH) who attempted to use data from the DB in a door system study.
- 3. Analysis of the information contained in the DB and other closely related data submitted by the transit systems in order to:
- determine the effectiveness of TRIP in meeting its long-term objectives,
 - identify shortcomings in order to recommend program improvements, and
 - aid in the determination of the long-term costs of the program.
- 4. Compilation of a final report which presented the conclusions and recommendations in a form which could be used by decision makers to determine the future direction of the program.

2.2 Report Organization

A brief description of TRIP is presented in Section 3.0. This description contains the TRIP goals, its organization and a short history of

the program from the perspective of its meeting the goals. This history was compiled using the minutes of the TRIP Liaison Board Meetings, numbers 1 through 12.

Section 4.0 contains a description of industry interviews which were conducted as part of the evaluation of the program. The interviews were conducted with transit properties which are participating in the experimental DB, transit agencies which are members of the Liaison Board but not participating in the experimental DB, carbuilders who are supplying U.S. transit properties, the Federal Government, and potential users of the information. These interviews, together with the information obtained from the DB, the TRIP documents and Liaison Board Meeting minutes, form the basis of the analysis presented in the remaining sections.

Section 5.0 presents a summary of the evaluation of the achievement of the TRIP program objectives. It is divided into two parts: the objectives which have been met and those which have not been achieved.

The costs of TRIP, determined from historical cost data obtained from the experimental DB operator and the transit properties and projected to future operation, are presented in section 6.0. These costs are determined using the estimated requirements for expansion of the DB as projected by the transit properties themselves, and from the analysis of the DB information. Opportunities for cost reduction were identified both for the DB and to the participating agencies.

The benefits of TRIP are discussed in section 7.0. Both the present and long term benefits are covered.

Section 8.0 presents a summary of conclusions about and recommendations for TRIP.

Section 9.0 contains a bibliography of the documents which were consulted and used during the course of the evaluation. Most of these documents were generated during TRIP.

Many people throughout the rail industry gave their time and expertise during this evaluation. Section 10.0 presents a list of people and their contributions toward the effort.

Finally, Section 11.0 is a set of appendices which contain the backup data and information which support the main body of the report and its conclusions.

3.0 BACKGROUND

The TRIP, begun in 1978, is financially supported by the Federal Government. An industry wide program, its principal thrust has been to establish an experimental DB for reliability related information on transit vehicles. Data are contributed voluntarily by rail transit agencies. Its major goals are realized when data from the central repository are used to compare equipment performance among different transit systems in order to improve productivity and reduce cost at the local property and/or industry level.

3.1 The TRIP Philosophy and Objectives

The objectives of the TRIP remain unchanged since the beginning of the program in 1978. They are stated in many of the documents which were reviewed.

- 1. Amalgamate current reliability efforts within the transit industry, and provide a focal point for a consolidated reliability effort;
- 2. Promote uniform reliability related definitions for the transit industry;
- 3. Provide a central repository for voluntary submittal of transit industry field failure data;
- 4. Provide means for periodic distribution of reliability data to potential users;
 - 5. Provide uniform processing and analysis of reliability data;
- 6. Provide data for factual comparison of reliability between related equipment; and,
- 7. Provide substantive data for specifying new equipment procurements, justifying product improvement projects and supporting systems analysis programs.

The present focus of the TRIP effort is to achieve objectives 1-4. Spin off from this effort should then aid the motion towards achieving objectives 5-7.

The basic thrust of TRIP is aimed toward the development of an industry wide program. The maximum utility of the program can best be obtained if the performance data from the DB is comparable between properties. It is not meant to be a focal point in which one property analyzes its own data. However, it should be pointed out that a natural extension of the program, as it is now structured, would be to educate the management of those properties which have less internal capability, in reliability and maintainability engineering and analysis.

3.2 The TRIP Organization

The block diagram in Figure 3-1 shows the detailed organization of TRIP. The principal members of the organization who were contacted for this evaluation include:

- The Office of Safety and Product Qualification, UMTA, the TRIP sponsor;
- The Transit Systems Branch, TSC, the TRIP project manager;
- The American Public Transit Association, APTA, the coordinator among the participating transit properties;
- The TRIP Liaison Board, whose members are the transit properties which are listed in Table 3-1;
- Dynamics Research Corporation, DRC, contractor for the TRIP experimental DB.

3.3 The TRIP History

Initially, TRIP was designed to have three phases of activity:

 $\underline{Phase\ I}$ - Definition of the functional and operational requirements of the TRIP DB, followed by the design and operation of an experimental DB for

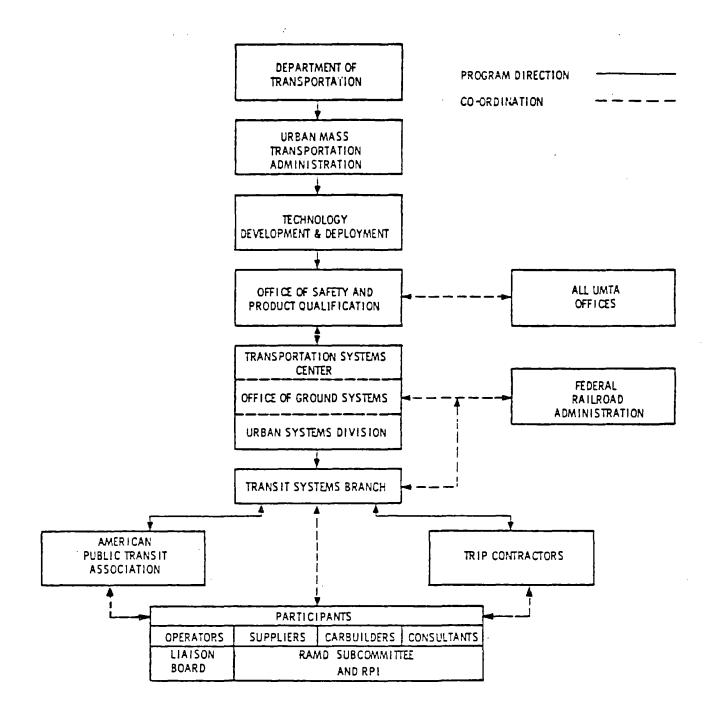


FIGURE 3-1 TRIP PROJECT ORGANIZATIONAL CHART

Reference taken from "TRIP Program Plan (Update Spring 1980)", Figure 3, p. 17.

TABLE 3.1 TRANSIT INDUSTRY MEMBERS OF TRIP LIAISON BOARD

RAIL SYSTEM OPERATORS

*BART - Bay Area Rapid Transit District (San Francisco)

*CTA - Chicago Transit Authority

GCRTA - Greater Cleveland Regional Transit Authority

MARTA - Metropolitan Atlanta Rapid Transit Authority

MBTA - Massachusetts Bay Transportation Authority

MDCTA - Metropolitan Dade County Transportation Administration

MTA-MD - Mass Transit Administration of Maryland (Baltimore)

*NYCTA - New York City Transit Authority

PAT - Port Authority of Allegheny County (Pittsburgh)

*PATCO - Port Authority Transit Corporation (Lindenwold Line)

PATH - Port Authority Trans-Hudson Corporation (New York)

SEPTA - Southeastern Pennsylvania Transportation Authority (Philadelphia)

*WMATA - Washington Metropolitan Area Transit Authority

EQUIPMENT SUPPLIERS

BUDD - The Budd Company

GE - General Electric Corporation

^{*}These rail system operators voluntarily contributed data and manpower support to the TRIP data base during the experimental phase.

selected systems on rapid rail and bus vehicles.

<u>Phase II</u> - Merge the bus and rapid rail experimental DB into a single DB and expand it to include all vehicle systems.

Phase III - Expansion of the DB to other classes of transit equipment.

The initial support contract was issued to the DRC in September 1978 by the Transit Systems Branch of the TSC. Under a separate contract with the APTA (also issued by the TSC), the TRIP Liaison Board was established, and its first meeting was held in November 1978. Appendix 11.1 contains a summary of minutes from twelve Liaison Board Meetings. Attendance at these meetings is summarized in Figure 3-2. As is evidenced from this attendance list, participation by the transit properties at the periodic meetings hosted by the program has been at the 80% level.

A functional flow diagram of the TRIP for its three phases of activity is shown in Figure 3-3. It is clear from the figure that the TRIP has many channels of communication with other programs and organizations. In fact, many of the members of the TRIP Liaison Board are also members of the APTA Reliability, Availability, Maintainability and Dependability (RAMD) Subcommittee, which is concerned with transit equipment reliability.

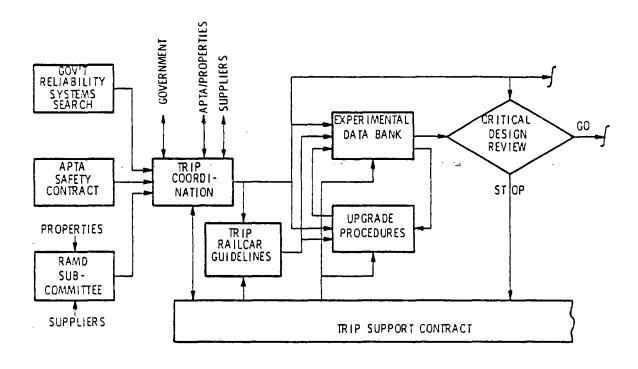
Six properties volunteered to submit failure and maintenance data to the experimental DB. These were: BART, CTA, GCRTA, NYCTA, PATCO and WMATA. The development of the experimental DB began with three vehicle systems: propulsion, doors and friction brakes. These systems were selected by a vote of the Liaison Board (see Liaison Board meeting #2 in Appendix 11.1).

The experimental DB began operation in August 1979, with the input of July 1979 data from BART and WMATA. The CTA and PATCO data input began in November 1979, and the NYCTA data input began in February 1980. The experimental DB presently contains data on the BART, NYCTA and WMATA from

LIAISON BOARD MEETINGS

PROPERTY	1	2_	3	4	5	6	7	. 8	9	10	11	12	13	-
BART	Х	χ	Х	X			χ	, X	. X	Х	Х	, X	Χ	
CTA	χ	Х	χ	Х	X	Χ	Х	Х	Х	Х	Х	Х	Х	
GCRTA	χ	X	χ	.X	Х	Х	Х	Χ	X		Χ			
MARTA		X	X	X	X	X	Х	Χ	X	χ	Χ	Х	Χ	
MBTA	Х	X	X	X	Х	Х			•		X	Х	Χ	
MDCTA														
MTA-MD	Х	Х			Χ	χ	Χ.	Х		χ	Χ	Х		
NYCTA	, X	X	X	Х	X	Х	Χ	Х	X	X	X		χ	
PAT	Х	χ	χ	X		X		Χ	Х		X			
PATCO	Х	Х	X	Χ		Х	Χ	X	· X	χ.		Χ		
PATH	Х		X	X	Х	X		Х	X	X	Х	Х	χ	
SEPTA	Х	Χ	X	X	Х	Χ	Х	Х	Х	Χ	Х	Х	Х	
WMATA		Χ	X	Х	X	Х	X	X	X	X	χ	X	Χ	
	<u>. </u>													

FIGURE 3-2 REPRESENTATION BY PROPERTIES AT LIAISON BOARD MEETINGS



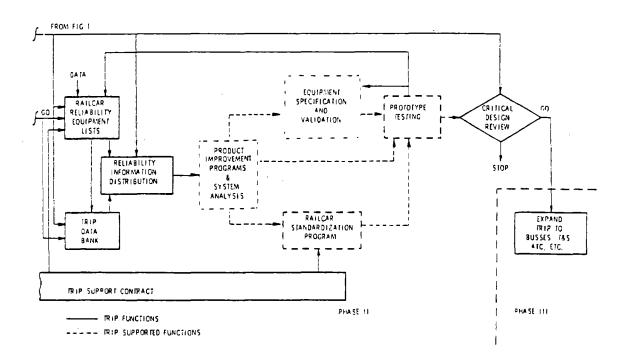


FIGURE 3-3 FUNCTIONAL FLOW DIAGRAM OF THE TRIP

Reference taken from Liaison Board Meeting minutes #1, Figure 1 and 2, p. 6 and 8.

July 1, 1979 to the present, and on the CTA and PATCO from August 1, 1979, to the present. The GCRTA data are expected to enter the DB in early 1982.

The first experimental DB output reports were published in September 1979, for July data from the BART and WMATA. After modifications to the report format suggested by the Liaison Board were incorporated, reports were published in November 1979, March 1980 and July 1980.

At the Liaison Board Meetings in November 1979, it was decided to extend the period of performance of Phase I nine months, to September 1980. In April of 1980, a critical design review of the TRIP was held. It was concluded at that time that the TRIP cannot be properly evaluated without twelve to eighteen months of additional experimental DB experience. The recommendations of this critical design review were:

- l. Operate and refine the experimental DB using three rail vehicle systems on ten vehicle types (series) on six transit properties for an additional fifteen months followed by six month merge period with the bus DB.
 - 2. Establish the bus DB.

At Liaison Board Meeting #9 in October 1980, it was announced that the experimental DB operation would continue until March 1981. A second critical design review of the TRIP was held in May 1981. The following conclusions were reached:

- 1. The TRIP experimental DB has proven that a rapid rail vehicle DB is worthwhile and viable.
- 2. The experimental DB information accurately presents the data reported by the participating properties.
- 3. The experimental DB information, although limited in scope, has been beneficial to transit operators.
- 4. There are still minor problems with generic part numbering, interpretation of the data and the manufacturer identity.

The following recommendations were made at that time:

- The TRIP experimental DB should be continued.
- 2. Initiate Phase II of the program.
- 3. The TRIP should complete the experimental DB with additional subsystems, car fleets and transit properties.
- 4. The TRIP should complete and document reference data which would be critical to comparison of reliability among the properties.

At this second critical design review, specific transit property comments concerning the usefulness of the TRIP were solicited. Sumamries of these comments are:

- 1. The twelve properties present at the design review expressed complete support for the TRIP. In addition, one of the carbuilders, the BUDD Company, which was present at the design review, also expressed its support for the TRIP.
- 2. Three of the properties present (the CTA, WMATA and PAT) suggested that the TRIP be expanded to include more vehicle systems, other modes of operation, (including light rail and commuter railroad) and other series cars. Summaries of these comments can be seen in Appendix 11.1 (Liaison Board Meeting #11), and the details are contained in Appendix 11.2 in the form of letters submitted by the transit properties.

4.0 INDUSTRY INTERVIEWS

Much of the information developed during this evaluation was obtained from the organizations which were closely associated with the TRIP, or used the DB for technical studies. Formal interviews, either on a personal or letter basis, were conducted with five active participants in the experimental DB, members of the TRIP Liaison Board who were not active participants in the experimental DB, and carbuilders who are suppliers to the rail transit systems. Informal discussions were held with other organizations closely associated with the program including APTA, UMTA, TSC and DRC. Since Booz-Allen & Hamilton requested and received information from the DB for vehicle door systems on which they conducted a study, they were interviewed on the usefulness of the data which they received.

The results of all of these interviews, together with information obtained from the TRIP documents, the experimental DB and attendance at the Liaison Board meetings are reported in Section 5.0-Achievement of Program Objectives, Section 6.0-Program Costs, Section 7.0-Program Benefits, and Section 8.0-Conclusions and Recommendations. This section presents the methodology used in the interviews, the nature of the responses and brief summaries, where appropriate.

4.1 Active Participants in the Experimental DB

The transit properties, which were actively contributing data to the experimental DB, were recognized as the best sources of information on its operation and the progress of the TRIP in general. Each of these five properties were formally interviewed. This formal process included a visit to their location, during which time they were personally interviewed, and a request that they submit a written response which would include a letter from their General Manager expressing his comments on the TRIP. The dates of the visits to the five transit properties were: BART (5/27/81), CTA (5/28/81), WMATA (6/4/81), PATCO (6/10/81) and NYCTA (6/13/81).

In preparation for these interviews, a questionnaire was sent to these organizations on May 11, 1981. It was designed to specifically address the questions of program cost and benefits and the achievement of the objectives. The questionnaire, together with the written responses, is contained in Appendix 11.3. The scope of these responses can be summarized as follows:

- BART Specifically addressed each question and provided a letter from the General Manager.
- CTA The response was from the General Operations Manager. It did not specifically address all of the questions, but did provide support for the TRIP in the bus area because of standard vehicles on many different properties.
- NYCTA Specifically addressed the questions posed by the interview questionnaire. The response was signed by the General Superintendent of Rapid Transit, a senior level management official.
- PATCO Some of the questions were addressed in the response but others were not. A copy of a letter from the General Manager previously sent to the APTA in support of the TRIP (dated 4/3/80) was attached.
- WMATA Most questions were addressed in the response. No letter was received from the General Manager.

In general, the responses showed unanimous support for the program and expressed the desire to continue operation of the DB. It was the general consensus that the full potential of the DB would be realized after a few years of operation, and, after reference data, which would allow comparison of equipment reliability among the properties, were incorporated.

4.2 Transit Property Liaison Board Members Who Are Not Active Participants In The Experimental DB

The formal interview with the members of the TRIP Liaison Board which were not active participants in the DB was accomplished by letter. A questionnaire was mailed to each of them on May 11, 1981. Each was asked to provide a letter from the General Manager expressing his view of the program.

Seven out of eight of these transit properties responded. The questionnaire, together with the responses, is contained in Appendix 11.4. Specific comments

on the nature of the responses follows:

- GCRTA No response.
- MARTA Specifically answered each question posed in the questionnaire.

 No letter from the General Manager. Response date 6/5/81.
- MBTA Specifically answered each question posed in the questionnaire. No letter from the General Manager. Response date 6/4/81.
- MDCTA Submitted the same letter which they sent to the second critical design review. This letter is listed in Appendix 11.2.
- MTA-MD Specifically answered each question posed in the interview. An attached letter from the MTA Administrator, dated 4/10/81, expresses both usefulness and support of the TRIP. Letters addressed to BART, which show the interaction between the two properties on failure reporting were also part of the response. Response date 7/1/81.
 - PAT Specifically answered each question posed in the interview. No letter received from the General Manager. Date of response-12/3/81.
 - PATH Specifically answered each question posed in the questionnaire. It was mentioned in the letter that it was reviewed and approved by the General Manager and General Superintendent and this represents their assessments of the program as well. Date of response-6/22/81.
- SEPTA Specifically addressed each question of the questionnaire. No letter was received from the General Manager. Date of response-6/15/81.

With the exception of the GCRTA, which did not respond to the questionnaire, all of the interviewees showed an enthusiastic support for the TRIP and expressed a desire to become active participants either as soon as the program could accommodate them, or as soon as they had new vehicles in operation.

4.3 Carbuilders

A questionnaire was sent on May 11, 1981, to five carbuilders which are presently supplying U.S. transit systems and to General Electric, which is a member of the Liaison Board (the GE questionnaire was sent on July 21, 1981). Responses were received from three out of the six contacted. The responses, together with the carbuilder questionnaire, are included in Appendix 11.5.

Specific comments on the interviews are:

BREDA TONING, INC. - No response.

BUDD - Specifically addressed each question posed in the interview. The response was sent by the General Manager of the Red Lion plant (passenger carbuilding plant) and signed by the Chief Engineer as well. The response was dated 7/8/81.

GENERAL ELECTRIC CO. - No response.

HAWKER SIDDELEY

CANADA, INC. - Specifically addressed each question of the interview. The response was dated 6/19/81 and was signed by the Director of Engineering.

KAWASAKI - Responded with a general letter on 7/30/81. The letter was signed by the SEPTA LRV Project Engineer.

VICKERS CANADA, INC. - No response.

The carbuilder responses address the potential future benefits of the TRIP. Present DB information was not being used by them because characterization of the environment and stress levels of the equipment (K-factors) have not yet been accomplished. The principal use of these data would be for product improvement, especially in the area of vehicle subsystems. It was pointed out that, because maintainability and maintenance cost data were not being collected, the resulting information may be limited in its application.

4.4 DOT-UMTA

An interview was conducted with Robert Haught, Acting Director of the Office of Safety and Product Qaulification of DOT-UMTA, Washington, D.C., on June 18, 1981. This is the office within UMTA that sponsors the TRIP and provides funding. The specific questions posed, and their answers, appear in Appendix 11.6.

The response indicates that the Federal Government sees the determination of resource allocation for research and development, improvement of efficiency and productivity of the properties, and the monitoring of equipment during the warranty period as the principal benefits to them. The TRIP would continue with full funding.

4.5 APTA

An interview was held with Theodore Gordon of the APTA, Washington, D.C., on June 18, 1981. The APTA has been responsible for coordinating the efforts of the transit properties on the Liaison Board. The APTA, under contract to the Federal Government, provides travel money to the property members of the Liaison Board for the periodic meetings. Manpower for these meetings is contributed by the transit organizations. The APTA chairs the Liaison Board meetings.

The results of the interview with the APTA are contained in Appendix 11.6.

The TRIP is not directly beneficial to the APTA, but more to the transit properties and carbuilders which are member organizations.

4.6 Booz-Allen & Hamilton

An interview was conducted with Robert Smith of Booz-Allen & Hamilton (BAH), Pittsburgh, Pennsylvania, on September 22, 1981. Under the "Subsystem Technology Application to Rail Systems" (STARS) program, of the Office of Technology Development and Deployment at UMTA, BAH has been asked to recommend future research and development needs for transit car door system improvement. This recommendation could take the form of better design, maintenance and/or better monitoring of door operation of the transit systems. Five properties, the BART, CTA, MARTA, MBTA and WMATA, were identified for detailed investigation. Door operation was observed and detailed interviews were conducted on each of the five properties.

As part of this investigation, data on the door subsystem from the DB for the BART, CTA and WMATA were requested and obtained from the DRC at a cost of \$2,500. This special report listed the generic part, symptom and defect of the door malfunctions.

A letter, commenting on the usefulness of the data obtained from the DB, is contained in Appendix 11.7. The principal conclusion was that, although

the TRIP-DB was able to provide cause and effect information in a variety of formats, it was not useful in this instance because it (information) was of questionable quality. It should also be pointed out that BAH chose to do onsite observation and data gathering rather than spend the time sorting out differences in reporting detail to the DB by the properties.

It is clear from the nature of the door system investigation that BAH was not performing a comparison among transit properties, but rather a detailed investigation of cause and effect on each of the properties. Under these circumstances, the internal failure reporting system of the property would be a much more useful tool for analysis.

5.0 ACHIEVEMENT OF PROGRAM OBJECTIVES

The seven objectives of the TRIP are listed in the first paragraph of Section 3.1 of this report. The first four objectives, which were directed toward consolidating reliability efforts within the transit industry, and establishing a central DB for voluntary submittal and distribution of reliability type data, have been achieved. The latter three objectives, the meeting of which depend on the ability to compare reliability among the rail transit properties for a variety of beneficial reasons, have not yet been achieved. In the next two sections, the achieved objectives are discussed on an individual basis, and evidence for the conclusions are presented.

5.1 Achieved Objectives

1. Amalgamate current reliability efforts within the transit industry and provide a focal point for a consolidated reliability effort.

Participation by the thirteen rail transit properties at the periodic meetings, hosted by the TRIP and detailed in Figure 3-2, has been at the 80% level. Before the program began in 1978, efforts toward consolidation of reliability efforts were done through the APTA RAMD Subcommittee which met on an annual basis to discuss these disciplines. In addition, efforts were put forth by the Office of Safety and Product Qualification of UMTA to improve reliability on an individual property basis. Life cycle cost reduction was stressed in these programs.

However, the enthusiastic support by the transit properties and carbuilders did not develop until the TRIP began. Both are looking forward to the program's long term benefits and indicate a strong desire for its expansion. This kind of motivation toward improved reliability of transit equipment by so many organizations, did not exist on an industry wide basis before the TRIP. The program has indeed provided a forum for focusing reliability efforts within the rail transit industry.

The program can go further, however. Other transit properties, which are in the process of designing and building new rail systems, should be encouraged to become members of the Liaison Board. Specific properties are the HCMTA-Metropolitan Transit Authority of Harris County (Houston), SCRTD-Southern California Rapid Transit District (Los Angeles), SCCTA-Santa Clara County Transportation Agency (Santa Clara), SDTC-San Diego Metropolitan Transit Development Board (San Diego), SEMTA-Southeastern Michigan Transportation Authority (Detroit) and TCMTD-Tri-County Metropolitan Transportation District of Oregon (Portland).

The remaining carbuilders, which now supply rail transit cars to the U.S. properties, should also be invited to join the program.

2. Promote uniform reliability-related definitions of the transit industry.

Previous to the TRIP, the APTA RAMD Subcommittee developed a Glossary which set forth a series of reliability, availability, maintainability and dependability definitions which would be used by all transit properties. To those organizations which did not have vigorous reliability/maintainability efforts underway, these definitions had little practical meaning. After the introduction of the TRIP, reviews of the distributed DB data and discussions at the Liaison Board Meetings advanced these definitions from the theoretical to the practical realm. As a result of the TRIP, it will be necessary to update the Glossary at some future date.

3. Provide a central repository for voluntary submittal of transit industry field failure data.

Present Status of the DB

Under contract to DOT-TSC, the DRC has been operating an experimental DB since August 1979. As of July 1981, the experimental DB contained 135,000

APTA Glossary of Reliability, Availability and Maintenance Terminology for Rail Rapid Transit, February 1978.

maintenance and utilization records submitted by five rail transit properties (the BART, CTA, NYCTA, PATCO and WMATA) on three vehicle subsystems (propulsion, doors and friction brakes) and on 1,300 rail transit cars.

Priorities for Expansion of the DB

The five DB participants, DOT-UMTA, APTA and the equipment suppliers were asked, as part of the industry interview, to state their priorities for expansion of the database in the near future. The following table provides a summary of their replies.

PRIORITY TABLE

		THEORETT TROCE	
Organization	Vehicle Systems	Vehicles on Present Properties	Other Transit Properties
BART	1	2	3
СТА	1	1	2
NYCTA	2	1	1
PATCO	1	2	3
WMATA	2	3	<u>.</u> 1
АРТА	1	2	3
UMTA	1	2	3
BUDD	2	3	1
HAWKER SIDDELEY	. 1	2	2

¹⁻Highest, 2-Second Highest, 3-Third Highest Priority.

The reasons presented for this selection were as follows:

- Those organizations who chose 1-2-3 or 1-2-2 as their priority sequence, gave as their reason, the ease of expansion. In other words, adding more vehicle systems to already existing ones is easier and less costly than adding new vehicles, which in turn is easier than adding new properties. One supplier (Hawker Siddeley Canada) indicated that little is known of failure rates on other subsystems, such as couplers, air conditioning, current collectors, lighting, etc. Note that adding new systems on existing vehicles, or new vehicles on existing properties, puts more of the cost burden on the properties rather than the DB.
- Those organizations that answered 2-3-1 or 2-1-1 as their priority sequence, pointed out that the full benefits of TRIP might be realized faster if more properties were added, thus expanding the participation as well as the operational environment in which the equipment would be seen.

Property Desires on DB Participation

The inactive properties were polled as to when they would be ready to join the active participants. The following is a summary of the replies.

GCRTA - Immediately

MARTA - Immediately

MBTA - Immediately

MDCTA - When cars are in service

MTA-MD - First quarter of 1983, when cars are in service

PAT - Late 1984 or early 1985, when cars are in service

PATH - At least 24 months, predicated on manpower availability

SEPTA - Not before 1982 [Not before completion of Vehicle Maintenance Management Information System and receipt of LRV's and Broad Street subway cars (1982-83)]

Program Duration

Only one property, the BART, addressed the question of the lifetime of the TRIP. They expressed the opinion that the program would continue to have value over the next 10 to 15 years. They suggested that it would require several

years before it would be fully operational, i.e., with the remaining transit properties contributing data to the DB.

4. Provide means for periodic distribution of reliability data to potential users.

Maintenance action data of the three vehicle subsystems are distributed on a monthly basis to the five contributing properties and the Federal Government. It was pointed out, by several of the interviewees (the NYCTA, PATCO, MARTA and BUDD), that the information distributed by the DB is not, strictly speaking, "reliability data".

In order to truly distribute reliability data, it is necessary to select the proper reliability indices in order to make fair comparisons among the rail transit systems. Figures 5-1, 5-2 and 5-3 display a set of unscheduled maintenance actions (UMA) indices for propulsion, door and friction brake subsystems of the rail transit vehicles included in the DB for the five participating properties for the period January-March 1981. These indices use a dividend UMA (definition: a maintenance action is a vehicle which is brought into the shop on a unique date and results in a unique repair record), and a divisor, which is one of the following: 10,000 car-miles, 10,000 carhours, 10,000 car-station stops or car-years. The index using car-hours is based on car-operating hours, and the index based on car-years uses calendar years. Conversion factors among these indices are discussed and presented in Appendix 11.8. Observation of these figures clearly indicates that the conclusions drawn from the comparisons among these reliability indices can be different, depending on the index selected. The present distributed information is based on car-miles. This index was selected because it was a traditional measure in the transit industry.

UNSCHEDULED MAINTENANCE ACTIONS (UMA) PROPULSION SYSTEM (JAN-MAR, 1981)

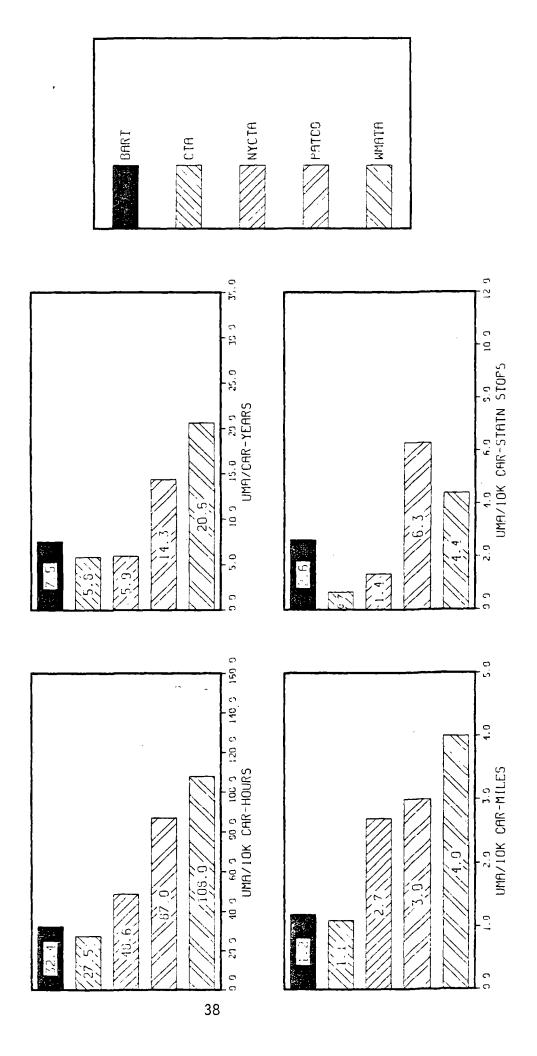


FIGURE 5-1

UNSCHEDULED MAINTENANCE ACTIONS (UMA)

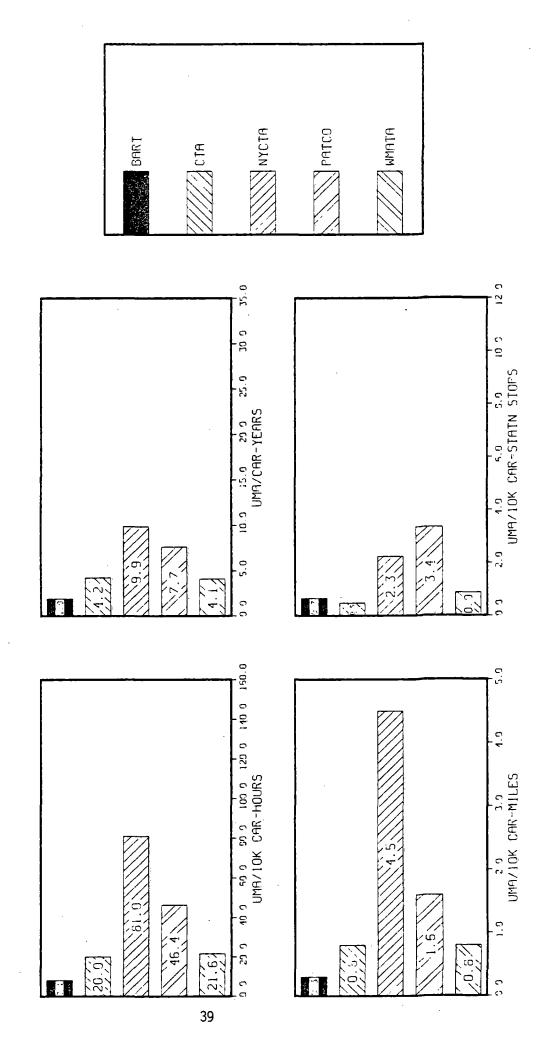


FIGURE 5-2

UNSCHEDULED MAINTENANCE ACTIONS (UMA) FRICTION BRAKE SYSTEM (JAN-MAR, 1981)

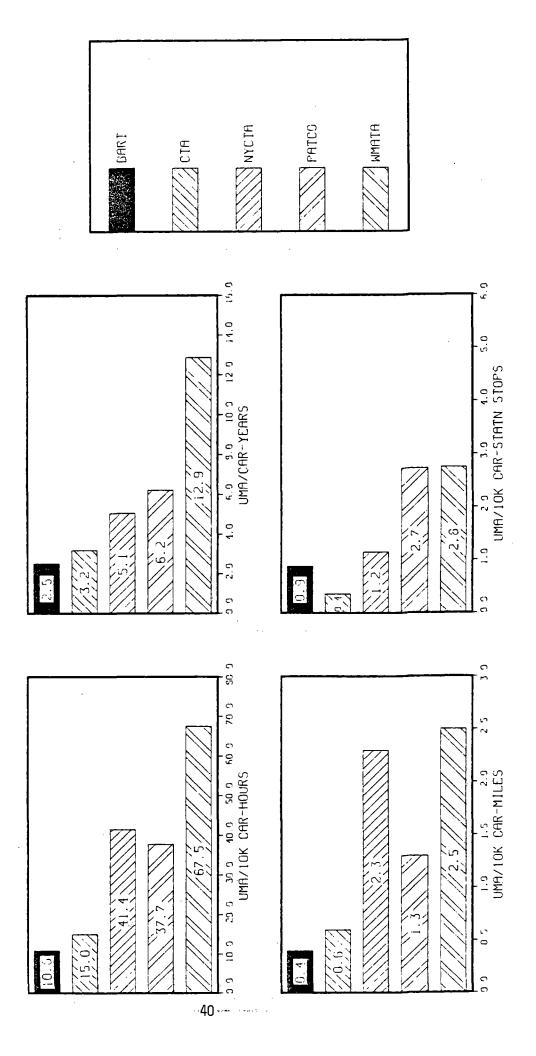


FIGURE 5-3

Classical reliability analysis and its theoretical foundation base their observational indices on operating time. In these terms, the appropriate index for the UMA rate is:

This definition can apply to the whole vehicle, subsystems or components by replacing the word "system" with "vehicle", "subsystem" or "component". For example, in comparing the door system, it is more appropriate to use door operating hours which are essentially proportional to car-station stops, and car-operating hours when comparing the propulsion system.

In my opinion, much of the danger of unfair comparisons could be removed by choosing the appropriate rather than the traditional index in the information which is distributed.

5.2 Objectives Not Achieved

The last three objectives mentioned in the first paragraph of Section 3.1 have not been achieved. They are repeated here for ease of reference:

- 5. Provide uniform processing and analysis of reliability data.
- 6. Provide data for factual comparison of reliability between related equipment.
- 7. Provide substantive data for specifying new equipment procurements, justifying product improvement projects and supporting systems analysis programs.

All of these objectives are discussed together since satisfying them involves the comparison of reliability data among the properties. The ability to accomplish this comparison is dependent on a proper characterization of the relative equipment stress levels and operational environments at the properties. This characterization is referred to by the Liaison Board members as the 'K-factors'.

There are two basic questions related to reliability which can be asked and answered using the data in the DB:

- 1. What is the reliability among the transit properties of a particular vehicle subsystem?
- 2. What will be the reliability of a particular system which is used on property A, if it is used on property B?

The first question can be asked and answered independent of performance level, using the data presently in the DB if subsystem-hours is the basis for the index of comparison. The second question requires that the total operational, maintenance and natural environment, and the equipment stress level on property A relative to B be known to some approximation.

If two nearly identical systems are operating on two different transit properties (A and B), it is possible to characterize the environment of one property vs. the other, directly.

This kind of characterization will be relatively simple in the bus TRIP, where the same buses are used on many different properties. It will not be easy on rail systems where technologies, supply and performance level are all variable.

After carefully examining the data now submitted to the DB, together with operational information from the property, it is my conclusion, that some degree of reliability information at the subsystem level can be generated in which functional comparisons can be made. However, this job will require competent reliability engineers with rail transit car system experience to generate the proper conversion factors. Once this has been completed, special reports may be generated to produce this information.

In order to accomplish this, it would be very useful to have UMA-data on different subsystems, serving the same function on the same property.

Some of this will occur when WMATA introduces chopper control, and NYCTA adds the R-46 cars to the DB.

The depth to which the characterization of equipment stress levels and operational environment is practical is now being evaluated but has not yet been determined by the TRIP.

The TRIP objective 7 is directly related to increasing rail transit productivity by both increasing system performance, and reducing life cycle cost. However, maintainability and maintenance cost data are not being submitted by the contributors to the DB, nor is there any intention to do so in the future. Thus, although the effect of reliability improvement on capital cost of new equipment and on improved system performance can be determined, the resulting change in maintenance cost and maintainability cannot be determined. It is certainly possible to initiate reliability improvement which has an adverse effect on maintainability and maintenance cost.

6.0 PROGRAM COSTS

The annual operating cost of the TRIP was estimated by using present cost data and the plans for potential expansion which would involve the thirteen transit properties on the Liaison Board. The costs were divided into two categories, namely, those which are borne by the properties for coordination during their voluntary submittals to the DB, and the cost to the Federal Government for the DB operation.

6.1 Transit Property Burden

The costs borne by the five transit properties for contributing data to the DB and attending liaison meetings, as reported during the interviews and in subsequent discussions, are listed in Table 6-1.

As expected, the CTA and WMATA, which are submitting their data manually while their automated failure reporting systems for rail operation are under development, show the highest annual cost.

The future annual costs, also shown in the table, are valid once the data base and output reporting becomes stable. Presently, the BART and NYCTA have the highest degree of automation and demonstrate the lowest cost. It is not unreasonable to assume that by 1984-85, when all thirteen properties may be contributing to the DB, that the degree of automation of all systems may be such that the average cost is \$1,500-\$2,000/year/property.

6.2 DB Annual Operating Cost

A projection of the operating cost of the DB to the Federal Government can also be made for the time when all thirteen rail properties are active participants. This estimate is best made by determining the present operating costs, placing them on a unit base, and determining the number of units per year during the estimate time.

TABLE 6.1 TRANSIT PROPERTY COST FOR THE TRIP PARTICIPATION

PROPERTY	PRESENT COST	FUTURE COST
BART*	\$4,100	\$1,500
CTA ^{**}	\$47,000	\$2,000
NYCTA***	\$4,200	\$1,800
PATCO ⁺	\$3,400	\$1,700
WMATA ⁺⁺	\$16,886	\$3,300

^{*}Questionnaire Response - Appendix 11.3

^{**}Based on present 8 hours/week -(clerical)for report input generation @ \$9.52/hr and 40 hours/week -(technical)for analysis at \$21.50/hr. Most of analysis is due to not having an automated failure system for rail.

^{***}Questionnaire Response - Appendix 11.3.

⁺Revised by telephone conversation of 2/16/82.

⁺⁺Questionnaire response - Appendix 11.3.

Based on 510 MH @ \$33.11/MH for input and review at present.

Less than 100 MH @ \$33.11/MH for input and review in the future.

The unit chosen for this estimate is the record. Two kinds of records are submitted to the DB: the maintenance record and the utilization record. A maintenance record is submitted whenever a car is taken out of service for maintenance. One utilization record per car is generated per month, and it indicates the mileage accumulated on the car during that month.

The present DB operating cost was estimated in two different ways.

- 1. Based on the cost of a three month extension of the DRC contract to operate the DB from March-May 1981. During this time, 20,025 maintenance and utilization records were entered into the DB at a cost of \$31,000 or \$1.55/record.
- 2. Based on information obtained from the DRC. In a letter dated June 16, 1981 (included as Appendix 11.9), the DRC indicated that of the \$593,214 spent on the contract, 35% or \$208,000 were ongoing costs as opposed to one time costs of development, establishment, refinement and expansion of the DB. Since 129,025 maintenance and utilization records had been processed prior to the date of the letter, the unit cost is \$1.61/record.

To determine the future annual operating cost of the DB in the year 1984, the following assumptions were made:

- 1. The cost per record is \$1.60 (1981 dollars).
- 2. Thirteen properties, which are the present members of the Liaison Board, would be active participants.
- 3. There will be 2,110 new cars added to the DB by 1984. These would include: CTA(120), MTA-MD(72), PATH(291), GCRTA(108), PAT(100), MBTA(127), NYCTA(825), MARTA(120), SEPTA(266), WMATA(18), PATCO(46) and MDCTA(20). These numbers were obtained from a survey taken at the 11'th Liaison Board Meeting (Appendix 11.1).
- 4. Adding the ATO system unscheduled maintenance actions to the DB will result in an additional 0.8 maintenance records/car/month. This number was obtained by analysis of the BART failure experience, the details of which are illustrated in Appendix 11.10. The ratio of the ATO system failure rate to the sum of the failure rates of the friction brake, door system, and propulsion, is 0.21 (0.4 x 35.1/(21.8 + 8.9 + 37.4)). Since the latter three systems contribute 4.0 maintenance records/car/month, the ATO system would contribute 0.8 records/car/month (0.21 x 4.0). In this application, it is assumed that the other ATO properties experience failure rates similar to the BART.

5. Adding the remaining vehicle subsystems will add 3.1 records/car/month. This number is deduced in a manner similar to that for the ATO system, using the BART failure data in Appendix 11.10. The ratio of the sum of the failure rates of the added systems (air conditioning, auxiliary electric, carbody, communications, trucks and suspension) to the sum of the original three (propulsion, friction brakes and doors) is 0.78, which results in 3.1 maintenance records/car/month for these added systems.

With these assumptions, which are admittedly weak, and with the assumption that six properties (BART, MARTA, MDCTA, MTA-MD, PATÇO and WMATA) will monitor ATO for a total of 1,120 cars, the total records generated per month are 29,500, i.e., [3,534 utilization records, 896 (1,120 cars x 0.8 records/car) ATO system maintenance records, and 25,091 (3,543 cars x 7.1 records/car) vehicle (minus ATO) maintenance records]. At a cost of \$1.60 per record, the annual cost of operation of the DB is \$567,000.

In the TRIP Phase I Report, the DRC made the assumption that 0.5 records/vehicle/day would be generated. The equivalent number for the analysis above works out to 0.28 records/vehicle/day. If the DRC number is applied to the 3,534 cars in 1984, the annual cost is \$1,032,000.

The numbers used in the analysis here are on the optimistic side.

According to the DB data, the BART has a lower than average failure rate on the three vehicle systems monitored. It is reasonable to state that the annual cost would be in the range of \$600,000-\$1,000,000 (in 1981 dollars) in 1984.

Cost reduction, which is discussed in the following section, can reduce this number.

In addition to the annual operating cost, one time costs are also expected as new properties and/or new vehicles are added to the DB. These will be mainly borne by the property involved, and are small in comparison to the DB operation cost.

TRIP Phase 1 Report, Dynamics Research Corporation, R-341U, Final Report, April 1981.

6.3 Opportunities for Cost Reduction

There is potential for reduction in the annual operating cost to both the transit operator and the operation of the DB.

- 1. All properties which actively participate in the DB could generate direct, machine readable records. Properties which intend to automate their failure reporting should consider the TRIP interface and the DB structure and codes in the development of their system. The cost per machine readable record is 20-25% less than a hard copy or manually input record.
- 2. The number of vehicle subsystems added to the DB may be limited to those with the highest failure rates and/or those whose failure rates have the highest potential for correction. This action will not only reduce the annual operating cost of the TRIP, but will insure that a higher return on the DB and transit property investment be realized.

There are other opportunities for cost reduction during the next few years as more rail transit properties are incorporated in the DB participation.

- 1. Suppliers could contribute to simplify the preparation of data in the area of equipment configuration.
- 2. The transit operators could complete the generic parts lists, since they are more familiar with their own equipment configurations than the DB operator. However, guidance must be provided by the DB operator.

6.4 DB Cost Support

It seems to be the consensus of the transit properties that the operation of the DB must continue to be federally financed. They are willing to provide the manpower to ease the financial burden, but cannot afford to pay for the operation of the DB.

7.0 PROGRAM BENEFITS

The benefits of the TRIP can be divided into those which are presently being realized, and those which have a potential for being achieved in the future, should the program continue. All benefits are related to the use of the data in the DB, and to the professional rapport which has developed among the transit operators as a result of the program. The two main sources of information concerning the benefits are the transit industry interviews, in which specific questions were posed addressing them, and the minutes of the Liaison Board Meetings in which some of them were discussed.

7.1 Present Benefits

The present benefits of the program have already been, and will continue to be realized over the next several years. They are generally related to the close association among the rail transit properties brought about by the TRIP. Three classes of benefits are recognized, none of which can be quantified.

. Improvement of transit management communications at the local level.

The BART uses the reports distributed by the DB operator to assure their general management and board of directors that their system maintains a favorable reliability comparison to other rail properties. This use is of particular importance to the BART which, over the past several years, was reported in many circles as having unreliable equipment when compared to the rest of the industry. The reports generated by the DB are showing that the BART is above average in reliability of the three vehicle systems of the five participating properties (see Figures 5-1 to 5-3). There is the disadvantage that communications would not be improved for those transit properties which have below average equipment reliability.

It is expected that other transit properties would use the DB reports in a similar fashion.

2. Encouragement for development of automated failure data reporting.

Two properties (the CTA and WMATA) are presently using the DB in lieu of their own automated failure reporting system while their systems are being developed.

Presently, the CTA has an automated data system for its bus operation. It has not been fully developed for rail. In the meantime, the CTA has used the TRIP-DB for several functions which would normally be accomplished by an internal failure reporting system.

By March 1982, the WMATA is expected to have their automated failure reporting system on line. The system, "Maintenance and Reliability Reporting System", is an on-line operation which will take over many of the functions for which the WMATA is now using the TRIP-DB. Information distributed by the DB is used by the Equipment Design and Rail Car Maintenance Office as a performance indicator for measuring the effect of retrofit and modification programs, and the Rail Car Maintenance Office for warranty compliance, inventory control and failure trend indications.

Transit operators which are not now active participants in the DB, and which do not now have automated reporting systems, are using the TRIP equipment and failure codes as the basis for development of their failure reporting systems. Two properties, the MTA-MD and MDCTA, have gone in this direction. The PAT plans to go in this direction once their new vehicles are received.

The MTA-MD has found the TRIP information beneficial, from a cost savings point of view, in the development of an incident reporting system. By using the TRIP codes, both time and resources have been saved.

The implementation of the malfunction reporting system at the MDCTA has integrated the TRIP codes into a format which will allow them to actively participate in the TRIP when their vehicles become operational.

The BART has offered its internal, automated failure reporting system to any member of the rail transit community, free of charge. The MTA-MD is now considering that offer. Since the BART failure reporting system is one of the most sophisticated on-line systems in the industry, transit properties, which do not now have such automated reporting, should be encouraged by the cost saving potential of this offer. It is reasonable to assume that more rail properties will consider this system.

3. Informal equipment reliability and maintenance improvement.

The TRIP is a forum by which the rail transit community is informally exchanging ideas and information on equipment reliability and maintenance improvement.

The CTA, by reviewing the BART preventive maintenance philosophy, is evaluating the extension of their inspection intervals to 12,000 miles.

There have been informal exchanges by telephone, between many members of the TRIP Liaison Board, directed toward equipment reliability improvement.

These exchanges were generally a result of the distribution of the DB reports.

Because of the TRIP, the rail transit supply industry has been made aware that the properties are interested in reliable equipment. Because of the periodic reports issued by the TRIP, equipment failure experienced by one property are visible to others.

Until recently, only the carbuilders (with the exception of General Electric) have been exposed to the TRIP. It is suggested that suppliers of the three vehicle subsystems, on which data are being submitted to the DB, be educated to the TRIP so that this benefit may be enhanced.

7.2 Long Term Benefits

The degree to which the long term benefits of the TRIP are realized will depend strongly on the emphasis that the general management of the transit systems places on equipment reliability and maintenance, and its improvement,

and the ability to arrive at a credible comparison of reliability data among the properties. Diminishing returns will be realized on the present benefits over the next few years; as a result, the long term benefits must be achieved in order for the program to continue to have value. As was stated by the BART in the interview, the TRIP should be reviewed on a periodic (three year) basis to determine the extent to which these goals are being met.

Four general categories of long term benefits have been identified using the Liaison Board Meeting minutes, the transit industry interviews and the TRIP documents. Each of them is summarized and discussed.

1. Improvement of transit productivity.

Basic failure data will exist in historical form for comparing functional subsystems (components) of the rail transit vehicle. This equipment will be of different technologies and suppliers, and will operate in different environments and at various performance levels. Such data can be useful in vehicle procurement, technology development and new rail starts and extensions. Choice of highly reliable equipment would tend to increase overall vehicle performance, thus improving transit productivity. The ability to achieve all of these goals is dependent on the capability to properly characterize the relative equipment stress levels, which result because of different performance levels, and the operational, maintenance and natural environment differences among the transit systems to be compared.

A second incentive for productivity improvement results from the ability of transit managers to compare, on an unbiased basis, the reliability performance of their equipment with similar or different equipment serving the same function on other systems. This perspective may promote a healthy competition among the transit operators to improve performance. However, as was mentioned in several of the questionnaire responses, a danger exists that the information contained

in the DB will be misused or misrepresented. Action of this sort would reduce the effectiveness of the program by defeating the competitive spirit, and decreasing the potential benefit to all concerned.

2. Transit cost savings.

Two areas of cost savings may result from the TRIP. These are maintenance costs and reduced rail car acquisition costs.

Reduced maintenance cost may result from the selection of vehicle subsystems which have a proven high reliability record. Under the present philosophy of the TRIP, it would still be necessary to assess the maintenance cost records for the equipment on the individual transit systems on which they are operating, in order to determine if a maintenance cost savings is possible. This investigation is required because maintainability and maintenance cost data are not submitted to the DB. Lack of this kind of data in the DB means that no direct measure of maintenance cost reduction benefits can be obtained after the new equipment is introduced as well. Because of the length of the rail car procurement cycle, these savings could not be realized before 1985.

Several reasons were brought out, in the interviews, for the potential reduction of rail car acquisition cost. The first, and most direct, is the reduced capital cost of procurement, due to the reduced number of cars required. This is a result of increased availability which follows from the selection of highly reliable subsystems. For example, the analysis of data from the BART (reproduced in Appendix 11.10) shows that an increase in the reliability of the propulsion system by 25% can increase car availability from 84 to 85%. This would mean that in a 100 car order, one less car would be purchased, a savings comparable to one year's cost of operating the DB. However, increases in availability through reliability improvements of this magnitude (25% in the case of the BART propulsion system) are difficult to achieve without an overall car cost increase.

A savings of \$1,000,000 (typical rail car cost) over a 100 car order translates to \$10,000/car which may be absorbed in the reliability improvement.

The second reason for reduced rail car acquisition cost relates to carbuilder actions which would reduce rail car construction costs. Through the TRIP, the established carbuilders can know the reliability performance of their equipment, under different performance conditions and operational environments, by simply having access to the DB. This method should prove less expensive than gathering the information themselves, and the resulting risk in formal reliability demonstration tests could be reduced. Both factors may mean less carbuilder cost, which theoretically, at least through the competitive building process, would mean lower rail car prices. It is my opinion that no one could ever measure this benefit.

A third avenue to lower rail car acquisition costs may concern the extended warranty/reliability demonstration approach to quality assurance. It was mentioned by the CTA in their interview response that, if realistic mean-time-between-failure (MTBF) requirements could be put into rail car specifications, reliability demonstration, rather than extended warranty, is the proper approach. If the MTBF requirements were within the present practice of the carbuilders and their suppliers, then this approach would be less costly than extended warranty. The present MTBF of the equipment can be obtained from the DB.

The supplier which has a problem on one transit system would be visible to all agencies; likewise, the supplier which has a problem on one property but no problems on all other systems which it supplies with equipment, may direct the industry's attention toward poor maintenance. The problem of poor transit property maintenance vs. poor equipment reliability is one of long standing controversy within the industry. It is generally discussed without objective facts. The TRIP can provide these facts.

3. An aid to equipment improvement by suppliers.

Opportunities exist for the rail transit car supply industry to benefit from, and further enhance, the benefits of the program.

The DB can provide objective service data on equipment failures. Suppliers can use this data for product improvement, comparative evaluation and direction for strategy decisions.

More of the rail car supply industry should participate in the TRIP. This participation can take several forms:

- 1. Direct contribution to the DB by aiding in the development of configuration information and 'K-factors' for their equipment.
- 2. Using the information which is now in the DB for their strategic objectives.
- 3. Larger representation on the Liaison Board and in the decisions on future directions of the program.

4. An aid to the Federal Government role.

The TRIP can be used as a tool in the capital grant program. It is the opinion of some legislators that if tax dollars are given to transit agencies to buy equipment, some assurance is required that the equipment is being specified, delivered and used properly. In this sense, the TRIP can be used to monitor the improvement of the productivity and efficiency of transit. Again, the lack of maintainability and maintenance cost data limits the degree to which the quality of maintenance can be determined.

Objective service reliability data are valuable in research and development programs which are initiated and funded by the Federal Government. Specific programs which may benefit are vehicle standardization and new technology introductions such as STARS. Lack of the maintainability aspect does not allow use of the DB in the computation of life-cycle cost, an important ingredient in new technology decision making.

It is common belief that European and Japanese transit equipment operates better than their U.S. counterparts. To provide a more accurate perspective, and a basis for further introduction of this technology to the U.S., the TRIP can be used in foreign technology exchange. Of particular interest to some of our transit agencies, is the performance of the equipment in São Paulo and Rio de Janeiro, Brazil, which is similar to that at the BART, MDCTA, MTA-MD and MARTA. Success in the foreign technology exchange venture would require a substantial effort because of the lack of uniform, worldwide transit reliability definitions, the language barrier and different philosophies of operation.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The TRIP is a valuable asset to the transit industry because it is encouraging rail properties to automate failure reporting systems, and is educating these properties in practical application of reliability analysis through group interaction at the periodic meetings hosted by the program. It is unanimously supported by thirteen rail transit properties and three carbuilders. These reasons for its value will remain valid over the next two to three years while the properties are automating their failure reporting systems and are becoming contributors to the DB. Both of these benefits alone will tend to improve equipment reliability without the need to compare reliability data among properties.

Beyond this two to three year time period, however, the value of the TRIP will depend on its achieving its long term benefits. This success will hinge on two points: 1) the ability to compare reliability data among properties through proper characterization of equipment stress levels and operating environments, and 2) the capability to measure these benefits by productivity increases and cost savings directly attributable to the program. Rail transit properties which will profit from the long term benefits will be those with enthusiastic support from their general management. Such support must go beyond "lip service" in improving equipment reliability.

8.2 Recommendations

Several opportunities for improvements were identified during the evaluation which would substantially strengthen the TRIP in terms of meeting its stated objectives.

1. Factual comparisons of reliability between related equipment on different transit systems depend on proper characterization of the relative

equipment stress levels and operational environments among the transit properties. An immediate study should be undertaken to determine the depth required in such a characterization and its resulting credibility. The results of this study would determine the degree to which the long term benefits of the program can be achieved.

- 2. More emphasis should be placed on encouraging transit operators to develop and use their own automated failure reporting and assessment systems. These systems should be developed and built to easily interface with the DB operation. Although this was not the original philosophy of the TRIP, the education process through the program is providing incentive for the transit agencies to proceed along this line.
- 3. Maintainability and maintenance cost data should be included in the DB where it is practical to do so. Lack of these data limits the ability of the program to provide substantive data for specifying new equipment procurements, justifying product improvement projects and supporting systems analysis programs.
- 4. The ability to use the TRIP to increase transit productivity and save dollars ultimately depends on the degree to which the general management of each property is aware of and believes in the program's capabilities. A low level of general management support is equivalent to no support. General management seminars, which are one day in duration, should be conducted to stress the use of the TRIP to improve transit productivity.

9.0 BIBLIOGRAPHY

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Raymond A. Oren

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SEPTA - Robert Sellman

WMATA - Edgar C. Green

Federal Government

DOT-TSC - Richard H. Robichaud

- Arthur S. Priver

DOT-UMTA - Robert Haught

Barbara Zumwalt John Durham John Goon

TRIP Contractor DRC

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APTA

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11.0 LIST OF APPENDICES

- 11.1 Summary of Liaison Board Meetings Minutes
- 11.2 Liaison Board Assessment of May 1981
- 11.3 Evaluation Questionnaires and Responses for Active Participants in the DB
- 11.4 Evaluation Questionnaires and Responses for Liaison Board Members who are not Active Participants in the DB
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- 11.9 Letter from Dynamics Research Corporation
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APPENDIX 11.1 SUMMARY OF LIAISON BOARD MEETINGS MINUTES

The history of the TRIP is best described by summarizing the liaison meeting developments which are both directly and indirectly related to the purpose of this report. Each of the eleven meetings were reviewed and are summarized.

Liaison Board Meeting #1 (Kickoff)

Place: Urban Mass Transportation Administration headquarters, Nassif Building

Washington, D.C.

Date: November 8-9, 1978

Representation

Federal Government: DOT-UMTA, DOT-OST, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MBTA, MTA-MD, NYCTA, PAT, PATCO,

PATH, SEPTA

APTA, RPI

DRC

Teknekron, JPL

PB - Decision Group

Significant Developments

- Opening statements made by groups involved:

1. UMTA

Rail cars will be the first sector to which TRIP is applied. TRIP is a U.S. government sponsored program for the benefit of transit operators and requires guidance by transit properties to achieve the desired improvements in transit system reliability.

2. TSC

Presented TRIP program plan.

3. APTA

The role and mission of the APTA Liaison Board was explained. The APTA committee on Reliability, Availability, Maintainability and Dependability (RAMD) will establish a task force to support the TRIP as the data bank can assist all sectors of the transit industry in achieving a common approach to reliability. The proposed active participants (those who will input data) were named and included six properties:

BART NYCTA
CTA PATCO
GCRTA WMATA

4. DRC- the TRIP contractor.

The data bank of the TRIP was to be factual and require a minimum of input tasks by transit maintenance personnel. Existing data, both manual and computerized, on transit car equipment will be converted in the data bank to user-oriented output.

Liaison Board Meeting #1 (continued)

- DRC, the TRIP data bank contractor, scheduled visits to active participants in the data bank. The purpose of these visits was to engage in discussions with reliability, maintenance and data processing personnel, who would be involved in providing data to the data bank. The schedule follows:

BART - 11/15/78 NYCTA - 12/6/78 GCRTA- 11/29/78 PATCO - 12/8/78 CTA - 11/30/78 WMATA - 12/11/78

- Regional Meeting Concept

Two day meetings to be held on a regional basis. The first day is to be an overview for middle management of both equipment suppliers and transit properties who will be directly associated with TRIP experimental data bank.

Liaison Board Meeting #2

Place: APTA headquarters, Washington, D.C.

Date : January 10-11, 1979

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, MBTA, MTA-MD, NYCTA, PAT,

PATCO, SEPTA, WMATA

APTA DRC SAI

Significant Developments

- The TRIP Task 1 report was discussed.
- Both the Reliability Analysis Center (RAC) and the U.S. Military Maintenance Data Systems are not recommended for use but their formats could serve as guidelines.
- Concern was expressed for the handling of failure data by the properties. The need for a common base for failure reporting was recognized. However, a question was raised as to whether a correlation between hours of operation, miles of operation and cycles during operation could be established.
- The concept of holding regional meetings to acquaint transit property management with TRIP was made firm. A short presentation would be given to the top management of the active participating properties. This would be followed by presentations to personnel directly involved with the TRIP data bank.
- A vote of the Liaison Board was taken on the vehicle systems to be tracked by the TRIP data bank. The results of that vote were:

Propulsion - 9 Friction Brakes - 8
Doors - 9 ATO/ATC - 4
Air Conditioning - 2

Liaison Board Meeting #2 (continued)

The remaining systems received no votes. APTA requested that air conditioning and electric couplers be included because of the value to the STARS (Subsystem Technology Applications to Rail Systems) program. (Three systems were finally selected for the DB: propulsion, friction brakes and doors.)

- TRIP data should not be considered as representative of "mean-time-between-failures" but rather "mean-time-between-replacements". The former differs from the latter in that it does not include preventive maintenance replacement.
- The question was raised concerning legal liability of DOT/APTA/Transit Properties with respect to the information contained in the TRIP data bank. Special concern involved inaccurate data which might be inadvertently reported.

Liaison Board Meeting #3

Place: APTA headquarters, Washington, D.C.

Date: March 6-7, 1979

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, MBTA, NYCTA, PAT, PATCO,

PATH, SEPTA, WMATA

APTA DRC SAI

Significant Developments

- DOT-TSC used a TRIP meetings contractor (SAI) to conduct regional meetings at the six active participating properties. These meetings would serve the purpose of informing property management of TRIP and briefing the personnel who would be involved in generating data. The schedule is:

BART (No meeting set) NYCTA - 5/7/79 CTA - 5/14/79 PATCO - 5/9/79 GCRTA - 5/16/79 WMATA - 5/11/79

- Concerns were expressed for the security of data in the TRIP data bank. Although this item was brought out in the discussion, no resolution was made at this time.
- The TRIP data bank was now set to track replacement data on four vehicle systems: propulsion, friction brakes, doors and control and air conditioning. A motion to add carborne ATO/ATC and cab signalling was tabled until Phase 2 because of the additional funding requirement. The delay which would result from attempting to obtain the change in scope and additional funding and a statement from MARTA which was the only property in a position to benefit from the addition of this system favored postponement.
 - Task 2 and task 3 reports, submitted by DRC were critiqued.

Liaison Board Meeting #4

Place: APTA headquarters, Washington, D.C.

Date: April 24, 1979

Representation

Federal Government:

DOT-UMTA, DOT-TSC

Transit Properties:

BART, CTA, GCRTA, MARTA, MBTA, NYCTA, PAT,

PATCO, PÁTH, SEPTA, WMATA

APTA

PB - Decision Group

DRC

Booz-Allen & Hamilton

Significant Developments

- Regional meeting progress. A revised schedule for regional meetings to brief the active participating properties is shown below:

PATCO - 5/9/79

WMATA - 5/10/79

CTA - 5/16/79

GCRTA - 5/16/79

NYCTA - To be rescheduled after 5/18/81

- Transit property responses as to how each planned to use the TRIP data bank are summarized below.

NYCTA

As the cars are maintained in several shops, it is requested that maintenance actions be identified by the performing shop,

Requests automatic flagging when data in the output reports varies more than 50 percent from the mean,

Desires aggregate of NDF's (No Defects Found),

Interested in comparison of performance of similar equipment used on other transit properties, and

Expects flagging of trends and repeater reports.

2. SEPTA

Interested in differences of car performance among transit properties,

Interested in comparative performance of cam control vs. chopper control, and

Appreciates the opportunity to track by component.

3. PAT (Pittsburgh, PA)

Comments similar to SEPTA

Liaison Board Meeting #4 (continued)

4. PATH

Comments similar to SEPTA

5. GCRTA

Desires comparison of similar equipment used on other transit properties,

Interested in percentages of NDF's (No Defects Found), and

Desires comparison of performance between vendor-rebuilt and in-house rebuilt equipment.

Liaison Board Meeting #5

Place: APTA headquarters, Washington, D.C.

Date : September 18-19, 1979

Representation

Federal Government: DOT-TSC

Transit Properties: CTA, GCRTA, MARTA, MBTA, MTA-MD, NYCTA, PATH,

SEPTA, WMATA

APTA

DRC

Booz-Allen & Hamilton

Significant Developments

- The regional meetings were assessed favorably by the Liaison Board members from the transit properties at which the meetings were held. These properties were:

> CTA GCRTA NYCTA WMATA

- At this time, only data from BART and WMATA is being processed.
- 1. BART is furnishing a magnetic tape of replacement information and hard copy of utilization data.
- 2. WMATA is furnishing hard copy of replacement data on two forms and car-mileage data on another copy.
 - 3. CTA is implementing new codes and data are expected by October 1, 1979.
- 4. PATCO is undergoing a computer changeover and changing data systems. Data are expected to be forthcoming in early November 1979.
- 5. Because of litigation problems with the R46 cars, NYCTA changed the tracking to the R44 car. Data are not expected until November 1979.

Liaison Board Meeting #5 (continued)

- 6. Many issues remain to be resolved with data input from GCRTA.
- The costs identified in handling the transit property data, operating and staffing the DB are being tracked and are to be included in the TRIP Phase I report.

The first-cut staffing requirements, including the data collection effort, for the TRIP data bank are estimated as:

Track#	<u>Function</u>	Personnel
1 2 3 4 5	Data Entry Programmers Engineering Support Operational Program Management	10 3 3 3 2 2
	TOTAL	24

The discussion concerning providing data inputs by transit properties resulted in the following <u>ACTION ITEM</u>: "There is a need to determine property costs to acquire and handle data associated with maintenance action; DRC is to perform Rough-Order-Of-Magnitude (ROM) estimates by 1 November 1979".

- <u>Critique of Output Reports</u> Consideration is being given to distributing the summary reports from the data bank to all contributors; detailed outputs from the data bank would be made available to only the transit property/organization that submitted the raw input.
- It was reiterated that the output of the data bank is not to be used for day-to-day maintenance but is intended to provide indices of: (1) historical performance, (2) evaluation of equipment/procedure modifications, and (3) life-cycle data. When anomalies are detected by the data bank operator, the submitting transit property will be informed and a request made for an explanation of the situation for inclusion in the monthly report; this procedure would be an assist in validation of data. The monthly reports will also direct attention to items which exhibit a high replacement rate.
- The TRIP-DB output reports are to be distributed to DOT-UMTA, DOT-TSC and the APTA Trip Liaison Board. To prevent using data out of context, these reports will use coding to identify transit properties and equipment manufacturers; code books would only be issued to active participants of the TRIP-DB.
 - Program Plans by DOT-TSC
- 1. The next addition to rail carborne equipment will be the on-board ATO subsystem.
- 2. Rail transit is expected to be expanded by task; by other transit properties and car fleets less than 10 years old.

Liaison Board Meeting #5 (continued)

3. Two-thirds of transit car equipment will be in TRIP-DB within 4 years as part of Phase II effort. March 1980 is anticipated to be the starting date.

Liaison Board Meeting #6

Place: APTA headquarters, Washington, D.C.

Date: November 27-28, 1979

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: CTA, GCRTA, MARTA, MBTA, MTA-MD, NYCTA, PAT,

PATCO, PATH, SEPTA, WMATA

APTA DRC

Significant Developments

- TSC Program Plans
- 1. The Rail TRIP-DB contract is to have its period of performance extended 9 months or until September 1980.
- 2. A critical design review of TRIP-Phase I will be set for next Liaison Board Meeting.
- Memos were requested from each of the Liaison Board members (due 3/1/80) describing their transit property's opinion of the DB based on latest output data. APTA will request opinions from the General Managers of the six active participating properties in the DB.
- Data was developed as to the ongoing cost of TRIP-DB by DRC. The average, rough order of magnitude estimates for a transit property to collect data is approximately \$3 per vehicle/per day.
- Critique of output reports for the period July-September 1979 were presented by DRC.

Liaison Board Meeting #7

Place: APTA headquarters, Washington, D.C.

Date: April 1-2, 1980

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, MTA-MD, NYCTA, PATCO,

SEPTA, WMATA

APTA DRC

Transtech

Liaison Board Meeting #7 (continued)

Significant Developments

- The representative from Transtech (Dr. Vilas Nene) is scheduled to make an overseas trip to study foreign technology as it relates to AC propulsion and microprocessors in rail transit. He was asked to investigate the possibility of obtaining reliability type information at the same time.
 - A TRIP chronology was developed.
- An assessment of TRIP that conveys the opinion of the six active participating properties in the DB is presented.

Transit Property	Assessment	Letter of Assessment
BART	Favorable	Yes
CTA	Favorable	Yes
GCRTA	Favorable	No (To be submitted)
NYCTA	Withheld (Management involved in labor negotiations)	No (To be submitted)
PATCO	Favorable	Yes
WMATA	Favorable	Yes
NYCTA PATCO	Withheld (Management involved in labor negotiations) Favorable	No (To be submitted) Yes

As a result of the favorable assessment, it was recommended that TRIP-DB be continued in its present form for several more months.

- A question on the validity of the "common basis" of data was raised. The number of times a vehicle was removed from revenue service for maintenance action can be obtained and primary cause of maintenance was there, however the secondary causes may be obscured. It was recommended that Average Miles/Maintenance Action be changed to Average Miles/Maintenance Shop.
- A detailed review of the DB output report format was made and many changes were recommended.

Liaison Board Meeting #8

Place: APTA headquarters, Washington, D.C.

Date: July 22-23, 1980

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, MTA-MD, NYCTA, PAT,

PATCO, PATH, SEPTA, WMATA

Equipment Suppliers: BUDD, GE

APTA DRC Liaison Board Meeting #8 (continued)

Significant Developments

- Considerable interest in participating in TRIP was expressed by foreign transit properties. This was conveyed to Dr. Nene on his visit and reported by UMTA.
- A study, which would allow the failure data to be interpreted from a reliability information point of view, was underway by DRC. It is referred to as the K-Factor study.
- Critical design review was held March 31, 1980. The committee consisted of representatives from APTA, BART, DOT-TSC, DOT-UMTA, CTA, GCRTA, NYCTA, PATCO and WMATA. The principal conclusions were:
 - 1. TRIP should be continued.
- 2. TRIP cannot be properly evaluated without 12-18 months of additional DB experience.

The principal recommendations were:

- 1. Three major assemblies from five vehicle series should be monitored until outure report confidence is satisfactory.
- 2. The present contractor should continue operating the DB until the DB is valid and stable.
- 3. Bus TRIP should begin by monitoring a sample of assemblies from a limited number of buses.

Liaison Board Meeting #9

Place: MARTA, Atlanta, Georgia Date: October 15-16, 1980

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, NYCTA, PAT, PATCO,

PATH, SEPTA, WMATA

Equipment Suppliers: BUDD, GE

APTA DRC

PBT (Consultant to MARTA)

Transtech

Significant Developments

- An 8 month extension (to March 1981) to TRIP was effected in July 1980. A second critical design review of TRIP is scheduled for March 1981. Liaison Board members will be requested to present their property's evaluation.

Liaison Board Meeting #9 (continued)

- The representative from Transtech (Dr. Nene) reported that maintenance data in Europe and Japan was kept manually. These properties are interested in some type of participation in TRIP.

Liaison Board Meeting #10

Place: PATCO, Lindenwold, New Jersey

Date: January 13-14, 1981

Répresentation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, MARTA, MTA-MD, NYCTA, PATCO, PATH,

SEPTA, WMATA

Equipment Suppliers: BUDD, GE

APTA DRC

Significant Developments

- The K-Factor study has been put on hold by DRC until sufficient funds are available.
- A cost-benefit assessment of TRIP-DB is to be an essential element of a critique by the transit operators in the Critical Design Review of Liasion Board meeting #11.
- Areas of differences between the TRIP-DB and a Reliability Data Bank were identified by the GE representative.
 - 1. Classical reliability data are not being collected.
 - Classical mean-time-to-repair data are not being collected.
 - 3. Configuration control is not mandated.
- 4. Hardware cannot be segregated by particular manufacturer and/or particular style/model.
 - 5. Cannot be used as a procurement tool.
 - Relationship of operating environment is not obvious.
 - 7. Timely identification of failure rate trends is needed.
 - 8. Slow feedback of data exists.
 - 9. Impact of preventive maintenance philosophy is not clear.
- Newspaper articles about BART based on TRIP data appeared. BART was informed that release was contrary to policy.

Liaison Board Meeting #11

Place: Transportation Systems Center, Cambridge, Massachusetts

Date: May 6-7, 1981

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, GCRTA, MARTA, MBTA, MTA-MD, NYCTA,

PAT, PATCO, PATH, SEPTA, WMATA

Equipment Suppliers: BUDD

APTA DRC CMU

Significant Developments

- Summary of TRIP Critical Design Review #2 attendees were representatives from DOT-UMTA, DOT-TSC, DRC, APTA and 5 of the 6 TRIP experimental Data Bank Properties.

- The following conclusions were reached:
- 1. The TRIP-DB has proved that a rapid rail vehicle data bank is worthwhile and viable.
- 2. The DB information accurately presents the data reported by the participating properties.
- 3. The DB information, although limited in scope, has been beneficial to transit operators, and
- 4. The TRIP Generic Part Numbering, 'K-factor' analysis and manufacturer's identity still contain minor unresolved problems.
 - The following recommendations were made:
 - 1. The TRIP-DB should be continued.
 - 2. Commence Phase #2 of TRIP.
- 3. TRIP should complete the DB with additional subsystems, car-fleets and transit properties, and
 - 4. TRIP should complete and document reference data.
 - Transit Property Assessments of TRIP

The Liaison Board members stated their specific transit property's assessment of TRIP.

- BART Supports TRIP, requests removal of prohibition against disclosure of DB data.
- CTA Supports TRIP, requests expansion of DB to include entire transit car and addition of CTA series 2600 cars. Has found information useful and is revising CTA Maintenance Information System (MIS).

Liaison Board Meeting #11 (continued)

- MTA-MD Fully supports TRIP, it will become important during the reliability demonstration.
 - PATH Fully supports TRIP, expects to use TRIP for new car acquisition.
 - GCRTA Supports TRIP.
 - SEPTA Supports TRIP, considers it beneficial and requests expansion.
- NYCTA Supports TRIP.
- WMATA Supports TRIP, expansion of DB to include both additional car subsystems and carfleets is desired.
- MARTA Supports TRIP, suggests data presentations in both operating time and mileage, suggests consideration be given to a warrantee database and reliability demonstration.
- MBTA Supports TRIP.
- PATCO Supports TRIP, considers TRIP more a measure of reliability and maintenance philosophies and not quite reliability per se.
 - PAT Supports TRIP, suggests expansion to include additional modes (Bus, Light Rail Vehicle and Commuter Railroad).
- BUDD Supports TRIP; as a carbuilder suggests inclusion of maintenance practices and policies, operational environment and 'K-factors'.
- It was stated that there has been a significant increase in technical data exchange among the properties as a result of TRIP (e.g. MTA-MD correspondence with BART, etc.).
- DOT-TSC described the present status of TRIP. The DB has been operating under the engineering change which extended the contract to July 31, 1981 to permit 12 consecutive (June 80-May 81) DB Output Reports. A continuation of the TRIP Phase contract is presently being processed by the Department of Transportation.

Transit property responses to providing the preferred type of data inputs and the number of new cars anticipated by the end of 1982 are tabulated and are shown on the next page.

Liaison Board Meeting #11 (continued)

Property	<u>Response</u>	Cars Added to DB by Dec. 1982
BART	Yes	0
СТА	Yes	120
MTA-MD	Yes	72
PATH	Conditional Yes	291
GCRTA	Conditional Yes	48 LRV + 60 HR
PAT	Conditional Yes	45 PCC + 55 LRV
MBTA	Yes, developing MIS for LRV	127 LRV
NYCTA	Conditional Yes (contingent upon staffing)	750(R46); 50-100(R62)
MARTA	Conditional Yes	. 120
SEPTA	Conditional Yes, developing MIS for LRV	141 LRV + 125 HR
WMATA	Yes	16-20
PATCO	NA	46
MDCTA	NA	20

Liaison Board Meeting #12

Place: Washington Metropolitan Area Transit Authority

Washington, D.C.

Date: September 2-3, 1981

Representation

Federal Government: DOT-UMTA, DOT-TSC

Transit Properties: BART, CTA, MARTA, MBTA, MTA-MD, PATCO, PATH,

SEPTA, WMATA

APTA DRC CMU

<u>Significant Developments</u>

Status of Foreign New Technology Monitoring.

U.S. DOT-UMTA representative (Robert Haught) stated the program to monitor technologies being developed and implemented by the foreign transit community is on "hold" pending the general review of all UMTA programs.

Liaison Board Meeting #12 (continued)

- The representative from the APTA (Ted Gordon) presented an overview of the U.S. DOT-UMTA STARS (Subsystem Technology Application to Rail Systems) Door Project which is being performed by Booz-Allen & Hamilton (BAH), under UMTA contract. The objective is to acquire and analyze data on transit car door malfunctions, and recommend changes (design, fabrication, assembly and/or maintenance) that will yield increased performance reliability in the most cost-effective manner. Accordingly, the TRIP Liaison Board consented to assist this STARS Door Project by making available to BAH the same data on doors which had been submitted by transit properties to the TRIP-DB. The DRC representative (A. McMillen) described the contract negotiated with BAH which resulted in the DRC Document "E-5968U, "TRIP EDB Special Report Number 6". This report, used in conjunction with DRC Document #R-338U, "TRIP EDB Operating Procedures Manual-Volume II", assisted BAH in the acquisition of data pertaining to maintenance actions on doors. This was the first use of the TRIP by anyone other than members of the TRIP Liaison Board.
- A Liaison Board discussion of the Statement-of-Work recommended that the CTA 2600 series cars and the MARTA cars be included in the TRIP-DB. Balloting by the Liaison Board to designate the sequence in which additional vehicle subsystems should be added to the TRIP-DB resulted in the following listing:

Rank	Subsystem
1	ATO/ATC - Cab Signal
2	Air Comfort (HVAC) System
3	Auxiliary Electrical System
4	Truck & Suspension
5	Coupler & Draft Gear

- The DRC stated that Report No. R-340U, "Reliability Verification Demonstration Plan for Rapid Rail Vehicles", was developed to indicate a possible use for the TRIP DB.

APPENDIX 11.2 LIAISON BOARD ASSESSMENT OF MAY 1981

This appendix contains the submittals of the members of the Liaison Board to the Critical design review #2.

Member	Date of Submittal
BART	5/1/81
CTA	5/11/81
GCRTA	N
MARTA	N
MBTA	N
MDCTA	6/15/81
MTA-MD	4/10/81
NYCTA	6/9/81
PAT	N
PATCO	4/15/81
PATH	4/3/81
SEPTA	4/14/81
WMATA	5/1/81
BIIDD	5/1/01
BUDD	5/1/81
GE	N

N - No Submittal



BAY AREA RAPID TRANSIT DISTRICT 800 Madison Street Oakland, California 94607 Telephone (415) 465-4100

May 1, 1981

American Public Transit Association Technical & Research Service Department 1225 Connecticut Avenue, Northwest Washington, D.C. 20036

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PRESIDENT

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BTH DISTRICT

WILFRED T. USSERY

7TH DISTRICT
EUGENE GARFINKLE

JOHN H. KIRKWOOD

Attention: Mr. Theodore S. Gordon

Dear Mr. Gordon:

In response to your letter of February 17th to the members of the T.R.I.P. Liaison Board, requesting an assessment of T.R.I.P. to date, we submit the following opinion.

The District's management continues to be fully supportive of the project's goals, and is very favorably disposed regarding the reports received to date.

We encourage extension of the experimental data base to include all vehicle systems at the earliest possible date. The District is fully prepared to support the required data submittal, and in fact has been submitting full vehicle history on all monthly inputs to the EDB contractor.

The District has in the past conducted its own surveys which involved travel, phone, and considerable staff time to clarify and reduce data to insure classification compatability inherent in the varied data reporting practices of heavy rail transit properties surveyed.

In regard to cost/benefits, we would estimate the cost of such comparative surveys of five properties to be about two thousand dollars, which provides a report covering a very limited data duration without the benefit of an unbiased reporting source.

Following action to report rates of unscheduled maintenance action for all vehicle systems, we urge the expansion of reporting coverage to include all APTA U.S. heavy rail properties. Additionally, we would urge consideration of inclusion of comparable data from foreign properties. We would be particularly interested in the participation of Toronto, Montreal, Mexico City, Sao Paulo, and Rio de Janeiro.

American Public Transit Association Mr. Theodore S. Gordon Page 2

The principal benefit to the District thus far has been the assurance to our Board of Directors that we maintain a favorable reliability comparison for the three critical vehicle systems currently reported.

We wish to affirm our belief that such data is, and should be in the public domain. We urge speedy resolution of remaining questions on the authenticity of all participants' inputs, and amendment of APTA's contractual agreements to permit extending this assurance to our patrons and the taxpayers of the BART District.

With regard to the request for cost/benefit attributes, we feel many of the benefits are intrinsic in the unbiased report source, and the continuous updating of the data.

A further anticipated benefit of the T.R.I.P. program is comparative component reliability data enabling more objective operational evaluation of alternative technology and supply. To that end, we urge efforts towards common nomenclature (and computer code) for components having a common functional purpose, and publication of reference data defining the technology and manufacture of the comparable functional components.

We have recently completed design and specification efforts in preparation for procurement of new revenue vehicles. This task required travel and communication expense, and staff labor to review and define the performance of competitive functional components applied at other properties. Even given this effort, most readily obtainable input is subjective opinion within the frame of reference of the responding property and suppliers. Objective comparative component failure rate data is very difficult to establish. Considering that this is an activity which each property must periodically undertake, involving both their own resources and those of the cooperating data sources, the cost/benefits to the industry should be considerable.

We believe that improved vehicle and subsystem MTBF are essential for increased acceptance of mass transit in the U.S. market. The application of extensive R&D activity toward pure reliability improvement projects are beyond the funding ability of an operating property. At the present time, only each properties' experience and the subjective evidence of preceding specification efforts provide guidance as to acceptable levels of specified MTBF requirements.

The existence of objective MTBF data permitting solid design prediction of attainable reliability, based on service demonstrated component performance, would be of considerable benefit not only to the specifying properties, but also to the goal of increased energy conservation through increased public acceptance of mass transit.

American Public Transit Association Mr. Theodore S. Gordon Page 3

We continue our opinion that the developmental effort of T.R.I.P. through TSC and the EDB contractor has been of high quality, and well administered. We support full implementation of the Project's objectives.

Very truly yours,

R. P. Demko, Director Maintenance & Engineering

cc: Mr. Richard Robichard, Code 722

USDOT/TSC

Kendall Square

Cambridge, MA 02142

The Chicago Transit Authority (CTA) assessment of the Transit Reliability Information Program remains positive.

Since the last CDR, and the extension of the Experimental Data Bank (EDB), CTA has gained information concerning its operation to maintain the 1100 rail cars in its fleet. This gain has occurred while only 194 cars of the fleet and only 3 sub-systems are reported in the data bank.

At present CTA does not have an automated source for information that provides average miles between inspection intervals, maintenance activities on the various types of defects and no trouble found data on its rail system.

There are documents that show these areas, but the analysis and recap of the data is TRIP generated.

The automated data system CTA now operates on its bus system has not been developed fully for rail. The interim system gathers car history but not the detail for defect failure or inspection analysis. The complete system is hoped to be on-line by the end of 1981.

Additionally, CTA is in the process of developing a System Assurance group to review performance.

We find many good things about the TRIP program:

The Chicago Transit Authority (CTA) assessment of the Transit Reliability Information Program remains positive.

Since the last CDR, and the extension of the Experimental Data Bank (EDB), CTA has gained information concerning its operation to maintain the 1100 rail cars in its fleet. This gain has occurred while only 194 cars of the fleet and only 3 sub-systems are reported in the data bank.

At present CTA does not have an automated source for information that provides average miles between inspection intervals, maintenance activities on the various types of defects and no trouble found data on its rail system.

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Additionally, CTA is in the process of developing a System Assurance group to review performance.

We find many good things about the TRIP program:

accuracy of the data fed into the system. CTA found data such as "no trouble found" and "reset/check ok" - should not be combined as it was. Consistency in the source of the data is very important industry-wide. Mileage information at CTA may be consistent due to the use of hubdometers, however, other properties may only estimate schedule miles by trips run which has many shortcomings for accuracy.

Improvements are expected as the remaining sub-systems are added to the data base. It is recommended that this begin quickly so that by 1982 the entire car will be on the system. Additionally, the area of signal systems needs to be developed and incorporated into the data bank. This is both wayside and carborne equipment. CTA would like to begin this operation of its 2600 series cars by inputing data into TRIP.

Specifically, CTA has used the TRIP EDB data in the area of Methods and Standards to evaluate our operation. From TRIP EDB data CTA is inspecting 59% of the total fleet each month while maintenance actions are 2.1 per car for the same period. This indicates that the current inspection plan may not be helping to reduce failures. As such, the inspection interval may be extended to better utilize manpower to attack problem areas. As a comparison, BART inspects 47% of its fleet with maintenance action at 1.1 per car over the same period. CTA is now evaluating the extension of inspection intervals to 12000 miles through its Methods and Standards area. CTA has assigned one person to evaluate the data from TRIP

ASSESSMENT OF TRANSIT RELIABILITY INFORMATION PROGRAM (TRIP) FOR SECOND CRITICAL DESIGN REVIEW (CDR)

and make recommendations to the Director, Vehicle Maintenance in areas that indicate the need to improve. CTA has validated the output of the EDB and corrected one error that was CTA generated. Through the new System Assurance Group, CTA will study and evaluate individually the status of vehicle and manpower utilization, inspections, maintenance practices, parts reliability and cost. Furthermore, the use of the data will provide a direct feed back to new design needs to eliminate unmaintainable systems.

Finally, CTA recommends the continuation and expansion of Rail TRIP. Furthermore, CTA recognizes the greater advantage in the development of Bus TRIP, as that industry has a better resource of standard vehicle designs that can be improved with the TRIP concept of information available to properties and suppliers.

CTA feels that the current operator/contractor of the EDB has performed in an outstanding manner to develop and operate the data bank. Continuation with the same personnel will enhance the effectiveness of further development in TRIP. CTA recommends the continued use of current EDB contractor as developer and operator of the TRIP Data Bank. CTA will continue to support the TRIP effort.

ORIGINATED BY:

Director,

Vehicle Maintenance

APPROVED:

H. H. Geissenheimer

General Operations Manage

APPROVED:

T. L. Wolgemuth Manager, Maintenance



METROFOLITAN DADE COUNTY · FLORIDA

44 W. Flagler St, 10th Flr MIAMI, FLORIDA 33130

OFFICE OF COUNTY MANAGER

TEL: 579-5311 4918

JUN 1 5 1981

Mr. Theodore S. Gordon, Senior Engineer American Public Transit Association Technical and Research Services Department 1225 Connecticut Avenue, NW Washington, D.C. 20036

Dear Mr. Gordon:

This is in response to your letter of May 13th to the members of the TRIP Liaison Board requesting our inputs regarding TRIP Experimental Data Bank.

We have carefully monitored the TRIP EDB and are in support of the objectives. The implementation of our malfunction reporting system has integrated the TRIP codes into a format that will allow us to actively participate in TRIP when our rail system becomes operational. Also, we will soon be receiving our fleet of vehicles and plan to utilize the TRIP EDB to support our equipment reliability program.

Since Metrorail is still under construction we will not be able to fully assess TRIP's benefits until our new vehicles are delivered, debugged and in operation. It is therefore premature for us to accurately quantify any cost savings, benefits or opportunities derived from utilizing TRIP, however, we do believe there to be a positive benefit, and are proceeding accordingly.

We support the development of TRIP and encourage expansion to include all vehicle subsystems. This program has demonstrated the ability of transit properties to effectively exchange information. We appreciate the role APTA has performed thus far.

Sincerely,

Transportation Coordinator

JAD:1g Enclosure



MASS TRANSIT ADMINISTRATION

TOU EAST REDWOOD STREET . BALTIMORE MARYLAND 21202

M, te echone number sign 383-6035

April 10, 1981

Mr. Theodore Gordon American Public Transit Association 1225 Conn. Ave. N.W. Washington, DC 20036

Dear Mr. Gordon:

The Mass Transit Administration have been carefully following the development of the APTA Transit Reliability Information Program. As an emerging rail property, the MTA has found the TRIP information beneficial from a cost saving point of view in the development of an incident reporting system. By using TRIP codes we have saved time and resources in developing this program. Although, we are not yet active participants in the TRIP data bank, it has proven quite useful for our purposes.

Additionally, the TRIP output reports have provided us with comparative information on equipment reliability. This is important to us in that we are in the process of procuring transit vehicles.

We fully support the TRIP effort and endorse its further development. This program is one indication of the mutual benefits that acrue from the cooperative efforts of APTA members.

Very truly yours,

L. A. Kimball, Administrator

LAK/cab

cc: Richard Robichaud - TSC

Donald J. Dzinski

New You

New York City Transit Authority

370 Jay Street, Brooklyn, N.Y. 11201 (212) 330-4122

Members of the loard

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Constantine Sidamon-Eristoff
Robert F. Wagner, Jr.
Robert T. Waldbauer

Executive Director John D. Simpson

June 9, 1981

Charles Kalkhof General Superintendent—Rapid Transit

Mr. Theodore Gordon, P.E. American Public Transit Association 1225 Connect cut Avenue, NW Washington, D.C. 20036

Dear Mr. Gordfy

The following is to confirm the position taken by our representative at the Critical Design Review of The TRIP (Transit Reliability Improvement Program) Experimental Databank on May 5, 1981.

The Transit Authority feels that the program is useful to the rail properties and important to the flow of information in the industry.

We will support the expansion of the system to include more car subsystems, new car classes and additional properties.

We would like to see more reference data included since there are significant differences in operations between properties. Without this type of data it is difficult to make proper comparisons.

The Transit Authority supports the concept of TRIP and will continue to supply information for it.

Sincerely

Charles Kalkhof

General Superintendent

Rapid Transit

25: JLG/st



PORT AUTHORITY TRANSIT CORPORATION

PHILADELPHIA:

PENNSYLVANIA AND NEW JERSEY BENJAMIN FRANKLIN BRIDGE PLAZA CAMDEN, NEW JERSEY 08102

CAMDEN:

April 15, 1981

Mr. Theodore S. Gordon, Senior Engineer American Public Transit Association Technical and Research Services Dept. 1225 Connecticut Ave. N. W. Washington, D. C. 20036

Subject: Transit ReliabilityInformation Program (TRIP) Critical

Design Review (CDK) #2

Dear Mr. Gordon:

In compliance with your request that PATCO provide an assessment of TRIP to date, the following is offered.

Our comments and position stated in our letter of April 3, 1980, same subject, still apply, particularly the last paragraph.

There has been some progress during the last year; the output reports have been developed and are satisfactory. However, there remain many minor questions of compatibilty of data as partially noted in Ray Oren's letter of October 23, 1980. Efforts to resolve these questions for our own understanding require time which is not always available. While these questions remain, the TRIP data does not get wide distribution at PATCO.

Each of the Liaison Board Members are aware that the name TRIP is a misnomer; reliability reporting is not part of the program. TRIP is more a measure of reliability and maintenance philosophies, and not quite availability. The potential usefulness of TRIP as a comparative tool exists, yet it is impossible at this time to provide Cost-Benefit attributes as requested.

PATCO shall continue to support the TRIP efforts as it has in the past, in the hope that continued development and experience will provide a starting basis for comparing equipment and equipment useage.

Yours truly,

PORT AUTHORITY TRANSIT CORP.

RBJ/JWV/ro cc/R.H. Robochaud (TSC) R. R. Johnston, General Manager Mr. Theodore S. Gordon, Sr. Engineer American Public Transit Association Technical and Research Services Dept. 1225 Connecticut Ave. N.W. Washington, D. C. 20036

Subject: TRIP Liaison Board Heeting #9

Dear Ted:

I have a couple of items from the subject meeting, one of which may be significant and the second should be considered for the next year's planning.

The first concern is the data which is used to tally the unscheduled maintenance actions for the TRIP EDB. It became apparent during the discussions that the EDB has an oranges and apples flavor. It was noted that BART, CTA add NYCTA report unscheduled maintenance actions only for incidents occurring during revenue serivce. Maintenance actions occurring as a result of an inspection are not included in their EDB data. In PATCO's reporting system, all maintenance performed outside the inspection is chargedlike against that system. As a consequence, discrepancies found during an inspection are recorded as ancidentent find their way into the TRIP EDB. I discussed with Phil Silvia of DRC a methodology for removing the unscheduled maintenance actions found as a result of an inspection from the TRIP EDB. This action would make the PATCO data similar to BART, CTA and NYCTA data. (I don't know what WMATA is reporting.) PATCO would like to have this done. Unfortunately, it quivisethabat DRC reprocess all of the PATCO input to date. Mr. Silvia stated that he does not have the resources for this action. I hope the resources are available in his next funding and that this data discrepancy can be cleared.

The second item was noted during the discussions of the BUS/TRIP Project status. I believe in the value of a BUS/TRIP project but there are some caveats in the proposed mechanism which might make the project costs prohibitive. The prime factor is the stress on the volume of hard copp data input. The need to define a representative cross section of users in order to implement a sound data base has led DRC to examine a number of different operators, geographically and population wise. The cross section selected has led them to define an extremely heavy emphasis on hard copy data input to any EDB development. I firmly believe that given a criteria to maximize the use of automated data input in the BUS/TRIP EDB, a careful re-examination of the important variable factors within the industry would yield a representative cross section of users and promote greater use of automated data handling, and this, as we know, would keep

Mr. Theodore S. Gordon

-2-

October 23, 1980

the project costs down. I hope, before the project is implemented under the present planning, a reconsideration for this aspect can be accomplished.

I found the meeting informative, stimulating, and look forward to the next. PATCO could host one of the future meetings if desired.

Yours truly,

PORT AUTHORITY TRANSIT CORP.

/sb

R. A. Oren, Equipment Engineer American Public Transit Association Technical & Research Services Department 1225 Connecticut Avenue, N.W. Washington, D.C. 20036

ATT: Mr. Theodore S. Gordon

Gentlemen:

This letter is in response to APTA's request that each TRIP Liaison Board member "submit a statement of his specific transit property's assessment of TRIP to date".

PATH has reviewed the information being provided through the TRANSIT RELIABILITY INFORMATION PROGRAM [TRIP] and respectfully submits its assessment of this program at this point of development.

PATH, a non-participant in the Experimental Data Bank [EDB], expects to benefit from TRIP by utilizing information in the following areas:

- The reliability related data reported by all properties having systems and components similar to those installed on the PATH car fleet.
- Determining components and systems utilized by other properties which exhibit high reliability and selectively experimenting with retrofitting the PATH car equipment with these new or modified systems.
- Observing reliability characteristics of the newer car equipment in operation at other rapid rail transit properties to obtain useful inputs in selecting criteria for PATH's next car purchase.

In considering a Cost-Benefits Analysis of TRIP, at this juncture, it must be pointed out that PATH:

- 1. Collects data manually on individual forms for its 290 revenue cars.
- Has not participated in the TRIP EDB and, therefore, cannot provide hard costs involved in supporting TRIP's data requirements.
- 3. Is not in a position at this time to speculate on the costs which may be incurred for:
 - a) TRIP Operational Charges
 - b) Special Report requests
 - c) Pre-processing of manual data.

Writer's pirecrip of the epitions 212-466-3577

Notwithstanding these difficulties in determining a hard dollar, Cost-Benefit Analysis of TRIP, PATH is of the opinion that the TRANSPORTATION RELIABILITY INFORMATION PROGRAM will fill the gap in providing comprehensive transit reliability information previously unavailable to the transit industry, and PATH will derive significant benefits from this program.

Very truly yours

Michael A. Scott

cc: F.A. Gorman

R.R. Kelly

J.J. Kirk

W.M. Miller

T.C. Rutmayer

D.T. Smith

L.G. Theofilos

R. Robichaud (USDOT-TSC)



Southeastern Pennsylvania
Transportation Authority
69th Street Elevated Shop
Upper Darby, PA 19082
200 W. Wyoming Avenue
Philadelphia. Pa., 19140

(215) 456-4000

April 14, 1981

Mr. Theodore S. Gordon, P.E. American Public Transit Association 1225 Connecticut Avenue, N. W. Washington, D. C. 20036

Dear Mr. Gordon:

The Southeastern Pennsylvania Transit Authority ("SEPTA") has been requested to submit its assessment of the Transit Reliability Program ("TRIP") to date.

TRIP has made important progress in developing a common pool of information which is useful in determining the reliability of transit vehicle units and parts and in helping avoid many transit authorities solving the same problem at the same time, thus saving many hours of unnecessary work.

The cost of managing TRIP should be reduced in unit cost as more transit authorities operate automated maintenance management systems, thus minimizing the hard copy data conversion systems presently used for some information provided to TRIP. As more authorities participate in TRIP, the information base will become more useful because of its broader base.

Development of TRIP should continue to expand its capabilities to provide reliability information on as many vehicles, units, parts, and systems as possible and be an important part of improving the reliability and service of transit vehicles.

Yours truly,

Robert Sellman

Resource Control Specialist



WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

600 Fifth Street N.W. Washington, D.C. 20001

(202 637-1234

May 1, 1981

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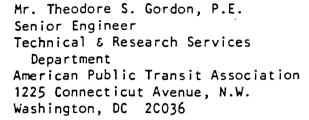
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for Transit Services

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Assistant General Manager
Tor Administration

DELMER ISON Secretary

JOHN R KENNEDY

General Counser



Dear Mr. Gordon:

As directed in your letter of April 3, 1981, we are submitting our comments regarding the "TRIP" program for discussion at the CDR on May 5th. It is our general opinion that "TRIP" should be continued beyond the experimental stage, that more industry participation should be encouraged, and that the proposed "Bus TRIP" should be designed and implemented in stages similar to those of "Rail TRIP". Should it be decided that "TRIP" is to continue, we ask that the following comments be considered:

°WMATA is presently involved in the development of an in-house, on-line Maintenance and Reliability System (MARS), that will be capable of providing staff with at least the information presently being reported by 'TRIP'.

*WMATA has a Transit Reliability Information and Monitoring System (TRIMAS) that was designed and is operated by the "TRIP" Contractor, Dynamics Research Corporation (DRC). The same information needed for the "TRIP" project and manually inputted by DRC personnel is already available in the TRIMAS data bank at the Contractor's facility. A cost savings on both ends would be realized if the Contractor would make arrangements to transfer the needed information.

°In order to provide all users with the information contained in the report, at least four copies will be needed.



*Better resolution of the graphs is needed.

- *Report UIM-02, "Monthly Unscheduled Maintenance-Vehicle Maintenance Actions", is misleading since the reported number of maintenance actions are based on unique dates, not actual maintenance action quantity.
- "All reports displaying failure information for 3, 6, and 12 month intervals/10K miles, should also display the current month's data/10K miles.
- No indication of how the number of maintenance actions reported is derived. WMATA uses three documents for reporting corrective actions on rail cars. The Vehicle Service Report (VSR), which is the first reporting document, gives a description of the problem and may or may not give a complete report of corrective action(s). A second document, the Vehicle Work Order (VWO), gives the corrective action, if not reported on the VSR, and the I.D. of any parts replaced. The third document, the Shop Work Order (SWO), gives the corrective action performed on the part(s) removed. If the VSR is the only document reviewed by "TRIP", then some data is omitted.

As we indicated previously, WMATA is willing to continue operation of "TRIP" and will support it as necessary.

Sincerely.

Edgar C. Green, Jr.

Vehicle Engineer

Office of Equipment Design

ct: Mr. Robert Robichaud
U. S. Department of Transportation
Transportation Systems Center
Cambridge, MA

Name and telephone number of each property representative should be included so that other members may call should inquiries be necessary.

^{*}Reports should be index tabbed for quick reference.



RAILWAY DIVISION - RED LION PLANT - PED L'ON & VERREE POADS - PHILADELPHIA PENNS ELVANIA 1911E - DIS EDBINCO

May 1, 1981

Theodore S. Gordon
Senior Engineer
Technical & Research Services Dept.
APTA
1225 Connecticut Avenue, N.W.
Washington D.C. 20036

SUBJECT: Action Item # 14 - TRIP Assessment to Date

Reference: Your Letter Dated 1/30/81

Dear Ted:

This letter is presented in response to your request for an independent assessment of the Transit Reliability Information Program (TRIP) to date.

- 1.0 Dynamics Research Corporation (DRC) should be commended for their fine efforts and conscientious attitudes toward collecting, evaluating, and producing of the experimental data banks (EDB).
- 2.0 Although I have not seen any of their input data sheets, I am certain that they are not homogenous and DRC must perform the miraculous feat of synthesizing the data into meaningful formats for all potential users of the information.
- 3.0 The current status of the EDB is of obvious benefit to operating transit authorities, but not of real usefullness to a carbuilder or subcontractors. The following data is needed for real benefit to manufacturers of rolling stock:
 - 3.1 Correlation between revenue service problems and shop incidents or maintenance actions.
 - 3.2 Correlation with maintenance practices such as:

Policies
Procedures
Tooling
Spares levels
Frequencies of maintenance
Repair Shop - Inside the property
Outside (Vendors)

Skill levels
Training programs
Ages of fleets
Duty cycles
Fleet sizes
Union Shop versus Open Shop

THE BUDD COMPANY

Page 2

3.3 Correlation with:

Ridership Terrain - Flat Hilly

No. of hours of operation per day/week/month/year

Average speed of operation

New properties VS established properties

Headways.

Population Densities

Ridership

Length of line trackage Number of station stops Type of manufacture

Body - Aluminum

SS

Propulsion - Cam

Chopper

Brakes - Air

Hydraulic

Disc

Tread

Doors - Air

Electric

Environmental Exposures

- 3.4 Basis for K factors
- 3.5 Failure mode trends and analyses
- 3.6 Configuration accountability
- 3.7 Effect of Warranties
- 3.8 Life Cycle Costing assessments
- 3.9 Validation of DRC reports by operating authorities
- 3.10 Comparison of maintenance actions to actual failures
- 4.0 Expansion of the data bank to reveal number of service failures for each reporting period.
- 5.0 It could be of measurable benefit to TRIP if a round-robin visit could be made to each contributing authority maintenance facilities to teach the initiators of the data exactly what must be collected and how.
- 6.0 To be of real value to manufacturers of rolling stock, the data needs to extend farther down in the subsystems to specifically identify the actual components that have failed.

THE BUDD COMPANY page 3

The TRIP program effort has gotten off to a good start and with minimal additional expenditures can blossom into a technically valuable tool for product assessment and evaluation. It is desired that the TRIP effort be continued.

Sincerely

R. W. Brindley

Mgr. RMSH

cc: Dick Robichand

Bob Haught Al Lock

/dz RMSH/RWB/10732/0501/PHIL

APPENDIX 11.3 EVALUATION QUESTIONNAIRES AND RESPONSES FOR ACTIVE PARTICIPANTS IN THE DB

Questionnaires and responses from active participants in the TRIP-DB:

Active Participant Property	Date of Response
BART	7/1/81
СТА	7/8/81
NYCTA	7/28/81
PATCO -	7/6/81
WMATA	6/24/81

TRIP Active Participant Ouestionnaire

As an aid in producing an impact assessment of the Transit Reliability Information Program (TRIP), lists of questions were prepared for transit properties which are active participants (now submitting data), transit properties which are passive participants (on Liaison Board but not submitting data) and the carbuilders which are now contracted to supply vehicles to U.S. transit properties.

The questions in this list should be answered in letter form. I am also requesting that you obtain a letter from the general manager of your property expressing his thoughts concerning the costs, benefits and opportunities, both positive and negative, of TRIP. Both your letter, which specifically answers the questions posed on this list, and the general manager's letter will be published as part of the impact statement. These letters may be addressed directly to me.

As a property which has actively participated in TRIP by sending data into the TRIP data bank, please answer the following questions:

- 1. What are the present and potential future benefits of TRIP to your operation?
- 2. Should TRIP be continued indefinitely, or do you see a time in the future when trip would no longer be beneficial to your transit property?
- 3. If the Department of Transportation would reduce its funding toward the continued operation of TRIP, would your property contribute to its continuation either in manpower and/or dollars?
- 4. What are the <u>specific</u> ways you now use the information generated by TRIP? What departments in your organization are on the circulation list for the TRIP property and industry report?
- 5. In considering the expansion of the TRIP data base, could you please state what priority you would place on extensions to:
 a) systems on vehicle, b) other vehicle series, c) other transit properties or combinations of a) c). Please discuss your reasons for selecting these priorities.
- 6. Please provide a <u>rough</u> estimate of the costs in manpower and materials of your contribution to the ongoing operation of TRIP. This estimate should include costs of submitting and correcting data bank information and the review and analysis of trip reports.

- 7. When do you expect to acquire new vehicles? If you plan to set reliability goals or requirements, how would you use the TRIP data bank to aid you?
- 8. When do you plan to buy major spare parts (over \$1 Million)? Will TRIP data influence the selection of the vendor?
- 9. It has been said that the health of the transit supply industry contributes to the healthy operation of your system. Please state the opportunities and possible dangers the continuation of TRIP may present to your suppliers.
- 10. What are your suggestions of ways the supply industry may participate to enhance the benefits and possibly decrease the cost of TRIP?
- II. If TRIP is continued and operational five years from now, what major changes would you introduce at any point in time to further enhance its benefit or reduce its cost? Among items which should be considered in such changes are participation by federal government, properties and suppliers and improvements in data handling and reporting.
- 12. What is your estimate of the annual ongoing cost of the TRIP to your property over the next five years, assuming the present role of the federal government?
- 13. Please add any comments on questions which were not addressed in this questionnaire, but which in your opinion are important in assessing TRIP from an institutional opportunity or cost/benefit point of view.

BAY AREA RAPID TRANSIT DISTRICT 800 Madison Street Oakland, California 94607 Telephone (415) 465-4100

July 1, 1981

JOHN H. KIRKWOOD

PRESIDENT

JOHN GLENN

VICE-PRESIDENT

KEITH BERNARD
GENERAL MANAGER

Richard A. Uher, Director, Rail Systems Center Carnegie - Mellon University Schenley Park Pittsburgh, PA 15213

Dear Dick:

DIRECTORS

BARCLAY SIMPSON

NELLO J. BIANCO 2ND DISTRICT

ARTHUR J. SHARTSIS

HARVEY W. GLASSER, M.D.

ROBERT S. ALLEN

5TH DISTRICT

JOHN GLENN 6TH DISTRICT

WILFRED T. USSERY

EUGENE GARFINKLE

JOHN H. KIRKWOOD

9TH DISTRICT

In response to your questionnaire, and as discussed with you during your visit, our input to your impact assessment study of the Transit Reliability Information Project is as follows:

 What are the present and potential future benefits of TRIP to your operation?

> The principal benefit to the District thus far has been the assurance to our Management and Board of Directors that we maintain a favorable reliability comparison for the three critical vehicle systems currently reported.

> A further anticipated benefit of the TRIP project is comparative functional component operational evaluation of alternative technology and supply.

 Should TRIP be continued indefinitely, or do you see a time in the future when TRIP would no longer be beneficial to your transit property?

No program should be continued indefinitely. Considering present projections of patronage, TRIP should be of use over the next 10 to 15 years. It will require several years to be fully operational and then it should probably be reviewed for continuation on 3 year periods.

3. If the Department of Transportation would reduce its funding towards the continued operation of TRIP, would your property contribute to its continuation either in manpower and/or dollars?

We are committed to a reasonable input of staff time for data input and coordination. We understand TRIP to be an effort of the Industry and Government toward increased public acceptance of mass transit and have no plans to provide property funding of this project.

4. What are the <u>specific</u> ways you now use the information generated by TRIP? What departments in your organization are on the circulation list for the TRIP property and industry report?

See response to #1 above. The industry report is given to our senior management and reviewed with the Board of Directors. The property report is used only for verification of input with our internal data.

- 5. In considering the expansion of the TRIP data base, could you please state what priority you would place on extensions?
 - Other Systems on Vehicle, because of the ease of this addition. In BART's case, the data for all vehicle systems has been regularly reported to the Data Base Contractor.
 - 2. Other vehicle series, because the existing properties are already trained and have input procedures developed.
 - 3. Other transit properties.
- 6. Please provide a <u>rough</u> estimate of the costs in manpower and materials of your contribution to the ongoing operations of TRIP. This estimate should include costs of submitting and correcting data bank information and the review and analysis of trip reports.

About 100 Labor hours per year for data input review and meetings. Material costs are negligible.

7. When do you expect to aquire new vehicles? If you plan to set reliability goals or requirements, how would you use the TRIP data bank to aid you?

> We have current plans for new vehicles to be designed and delivered over the period 1982 - 1985. In cases where a nearly identical functional system is in use by a property, conformance of reliability, with due

consideration of environmental differences, will be an input to our design review and testing.

8. When do you plan to buy major spare parts (over \$1 Million)? Will TRIP data influence the selection of the vendor?

This magnitude of investment would infer a specific major component replacement and not generically available material. In these cases the successful bidder is generally the original supplier. Other than as discussed above for selection of new designs, TRIP data would not be a factor.

9. It has been said that the health of the transit supply industry contributes to the healthy operation of your system. Please state the opportunities and possible dangers the continuation of TRIP may present to your suppliers.

We see the health of the industry as dependent on providing an attractive transportation alternative in terms of cost, comfort and dependability of service. The competition to provide components which result in service improvements, as verified by TRIP, should aid in the objective comparative process and be a positive force in the industry.

10. What are your suggestions of ways the supply industry may participate to enhance the benefits and possibly decrease the cost of TRIP?

Suppliers have claimed they cannot get objective service data. They could use TRIP data for product improvement and comparative evaluation. Suppliers could also participate by aiding in reference data, comparisons of predicted vs actual failure rates, qualifications' test results, etc.

11. If TRIP is continued and operational five years from now, what <u>major</u> changes would you introduce at any point in time to further enhance its benefits or refuce its cost?

Most of the expense of this process is "front end loaded". Once fully operational, with all Properties participating and under stable processes, the continuation costs should be minimal. Properties should be encouraged to provide direct machine readable input. A way to streamline the funding process is needed to permit TSC to implement changes when the Liaison Board feels we are ready to proceed. An UMTA commitment to the completion of the program rather than one step at a time with long waits for the next funding increment is needed. If we can proceed and sustain the momentum we will get more active participation of the properties to reduce the Data Base Contractors expense. Suppliers could contribute to simplify the preparation of Reference data.

12. What is your estimate of the annual ongoing cost of TRIP over the next five years, assuming the present role of federal government?

We estimate about \$4,100.00, mostly labor time for Liaison Board & Design Review activities. Once the data base design and output reporting is stable the ongoing annual costs to BART should be less than \$1500.00 per year.

13. Please add any comments which were not addressed in this questionnaire, but which in your opinion are important in assessing TRIP from an instructional opportunity or cost/benefit point of view.

Please refer to the attached letter to APTA which we submitted for the most recent TRIP Critical design review.

Best regards,

Jim King

Supervisor of Reliability Engineering

JK:pw

*Letter to APTA referenced in answer to #13 included in Appendix 5.12.

BAY AREA RAPID TRANSIT DISTRICT 800 Madison Street Oakland, California 94607 Telephone (415) 465-4100

July 1, 1981

JOHN H. KIRKWOOD

PRESIDENT

JOHN GLENN VICE-PRESIDENT Schenley Park Pittsburgh, PA. 15213

Carnegie-Mellon University

KEITH BERNARD

GENERAL MANAGER

Dear Dr. Uher:

DIRECTORS

BARCLAY SIMPSON 1ST DISTRICT

NELLO J. BIANCO 2ND DISTRICT

ARTHUR J. SHARTSIS 3RD DISTRICT

HARVEY W. GLASSER, M.D. 4TH DISTRICT

> ROBERT S. ALLEN 5TH DISTRICT

> > JOHN GLENN 6TH DISTRICT

WILFRED T. USSERY 7TH DISTRICT

EUGENE GARFINKLE 8TH DISTRICT

JOHN H. KIRKWOOD 9TH DISTRICT

In response to your request for a critique of the Transit Reliability Information Project for your Impact Assessment study from the General Manager of each participating Property, BART submits the following:

Richard A. Uher, Director, Rail Systems Center

- We utilize the present Experimental Data Base reports and find the regular comparative Property data useful in its assurance of the effectivness of our ongoing efforts to provide the highest possible System Reliability to our patrons.
- 2. We believe the usefulness of the reports could be increased by inclusion of data on all Vehicle Systems and all domestic heavy rail Properties, at the earliest possible date. Further, inclusion of comparable data from Toronto, Montreal, Mexico City, Sao Paulo, Rio de Janeiro and Hong Kong would be benificial for our use.
- 3. We desire that the restrictions regarding public release of the T.R.I.P. data be removed.
- 4. We believe the existence of objective functional component reliability data comparisons between competing technologies, based on service demonstrated performance, will be of benefit to the new vehicle specification process and ultimately to the good of increased energy conservation through increased public acceptance of mass transit.

C. K. Bernard General Manager

CKB:JK/hm

July 8, 1981

Mr. Richard Uher Carnegie - Mellon University Rail Systems Center Schenley Park Pittsburgh, PA 15213

Dear Mr. Uher:

In response to your request, as part of the assessment of the Transit Reliability Information Program (TRIP), the Chicago Transit Authority fully supports this effort.

From its inception, TRIP has been seen as an asset to CTA and the industry in solving mutual problems in providing reliable transit. The statements made at the first and second critial design reviews on this project reflect a positive approval for TRIP.

As expansion takes place, a large benefit will be in the bus area. This is based on the standardization in this part of the industry.

Attached are the statements mentioned above for inclusion in your assessment.

Sincerely,

Harold H. Geissenheimer General Operations Manager

JRP/j

Attachments

*Assessment of TRIP for Second Critical Design Review, See Appendix 5.12. /R A. Uher

cc: J. R. Pankonen

J. Stewart

R. Robichaud, TSC

T. Gordon, APTA

Chicago Transit Authority

Merchandise Mart Plaza - PO Box 3555. Chicago, lilinois, 60654 312-664-7200

TRIP Critical Design Review

The Chicago Transit Authority (CTA) assessment of the Transit Reliability Information Program (TRIP) for Phase I is positive.

The central accumulation of data relating to equipment reliability has been needed for some time. While in railcar fleets the configuration of rail equipment may differ, from property to property, some sub-assemblies may be similar. Data on operation in these similar areas is seen as a great need to improvement in reliability. With the advancement into the bus fleets where standardization is more of a real thing, TRIP can bring together industry knowledge to allow suppliers to correct unreliable and unmaintainable units to perform better. Informal discussion with GMC Truck and Coach people have indicated desires to participate in TRIP.

The CTA has been operating a maintenance computer system for some years in our bus fleet and just recently expanded to our rail fleet. The knowledge we gain from our operating experience, while analyzed in our computer reports, does not get out to the industry. TRIP will provide the knowledge, if desired, to any participating property or supplier.

The Bus Technology Committee also has the potential to use the TRIP data as a means to perform its mission in equipment development.

As a member of the RAMD Committee, TRIP is viewed as a means that smaller or newer transit systems can gain reliability data when in the design phase of development.

The design and specification of new vehicles is another area where TRIP will have input. During discussions concerning terms and conditions for rapid railcar procurement, it was mutally agreed by APTA, RPI and UMTA that realistic MTBF requirements in specifications is the proper avenue to quality assurance rather than the extended warranty approach. All agreed, however, that no data base existed for realistic MTBF figures for rapid railcars. The CTA Engineering Staff, involved in new car design, understand that the TRIP program would provide the data base necessary for determining realistic car level and subsystem MTBF numbers for inclusion in new car specifications. This data is essential to quality assurance of new rapid railcars.

CTA operates 1100 railcars and 2420 buses. The Maintenance Department includes a Methods and Standards Area which is consistently working to improve product life and reliability. TRIP information on similar equipment and operating experience will be valuable to allow this group to perform its mission to reduce the cost of operation through improved reliability.

TRIP Critical Design Review

CTA does see that much work needs to be done to make TRIP as valuable as its intent. It is CTA's solid recommendation and endorsement that TRIP continue in the railcar areas and expand into the bus fleet areas.

PREPARED BY:

J. R. Pankonen

Director, Vehicle Maintenance

APPROVED BY:

F. H. Gersenheimed 3/2

H. H. Geissenheimer

General Operations Manager

/bs

New York City Transit Authority

370 Jay Street, Brooklyn, N. Y. 11201 (212) 330:4321

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Calci Beneri Steplich Dunger David voll Brown Johann Botoner Helbert J. Lobert John F. Wolster, ey Rollsy Treprintel William J. Spoulfan Constantine Cloamon-Eristoff Robert F. Wagner, Jr. Robert T. Waldbauer

John D. Shinpson President

July 20, 1981

Mr. Richard A. Uher, Director Rail Systems Center Carnegie - Mellon University Schenley Park Pittsburgh, Pennsylvania 15213

Dear Mr. Uher:

This is in response to your request of May 11, 1981 for an appraisal of The Transit Reliability Improvement Program - Experimental Data Base (TRIP - EDB) systems for your independent assessment of the project.

The numbers below correspond to your questionnaire.

As per your discussions with our Mr. Gross, we have a unique problem with respect to utilizing TRIP. At the time of the selection for EDB, only the R-44 and R-46 were within the age guidelines. When the R-46 had to go into litigation, we had to switch to the R-44, which is one of our worst performers. Although this data is useful, it is not representative of our system and makes comparison difficult. When clearance is received from our legal staff, we intend to supply R-46 data when the EDB can accept it.

1. Due to the situation of the R-44 (above) and the lack of reference data (see item 13), TRIP at this time is not widely used within the Authority. Once the reference base is established, TRIP will provide a useful tool to evaluate technologies not currently in use on our system, as well as a common yardstick for comparison between systems.

- 2. The industry is beset by quality problems as well as being confronted by increased sophistication of the equipment. As both an incentive for Maintenance Departments to communicate and as an instrument to conduct that dialogue, TRIP should remain valuable.
- 3. At this point in time, the Authority is involved in an ongoing fiscal crisis. It is not possible to predict any contributions towards TRIP except in light of the benefits discussed in item 13.
- 4. Currently, TRIP is used by Engineering to examine the differences between systems; however, as indicated in (1), the lack of reference data limits its usefulness. The report is currently limited to the Car Maintenance Department and my office.
- 5. With respect to expansion, depending on the time frame, we would like to see expansion to other vehicles (and/or properties) to widen the database, followed by expanding the number of car subsystems.
- 6. The costs involved in TRIP for the Transit Authority include:
 \$100/month to provide the raw data.
 \$250/month to review report (including correction when required).
- 7. We are currently in the process of acquiring new vehicles, and expect to continue at a regular rate. We are using our own experience for guidelines, but if the industry began to use TRIP for such purposes, the Authority would probably concur to the extent that timeliness did not present a problem. (Our own reports are ready about 2 weeks after month end-TRIP, from our understanding, has a minimum lag of over six weeks).
- 8. Major parts buys will probably be involved with CORE (Car Overhaul, Rehabilitation and Enhancement). This is an intensively funded program to catch up on and reinstate our preventive maintenance programs that have been eroded over the past few years by the fiscal crisis. At this point in time, TRIP will not be a factor, since we are relying on our experience.

- 9. When fully functional TRIP obviously creates an additional opportunity for vendors to prove good performance. It is just as possible, however for a poor performing product to cause damage to a supplier's reputation out of proportion to the application. Overall, however, it should provide an additional force towards quality in the market place.
- 10. The major support suppliers could furnish is maintaining the EDB itself, but this could raise ethical questions. Since the coding of equipment parts will remain the province of the properties, it is difficult to foresee any other major impact the suppliers can make, other than continued representation on the Liaison Board and RAMD Committee.
- 11. Since TRIP is still an evolving product, it is difficult to predict the final form. The major cost savings could come from:
 - a) all input on computer media.
 - b) time restriction on the database (storage).
 - c) limiting number of car sub-systems.
- 12. There should be little change in cost to the Authority as the system expands. Adding a car class will cost about \$200 on a one-time basis. If the entire fleet is included, the computer costs to supply data should not increase to more than \$150.00.
- 13. The cost benefit of TRIP is difficult to pinpont. It is, however, fair to say that if it enables the industry to obtain a more reliable car, the spare factor for the car fleets will be reduced. For the Authority, each car removed from the fleet is a capital savings of about \$1,000,000 (of which the Federal Government usually supplies 80%). Further, an average yearly maintenance cost of over \$25,000 (excluding fringes) would be mostly eliminated. (Some overhead cost would remain unless drastic reductions are made). As discussed at the meeting, the Authority is interested in obtaining the reference base that is required so that we can apply relative failure rates. For example, BART averages 2 miles between stations, we average 0.5 miles. An R-44 has 8

door operators per car per side, a BART car only 4. Thus for the same 1,000 miles run, a BART car experiences only 2,000 door operator cycles, the R-44 goes through 16,000 - a ratio of over 8 to 1. Thus, if BART's raw failure rate indicated in TRIP was only 20% of the R-44's their performance would be worse! Since station spacing affects the number of propulsion/brake system cycles, this factor also impacts in this area. This, in our view, makes the reference data an important part of the TRIP system.

We recognize, of course, that the reference data will be difficult to quantify, but we feel it is vital that it be available to bring systems into a rough equivalence. We do not expect exact comparisons to result. These reports will always need experienced personnel to assess them, and put them into the proper perspective, but some kind of rough "indexing" is very important to the proper use of the reports.

Additionally, the R-44, as stated before, is a poor performer, and also only 5% of the fleet. We can benchmark our performance using CEIS, our own internal system. While TRIP will provide a valuable reference base to other systems, we do not plan to use it, as some properties currently are, as a replacement for internal reports.

The Authority currently owns over two thirds of the U.S. heavy rail fleet, so you must take into consideration that we generate the bulk of the nation's reliability data ourselves.

Sincerely,

Charles Kalkhof

General Superintendent

Rapid Transit

25: JLG: 10



PORT AUTHORITY TRANSIT CORPORATION

PHILADELPHIA: 215-922-4600

PENNSYLVANIA AND NEW JERSEY BENJAMIN FRANKLIN BRIDGE PLAZA

CAMDEN, NEW JERSEY 08102

CAMDEN: 609-969-8300

July 6, 1981

Dr. Richard A. Uher Director, Rail Systems Center Carnegie-Mellon University Schenley Park Pittsburgh, Pa. 15213

Dear Dr. Uher:

The following is provided in response to your request concerning your task on an impact assessment of TRIP. PATCO's position remains the same as stated in our letters provided for the 11th Liaison Board Meeting on May 6-7, 1981. Copies of those letters are contained in the minutes of that meeting.

There is no present use of the TRIP data at PATCO. The discrepancies in malfunction reporting, the misnomer of "reliability" and lack of manpower keep the reports from being distributed within PATCO.

The potential future benefits of TRIP to PATCO would be the ability to compare components' performance with other users. This might enable PATCO to improve our performance and it might assist in identifying component design flaws. However, unless there is a major change in the data bank collection, TRIP will not be able to establish equipment reliability goals or requirements. The data is currently useful for providing indicators of maintenance operations differences.

PATCO costs for supporting TRIP are around four to five man-days per month. PATCO can continue this level of support. It is unlikely that PATCO could contribute financially to support and maintain the TRIP data base.

PATCO shall continue to support the TRIP efforts as it has in the past in the hope that continued development and experience will provide a starting basis for comparing equipment and equipment usage.

Yours truly,

PORT AUTHORITY TRANSIT CORP.

/sb cc/R.B.Johnston R. A. Oren, Equipment Engineer



PORT AUTHORITY TRANSIT CORPORATION

HILADELPHIA:

PENNSYLVANIA AND NEW JERSEY BENJAMIN FRANKLIN BRIDGE PLAZA CAMDEN, NEW JERSEY 08102

CAMDEN: 609-963-8300

April 3, 1980

Mr. Theodore S. Gordon, Senior Engineer American Public Transit Association Technical and Research Services Dept. 1225 Connecticut Ave. N. W. Washington, D. C. 20036

Dear Mr. Gordon:

In response to your letter of March 2nd to the members of the TRIP Experimental Data Bank asking for our opinion and official position concerning TRIP, I offer the following.

PATCO's management is fully supportive of TRIP and its objectives. PATCO was one of the first to implement a data processing system for car equipment maintenance and would like to use the information it now has to compare its results with other transit porperties. PATCO's policy has always been to support activities of benefit to the transit industry and we plan to continue to do so.

One of the objectives of our Equipment Department will be to compare our reliability rate on selected components with those of other properties. Should we find others having better experience than ourselves, we would investigate in detail why such other properties would have better experience and would hopefully apply their experience to ourselves.

We would like to see TRIP continue for at least a few years until such time that it is debugged and operating routinely. At that time we should be able to make a decision to expand it and continue it indefinitely or discontinue it. There has been a substantial effort that went into setting up the experimental data bank. We feel that it is premature to judge whether the program is effective for the members or not at this point. Only experience with a routinely functioning system will provide us with the basis to make such a decision.

Yours truly,

PORT AUTHORITY TRANSIT CORP.

RBJ/JWV/sb

cc/R. H. Robichaud (TSC)

R. B. Johnston, General Manager



WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

600 Fifth Street, N.W., Washington, D. C. 20001 (202) 637-1234

June 24, 1981

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Assistant General Manager
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DELMER ISON Secretary

JOHN F. KENNEDY General Counsel Mr. Richard A. Uher Director Rail Systems Center Schenley Park Pittsburgh, PA 15213

Dear Dick:

In response to your "TRIP" Active Participant Questionnaire we are providing the following comments.

Information obtained from the "TRIP" Program is presently used by two offices at WMATA - Equipment Design and Rail Car Maintenance. Both offices use the published "Property" information as a performance indicator for measuring the effect of retrofit and modification programs. The Office of Equipment Design reviews the report with an eye on system reliability requirements while the Office of Rail Car Maintenance is concerned with warranty compliance, inventory control, and failure trend indications. Both offices use the "Industry Volume" to compare WMATA's equipment performance with like equipment at other properties.

Within approximately 8 months, WMATA will have its own in-house, on-line "Maintenance and Reliability Reporting System" (MARS) functioning. At that time, the current "Transit Reliability Information Monitoring and Analysis System (TRIMAS) will be abandoned. MARS will provide all the information that is presently being reported in the "Property Volume" and will eliminate WMATA's need for that report. The MARS, obviously, will not provide the information being reported in the "Industry Volume". From that aspect, WMATA will continuously be dependent upon the "TRIP" system and will continue to support it.

WMATA's input to the system involves about 64 mandays of labor per year. Since we have appropriated funds for both MARS and TRIMAS and expect to benefit more from it than TRIP, we would not be able to justify any additional funding for TRIP. It is anticipated that the labor requirements will soon decrease if an agreement to use the data from the Transit Reliability Information and Monitoring System, that the contractor, Dynamics Research, presently operates



for WMATA could be reached. We would, however, like to see the change we discussed during the last Liaison Board Meeting implemented as well as the expansion of the data bank to include other transit properties, since this is an information sharing program, other systems on vehicle and other vehicle series in that order.

WMATA is expecting delivery of 294 new vehicles commencing May 1982. The same performance review procedure used now will be used for those vehicles with consideration being given to the different reliability requirements.

All orders for spare parts take into consideration the past performance of the part both here and when applicable at other transit properties. Since the information derived from TRIP will play a big part in spare part selection, it would be beneficial to all involved to encourage more participation from suppliers. This type of an information exchange would undoubtedly encourage suppliers to provide equipment superior to the contractor's -- a plus for the entire industry.

Again, we find "TRIP" to be of benefit to the Authority and remain ready to support it as we have in the past.

Sincerely,

Edgar C. Green, Jr. Vehicle Engineer Office of Equipment Design

APPENDIX 11.4 EVALUATION QUESTIONNAIRES AND RESPONSES FOR LIAISON BOARD MEMBERS WHO ARE NOT ACTIVE PARTICIPANTS IN THE DB

Responses to questionnaire of Liasion Board members who are not active participants in the TRIP.

Board Member	Date of Submittal
GCRTA .	N
MARTA	6/5/81
MBTA	9/2/81
MDCTA	*
MTA-MD	7/1/81
PAT	12/3/81
PATH	6/22/81
SEPTA	6/15/81

(The equipment suppliers GE and BUDD were not included here but in Appendix 11.5).

N - No Submittal

^{* -} Resubmitted the same letter as for the second critical design review. See Appendix 11.2.

TRIP Liaison Board Participant Questionnaire

As an aid in producing an impact assessment of the Transit Reliability Information Program (TRIP), lists of questions were prepared for transit properties which are active participants (now submitting data), transit properties which are passive participants (on Liaison Board but not submitting data) and the carbuilders which are now contracted to supply vehicles to U.S. transit properties.

The questions in these lists should be answered in letter form. I am also requesting that you obtain a letter from the general manager of your property expressing his thoughts concerning the costs, benefits and opportunities, both positive and negative, of TRIP. Both your letter, which specifically answers the questions posed on this list, and the general manager's letter will be published as part of the impact statement. These letters may be addressed directly to me.

- Does your transit property plan to become an active participant in TRIP? If so, and TRIP continued into Phase II with no problem in accepting you, when do you feel you could begin?
- 2. What are the potential benefits of TRIP to your operation?
- 3. If the Department of Transportation reduced its funding toward the continued operation of TRIP, would your property still become an active member, if it had to contribute to its continuation either in manpower and/or dollars?
- 4. If TRIP continued with full government support, please provide a rough estimate of your contribution to beginning TRIP participation on your property.
- 5. Do you see any potential problems with TRIP? If so, please discuss.
- 6. Do you have any suggestion on how the supply industry might participate in TRIP in order to enhance its benefits and possibly reduce its costs?
- 7. If TRIP is continued and operational five years from now, what major changes would you introduce at any point in time to further enhance its benefits or reduce its cost? Among items which should be considered in such changes are: participation by federal government, transit properties, suppliers and others and improvements in data handling and reporting.
- 8. Please add any comments on questions which were not addressed in this questionnaire but which, in your opinion, are important in assessing TRIP from an institutional opportunity or cost/benefit point of view.

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上海海の変ができた

2200 Peachtree Summit 401 West Peachtree Street, N.E. Atlanta, Georgia 30308

June 5, 1981

Mr. Richard A. Uher Carnegie-Mellon University Rail Systems Center Schenley Park Pittsburgh, Pennsylvania 15213

Subject: TRIP Liaison Board Participant Questionnaire

Dear Mr. Uher:

The subject questionnaire which you forwarded concerning the Transit Reliability Program (TRIP) has been reviewed by MARTA. The answers to your questions are presented below.

1. Question: Does your transit property plan to become an

active participant in TRIP? If so, and TRIP continues into Phase II with no problem in accepting you, when do you feel you could

begin?

Answer: MARTA has been a member of the TRIP Liaison

Board since the inception of the program. It has functioned as a passive participant (on Liaison Board but not submitting data) in this respect. Now that the MARTA rail system has been in revenue service for 2 years and a transit vehicle data base has been accumulated, it would welcome the opportunity to become an active participant (data submitter). MARTA could begin sub-

mitting data to TRIP immediately.

2. Question: What are the potential benefits of TRIP to

your operation?

Answer: The most basic benefit that TRIP will provide

to MARTA is a structured model for the capture, assessment, storage/recording and evaluation of system incidents. In addition, active participation in TRIP will provide opportunity to compare transit vehicle experience with other properties. This should identify areas for

possible improvement in performance or

reliability growth. Also, since many suppliers of equipment are the same for different transit

Mr. Richard A. Uher June 5, 1981 Page 2

vehicles the pooling of reliability data on these equipments should result in increased confidence in computing the reliability figures. Finally, the performance of vehicles and equipment in revenue service as documented by the TRIP program should be of material assistance in establishing reliability specification performance requirements for this equipment.

3. Question:

If the Department of Transportation reduced its funding toward the continued operation of TRIP, would your property still become an active member, if it had to contribute to its continuation either in manpower and/or dollars?

Answer:

Yes

4. Question:

If TRIP continued with full government support, please provide a rough estimate of your contribution to beginning TRIP participation on your property.

Answer:

MARTA could begin to submit operational data on 94 transit vehicles immediately. This would increase to 120 vehicles by calendar year-end.

5. Question:

Answer:

Do you see any potential problems with TRIP? If so, please discuss.

T 1

The principle problem foreseen is misinterpretation of data. For example, TRIP is now collecting data on only three vehicle subsystems (brakes, propulsion and doors). TRIP data can presently be misinterpreted as reflecting entire car operating experience. Also, dangers are inherent in making property comparisons. In this respect, TRIP now collects data in terms of car operating miles per maintenance action. Since properties vary in terms of average operating speed by a factor of approximately 2 to 1, it is conceivable that on a miles operated comparison one property may stand out but if the comparison ever changed to hours of operation the ranking would change in favor of another property. These dangers can be minimized by expanding TRIP to include all vehicle equipment, and by incorporating additional data analysis in TRIP Reports which would include both reliability and maintenance information, and present results in both miles and hours of operation.

6. Question:

Do you have any suggestions on how the supply industry might participate in TRIP in order to enhance its benefits and possible reduce its costs?

Mr. Richard A. Uher June 5, 1981 Page 3

Answer:

A system such as TRIP should be the standard for the universe of organizations involved in the design and application of transit equipment. Indeed, the data base would seem to have questionable validity if it were not accepted as viable by all parties including suppliers. By working cooperatively to standardize configuration definition, program cost should be reduced and utility enhanced. The suppliers should be requested to provide funding support in order to emphasize their commitment to TRIP as the industry standard. Also, with the increase of Light Rail Vehicles (LRV) operation in this country, these vehicles should ultimately become part of the TRIP data base. Also, it is reasonable to consider collecting data on other transit subsystems such as train control equipment, fare collection equipment, electrification equipment, communications equipment and so forth. Finally, it would be reasonable to consider inviting other North American and South American transit properties to join TRIP since they are currently operating advanced equipment. With respect to a broadened RAMD data analysis capability, TRIP should be able to produce the full qauntlet of reliability, availability, maintainability and dependability data outputs.

7. Question:

If TRIP is continued and operational five years from now, what major changes would you introduce at any point in time to further enhance its benefits or reduce its costs? Among items which should be considered in such changes are: participation by federal government, transit properties, suppliers and others and improvements in data handling and reporting.

Answer:

The recommended future changes to TRIP would involve expanding the data base and developing a broadened RAMD data analysis capability. For example, TRIP should be expanded to collect data on all vehicle equipment and not 3 subsystems as at present.

8. Question:

Please add any comments on questions which were not addressed in this questionnaire but which, in your opinion, are important in assessing TRIP from an institutional opportunity or cost/benefit point of view.

Mr. Richard A. Uher June 5, 1981 Page 4

Answer

In my view, any assessment of transit related programs must address the broad scope of national interests affected by government policy and prioritized by the allocation of funds. TRIP is one such program in that the positive impact of a standard data base on design, procurement, operation and maintenance of transit systems and equipment is inestimable. Improving the effectiveness of existing and expanding or developing new transit systems is supportive of the energy independence policy, is supportive of the move to retain the urban infrastructure that has historically been part of the backbone of the U.S. economy, and provides links in the national transportation network which impact national defense and much of the psycho-social make-up of our population. Therefore, the potential benefits of TRIP must be secured by continuing the development into an active system.

This concludes our comments to your questions.

Sincerely,

Albert M. Lock

Manager, Systems Assurance

AML:bc

MASSACHUSETTS BAY TRAMSPORTATION AUTHORITY

Rail Equipment Department 80 Broadway, Everett, Mass 02149

June 4, 1981

Richard A. Uher, Ph.D. Carnegic-Mellon University Rail Systems Center Schenley Park Pittsburgh, PA 15213

Dear Doctor Uher:

I was extremely pleased to have attended my initial TRIP Liaison Board meeting on May 6-7, 1981 and appreciate the opportunity to respond to the questionnaire forwarded by your letter of May 13, 1981. My comments are consistent with the sequence of your questionnaire.

1. Based on limited exposure to TRIP, the Massachusetts Bay Transportation Author by will become an active participant predicated on continuation of the program under present concepts and its timely achievement of goals. Regretfully, we did not actively participate in the early stages of the program, thereby missing the opportunity to become an initial member of the "Experimental Data Bank" (EDB).

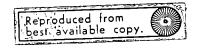
Presently, we possess or are in the process of accepting three types of vehicles we would like to incorporate into the TRIP data bank as soon as possible. The vehicle types and current program status follow:

a. Hawker Siddeley Type 4 (East Boston) car: We possess seventy (70) of these cars. The cars were accepted during the period July, 1979 through August, 1980. The manufacturer's warranty will expire on sixteen (16) cars during 1981. By August, 1981, the warranty will expire on all cars. Incorporation of these cars into TRIP and access to output products will provide invaluable data relating to reliability and performance as the Authority assumes all costs for maintenance of the fleet. Hard copies of work orders exist and could be provided on short notice upon request.



Richard A. Uher, Ph.D. Page Two
June 4, 1981

- b. Hawker Siddeley Type 12 (Main Line) Cars: We currently are in the process of accepting one handred twenty (120) of these cars. The first car was accepted in February, 1981, fifty-six (56) have been accepted as of this date. It is estimated the acceptance program will terminate in February, 1982. The Type 12 car is quite similar to the Type 4 car. The advantages are apparent of being able to analyze TRIP output data on similar type fleets, one in the development stage and the other phasing out of warranty. Additionally, the two fleets operate on different lines, the Type 4 car on the Blue Line and the Type 12 car on the Orange Line. Comparative data for similar fleets on different lines within the Authority would be most beneficial in determining effectiveness of management, operating and maintenance procedures. Again, hard copies of work orders exist and could be provided on short notice.
- Standard Light Rail Vehicle (SLRV): Although no light rail vehicles are currently in the data bank, we feel statistical data accumulated on the SLRV manufactured by the Boeing Vertol. Company would be of significant benefit to internal management options on maintenance of the fleet and to any property operating or contemplating procurement of light rail vehicles. Currently, we have one hundred seven (107) cars in the fleet. A capital program is currently on going to rehabilitate and modify out of service cars. The maximum number anticipated is one hundred twenty six (126) which should be achieved in late 1982. All maintenance data for the period November 1, 1977, through June 30, 1979, is on magnetic tape. It was accumulated as a result of a contract with Call Data, Inc., using the System 2000 program. Since termination of the contract, hard copies of the maintenance work order are available and have been filed by system. It should be noted that the maintenance data system used on the SLRV is similar to TRIP. In lieu of the twelve-character Generic Part Number, we used a five-character "Work Unit Code". Additional data indicators were used; such as, "Malfunction Code", "When Discovered Code", "Repair Code", etc. Both the magnetic tape and copies of the maintenance work order could be provided on short notice. With consideration to similarity of data, the SLRV could be interfaced with the TRIP program with little effort.
- 2. At this time, as a non-participant in the EDB, the tangible benefits of TRIP are somewhat limited in relation to the active EDB properties. Pending acceptance into the EDB, the primary benefits we anticipate are:
 - a. Evaluation of system and component reliability data for consideration in the development of design and specifications for procurement of new vehicles.

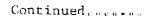


Richard A. Uher, Ph.D. Page Three June 4, 1981

- b. Analysis of comparative data for similar systems and interface with members of the TRIP Linison Board to investigate significant variances. Given similar systems and operating environments, analysis of variances and their causes may lead to improved maintenance and operating procedures.
- c. Although not directly related to assessment of output data, participation in the TRIP Liaison Board meetings is a positive benefit in itself. Recurring cross feed of information between properties on procedures, problems and programs is invaluable.

Upon acceptance into the EDB, we anticipate other benefits directly relating to:

- a. Analysis of comparative system/component reliability data to assist in decisions on continued maintenance of systems or the initiation of product improvement programs to modify and/or replace systems on a cost effectiveness basis.
- b. Use of comparative data to evaluate effectiveness of internal management, operational and maintenance procedures in relation to other properties under similar conditions.
- e. Comparison of data to determine effectiveness of inspection and preventative maintenance programs to minimize unscheduled maintenance costs.
- d. Basic cost/benefit analysis.
- 3. If circumstances result in the Department of Transportation reducing its funding toward continued operation of TRIP, our ability to contribute in manpower would be very limited and almost nonexistent in regard to funding. Allocation of manpower would be limited to that addressed in response number four.
- 4. Even if TRIP continued with full government support, austere funding and manpower limitations within the Authority would limit our contributions to:



- a. Assistance in the conversion of manufacturer's part numbers to TRIP Generic Part Numbers (GPN). As indicated above, this could be accomplished with relatively little effort in the case of the SLRV.
- b. Reproduction of all existing maintenance work orders and continued reproduction for input into the TRIP programs
- 5. With limited exposure to TRTP, the major problem at this time appears to be the question of adequate funding to continue the program as conceived.
- 6. With adequate publicity and assurances of a continuing system, it seems feasible that suppliers may be enticed to provide supplemental funds to assist in the collection of reliability and performance data for their newly designed systems. A second advantage for them would be to accumulate comparative data through TRIP on existing systems modified by the original supplier.
- 7. With the assumption that TRIP will be operational five years from now and beyond, the following goals are proposed:
 - as Absend data coverage to all car systems.
 - b. Expand in a timely manner property options to participate in the data bank.
 - c. Reduce the current accepted minimum time to process and distribute data from eight weeks to four weeks.
 - d. Reduce the twelve-character Ceneric Part Number to a more convenient and usable code with fewer characters. The SLAV "Work Unit Code" listing may be helpful in this endeavor.
 - e. Develop an "On Equipment" and "Off Equipment" concept. Basically, a system that would accumulate data on maintenance actions accomplished on the car and interface with maintenance data and costs relating to repair and/or disposition of components removed from the car. Such a system would aid in the repair/scrap decision process. Additionally, it would provide encouragement for suppliers participation as addressed above.
 - f. Pursue the feasibility of a standard maintenance work order form.

Richard A. Uher, Ph.D. Page Five June 4, 1931

8. Other than the question of adequate funding for continuation of TRIP, only one other remains. If the program continues as it currently exists, when will a fire commitment be made to absorb additional properties in the data bank? Currently, the Authority does not have an automated management information/maintenance data collection system; however, development of such a system has top priority within available resources. With knowledge as to when we may expect to become a participant in the data bank, internal development of the Authority's data system could possibly be tailored to interface with the TRIP program.

In summary, I personally am an enthusiastic supporter of TRIP and look forward to its continued growth and my participation. I trust my comments to your questionnaire will assist in achieving these goals. If any clarification is required, please call on $m_{\rm P}$, (617) 722-5210.

Very truly yours,

Kenneth D. Crane Resource Manager

KDC/ev.

cc: Mr. Richard Robichard, Code 722
 USDOT/TSC
 Kendall Square
 Cambridge, MA 02142



383-7922

July 1, 1981

Dr. Richard A. Uher
Rail Systems Center
Carnegie-Mellon University
Schenley Park
Pittsburgh, PA 15213

Dear Dr. Uher:

The following information is provided in response to your questionnaire concerning the TRIP impact assessment. Please keep in mind that Baltimore is not yet an operational system and answers provided reflect this fact.

- 1. When the Baltimore Metro becomes operational (First Quarter of 1983), the MTA would definetly like to be considered as an active participant in TRIP.
- 2. TRIP would provide Baltimore Metro with comparative data to help assess operational efficiencies. TRIP has already provided many short cuts in attaining automated data capabilities for maintenance purposes.
- 3. MTA feels TRIP is of sufficient benefit to remain an active member even if UMTA funding were reduced, however, participation at meetings would have to be considered at that time, since non-reimbursed travel would have to be consistent with MTA budget considerations.
- 4. The MTA would provide whatever support necessary. We are now in the process of developing our own data bank on UNIVAC hardware. At time of completion, it should be possible to provide a data tape to TRIP.
- 5. The problems so far with TRIP seem to be with the sensitive nature of the information. Because of an unfavorable media relationship with which the industry must frequently deal, this can frequently be used against us. Some how these problems must be defused by an aggressive media approach. Unless this information can be exchanged openly and honestly for the purpose intended, its usefulness declines.

Letter to Dr. Richard Uher Page 2 July 1, 1981

- 6. The supply industry should coordinate its efforts in terms of codes and catalogue numbers to avoid duplication as much as possible. Any other support offer should be gratefully appreciated.
- 7. At some point in time UMTA should consider operating the data bank itself on hardware directly accessible by all properties via telecommunications. More immediately the program should be expanded to handle all aspects of transit reliability including Fare Collection and Train Control equipment as well as all operating properties.
- 8. All due efforts should be given to coordinate TRIP with other UMTA program such as Project FARE and SIRAS. This would help to avoid costly duplication of efforts and help expedite a central, industry-wide data capability for all purposes.

Copies of letters from the MTA to San Francisco Bay Area Rapid Transit System are also enclosed. You will note that those letters indicate a frequently mentioned intangible benefit of TRIP, that is the increased cooperation fostered amongst TRIP participants.

Please advise me if you need any additional information.

Sincerely,

Donald J. Dzinski, Manager Safety & Systems Assurance

DJD/cab

cc: T. S. Gordon, APTA

R. H. Robichaud, TSC

Enclosure



383-6035

April 10, 1981

Mr. Theodore Gordon American Public Transit Association 1225 Conn. Ave. N.W. Washongton, DC 20036

Dear Mr. Gordon:

The Mass Transit Administration have been carefully following the development of the APTA Transit Reliability Information Program. As an emerging rail property, the MTA has found the TRIP information beneficial from a cost saving point of view in the development of an incident reporting system. By using TRIP codes we have saved time and resources in developing this program. Although, we are not yet active participants in the TRIP data bank, it has proven quite useful for our purposes.

Additionally, the TRIP output reports have provided us with comparative information on equipment reliability. This is important to us in that we are in the process of procuring transit vehicles.

We fully support the TRIP effort and endorse its further development. This program is one indication of the mutual benefits that acrue from the cooperative efforts of APTA members.

Very truly yours,

(100 Sall

L. A. Kimball, Administrator

LAK/cab

cc: Richard Robichaud - TSC

Donald J. Dzinski

Administration of the Con-



MASS TRANSIL ADMINISTRATION

383-6035

April 13, 1981

Mr. G. Keith Bernard General Manager Bay Area Rapid Transit District 800 Madison St. / Oakland, CA 94607

Dear Mr. Bergard

The MTA is moving forward on the process of implementing an automated incident reporting system. The staff members involved in this project inform me that the accomplishments to date have been due in large part to the help given them by members of your staff. Specifically, Jim king and John Thomas provided us with the kind of demonstrations and information that made it possible to develop our own system in less than four months. There are some administrative details still in progress, but we hope the data system will be operational before the arrival of our first transit vehicles this summer.

In addition to the help on the incident reporting system, our two staff members who visited your property (A. S. Hoveskeland, and D. J. Dzinski) were extremely impressed with the operation of your system. Frequently, we have nothing but press reports to form impressions. In this case, they both reported that BART indeed does a fine job in moving people, mainly because of the obvious dedication of the BART staff with whom they had contact.

Once again I would like to thank you for the help given us and hope that we can someday return the favor.

Sincerely

L. A. Kimball Administrator

LAK/cab

cc: James H. King, Jr. - BART John L. Thomas - BART Donald J. Dzinski



MASS TRANSIT ADMINISTRATION

109 EAST REDWOOD STREET . BALLIMURE, MARYLAND 21202

My telephone militer (8 (301) 583-7922

April 9, 1981

Mr. James H. King, Jr.
Supervisor of Reliability Engineering
Bay Area Rapid Transit District
800 Madison St.
Oakland. CA 94607

Dear Jim:

We are finally getting down to the point of implementing a data system for maintenance incidents. As you can imagine, we have had the usual amount of bureaucratic problems, but have moved forward with a requisition for a system utilizing CDC real time. I would like to personnally thank you and John Thomas for the help you've given us in this effort. If left to start from scratch, we would probably still be looking for the first step.

We still have a way to go before the system is operational (provided we get approval), but we should be up and running by the time the first vehicles arrive this summer. When that happens, I hope both you and John get the chance to stop in and yisit us.

Our thanks to you and all of the BART staff who met with us for their help in this matter and for the wonderful hospitality we experienced back in November. Both Ardell Hoveskeland and I were extremely impressed with the BART system and were able to learn a lot about transit operations over and above your data system. You and your colleagues are to be congratulated for your contributions to the transit industry.

Sincerely,

Donald J. Dzinski, Manager Systems and Safety Assurance

DJD/cab

cc: John Thomas - BART



PORT AUTHORITY OF ALLEGHENY COUNTY Beaver and Island Avenues

Beaver and Island Avenues Pittsburgh, Pennsylvania 15233 (412) 237-7000

December 3, 1981

Dr. Richard A. Uher Rail Systems Center Carnegie-Mellon University Schenley Park Pittsburgh, Pennsylvania 15213

Dear Dr. Uher:

This letter comprises the response of the Port Authority of Allegheny County to the Transit Reliability Information Program (TRIP) Liaison Board Participant Questionnaire. I apologize for the lateness of this response.

Our response to the eight questions is as follows:

1. Does your transit property plan to become an active participant in TRIP? If so, and TRIP continued into Phase II, when could you begin?

The Port Authority supports the continued development of TRIP, and its continued implementation at as many properties, and covering as many vehicles and vehicle sub-systems, as possible. The Port Authority currently plans to become an active participant of TRIP. This would take place at the time the Authority's light rail vehicles are put into service in late 1984/early 1985.

2. What are the potential benefits of TRIP to your operation?

As we see it, the potential benefits of TRIP are two-fold. First, it provides information relative to common vehicles and vehicle types used by a number of different transit authorities, that is helpful to the authorities involved, as well as to other properties. Associated with this benefit is the personal interaction of maintenance management personnel at the various properties, that is fostered by the TRIP process. Secondly, it provides a common format to the various transit reliability data bases that are in place at the participating properties. This can facilitate the development of these data bases at each property, as well as serve to improve the usefulness of the data. The Port Authority will be interested in developing a reliability data base for its future LRV's, and it is intended that this data base be compatible with the TRIP data base.

3. Would your property still become an active member of TRIP, if it had to contribute to its continuation either in manpower and/or dollars?

The Port Authority would still hope to become an active member of TRIP. Of course, this decision would have to be made at that time by the Executive Director, who would have to take into account the impact on PAT's operating budget, as well as the benefits of TRIP. However, given that the Port Authority will be interested in developing a reliability data base for its LRV's, it is hoped that PAT can become an active member of TRIP.

4. If TRIP continued with full government support, please provide a rough estimate of your contribution to beginning TRIP participation on your property.

Given that about 3 years will elapse until TRIP can be implemented at PAT, it is difficult to say with certainty what the contribution will be. However, given that our MIS staff has implemented a bus maintenance record program and a maintenance inventory program, it is expected that their expertise will come in handy at the time TRIP is implemented.

5. Do you see any potential problems with TRIP?

We foresee potential problems with TRIP as with any large computer program, i.e., it frequently takes longer to implement than is originally anticipated. It is hoped that continued Federal support of TRIP will enable such problems to be mitigated.

6. Do you have any suggestions on how the supply industry might participate in TRIP?

Our only comment is that the supply industry should be involved in TRIP.

7. If TRIP is continued and operational 5 years from now, what major changes would you introduce at any point in time to further enhance its benefits or reduce its cost?

I would suggest that maximum Federal support be tendered so that TRIP can be successfully implemented as soon as possible. I would hope that the results of TRIP can be disseminated as widely as possible. In addition, I would hope that there can be as much interaction as possible with suppliers so that their methods and products can be improved to better serve the transit industry.

8. Additional comments

We have no additional comments at this time, however, we appreciate the opportunity to participate on the TRIP Liaison Board.

Very truly yours,

Robert P. Sedlock

Manager, Systems Technology

June 22, 1981

Dr. Richard A. Uher Rail Systems Center Schenley Park Pittsburgh, Pennsylvania 15213

RE: TRIP IMPACT ASSESSMENT

Dear Dick:

I have reviewed the questionnaire forwarded with your letter of May 13, 1981, which forms a part of the independent assessment of TRIP which you have been contracted to perform, and have indicated my response to each item below:

1. Does your transit property plan to become an active participant in TRIP? If so, and TRIP continued into Phase II with no problem in accepting you, when do you feel you could begin?

PATH has viewed TRIP as a program benefiting the entire rail transit industry, and, based upon our assessment of the program to date, does intend to become an active participant. The timing for active participation in TRIP, assuming continuation into Phase II, will be predicated upon manpower requirements involved in start up activities and integration of this work with other priority MIS and data processing developmental activities proposed and/or underway at PATH. I would presently estimate a period of 24 months before PATH could consider supporting active TRIP participation.

2. What are the potential benefits of TRIP to your operation?

This question was addressed in my 4/3/81 letter to Theodore S. Gordon of APTA, copy attached.

3. If the DOT reduced its funding toward the continued operation of TRIP, would your property still become an active member if it had to contribute to its continuance in either manpower and/or dollars?

As a nonparticipant in the TRIP EDB, PATH cannot speculate on the costs and manpower either currently required for operation of TRIP or to be required if TRIP moves into the fully operational mode. The spectre of constantly increasing costs for the basic operation of a transit system will necessitate a careful cost benefit analysis of every current PATH program as well as any proposed additional systems. To indicate PATH would be in a position to contribute in terms of labor or dollars at a future date is, therefore, not possible at this time.

Dr. R.A. Uher Page 2 June 22, 1981

4. If TRIP continued with full government support, please provide a rough estimate of your contribution to beginning TRIP participation on your property.

When PATH determines it is able to become a full participant in the TRIP data bank, it would make every effort to provide manpower to:

- A. Prepare a Master Generic Parts List for TRIP from the existing PATH parts catalog and vehicle roster.
- B. Assemble reference data on equipment configuration and specifications where feasible.
- C. Provide a Property Reference Profile for PATH's operation including parameters for climate, loading, station spacing, etc.
- 5. Do you see any potential problems with TRIP? If so, please discuss.

No apparent problems observed to date.

6. Do you have any suggestion on how the supply industry might participate in TRIP in order to enhance its benefits and possibly reduce costs?

Cooperation received to date from the TRIP Liaison Board members representing transit suppliers has been of great help in the development and fine tuning of TRIP. Their continued support of TRIP by participation in the refinement of the basic system will prove to be a tangible contribution to all transit properties in the data bank.

7. If TRIP is continued and operational five years from now, what major changes would you introduce at any point in time to further enhance its benefits or reduce its cost? Among items which should be considered in such changes are: Participation by federal government transit properties, suppliers and others and improvements in data handling and reporting.

Throughout the course of each meeting of the TRIP Liaison Board, deliberations on improvements to the basic system take place. These discussions are based upon current system output and speculation on future needs.

Beyond the topics discussed to date, I can foresee changes to the system hardware/software configuration that could provide more expeditious handling of data entry and report generation. In essence, I believe data that requires an 8+ week cycle before results are available to be studied can be improved substantially. Furthermore, it may be feasible, as future enhancements and systems are introduced to TRIP, to make TRIP an on-line system. Such a system could permit direct data entry from each property via a time sharing data terminal hookup. This in effect would eliminate the rehandling of data and result in significant time savings in terms of mailing data.

Dr. R.A. Uher Page 3 June 22, 1981

8. Please add comments on questions which were not addressed in this questionnaire but which, in your op8nion, are important in assessing TRIP from an institutional opportunity or cost/benefit point of view.

In any system where a vast amount of information is inputted into a data bank, there are numerous methods in which those data can be analyzed. It would be helpful to identify the special report capabilities that TRIP will be able to support as the system is further developed and put in its final format.

As indicated at the last TRIP Liaison Board Meeting, PATH was requested by APTA to submit its assessment of TRIP and forwarded same in a letter dated April 3, 1981, (copy attached). This letter was reviewed and approved by the General Manager and Vice President of PATH, Francis A. Gorman, along with the General Superintendent, Theodore C. Rutmayer, and should suffice as our General Manager's assessment of the program.

Sincerely yours,

Michael A. Scott

Construction Management Engineer

CC: F.A. Gorman

R.R. Kelly

J.J. Kirk

W.M. Miller

T.C. Rutmayer

D.T. Smith

L.G. Theofilos

R. Robichaud (USDOT-TSC)

T. Gordon (APTA)



Southeastern Pennsylvania Transportation Authority

69th Street Elevated Shop Victory Avenue Upper Darby, PA 19082 (215) 471-2871

June 15, 1981

Richard a. Uher Carnegie-Meloon University Rail Systems Center Schenley Park Pittsburgh, PA 15213

Dear Mr. Uher:

This letter is in response to your request dated May 13, 1981, for certain questions to be answered regarding the APTA Transit Reliability Information Program ("TRIP").

- 1. SEPTA would expect to become an active participant in TRIP. The timing of our participation would depend upon both the receipt of new vehicles (LRV's should be received in 1981 and new Broad Street Subway cars in 1982-1983) and the implementation of our Vehicle Maintenance Management Information System. Our earliest participation could probably not occur before 1982.
- 2. TRIP could provide a source of information for reliability of vehicle components and systems at other transit properties, help indicate properties who may have solved a particular problem or with whom we could jointly solve the problem, and provide a long term aid in the design of new equipment.
- 3. SEPTA would give serious consideration to providing some manpower to support TRIP.
- 4. Based on our Vehicle Maintenance Management Information System being fully operational, the small amount of manpower commitment which would be necessary to begin TRIP participation at SEPTA could be provided.
- 5. One potential problem with TRIP is the use of the rigures by people who are not in a position to properly interpret them. Comparison of data at different transit properties can be invalid if operating conditions are not considered.

- 6. Participation by suppliers would mean an active interest in the reliability of their products in actual operation and provide opportunities to determine improvements to products while fostering competition.
- 7. Future operation of TRTP would require wider participation while fimiting participation to automated systems. Manual data collection imposes a high cost on the TRTP system. Automated data collection could even include direct transmission of data to speed up the TRTP operation. Participants should also be able to directly ask TRTP the reliability history of specific parts, preferably through remote terminals.
- 8. The cost of collecting information for TRIP should be reduced substantially as the system is refined and fully automated, while the useful information available from the system will increase dramatically as more properties are included in TRIP and all vehicle systems are measured.

Yours truly,

Robert Sellman

Resource Control Specialist

APPENDIX 11.5 EVALUATION QUESTIONNAIRES AND RESPONSES FOR CARBUILDERS SUPPLYING U.S. PROPERTIES

Equipment suppliers responses to questionnaires.

Requested Equipment Supplier	Date of Submittal
BREDA TONING, INC.	N .
THE BUDD COMPANY	7/8/81
GENERAL ELECTRIC CO.	N
HAWKER SIDDELEY CANADA, INC.	6/19/81
KAWASAKI	7/30/81
VICKERS CANADA, INC.	. N

N - No Submittal

TRIP Assessment - Carbuilders Questionnaire

As an aid in producing an impact assessment of the Transit Reliability Information Program (TRIP), lists of questions were prepared for transit properties which are active participants (now submitting data), transit properties which are passive participants (on Liaison Board but not submitting data) and the carbuilders which are now contracted to supply vehicles to U.S. transit properties.

As a carbuilder supplying equipment to U.S. transit properties, who are now providing data to TRIP or may provide these data in the future, please answer the following questions:

- 1. What do you regard as the present and future benefits of TRIP to the supply industry?
- 2. How would you as a carbuilder use the information which is on file in the TRIP data bank?
- 3. In considering the expansion of the TRIP data base, which now covers three vehicle subsystems (propulsion, brakes and doors) on five U.S. transit properties (BART, WMATA, NYCTA, CTA and PATCO), please state the priority you would place on extensions of the data base.
 - a. Other vehicle subsystems,
 - b. Other transit properties,
 - c. Other vehicle series on the same property,
 - d. A combination of a-c.

Please discuss the reason for setting the priorities.

- 4. It has been said that a healthy supply industry contributes to the healthy operation of the transit industry. Please state the opportunities and possible dangers which you see in the continuation of TRIP.
- 5. How can you participate in TRIP to enhance its benefits and decrease its cost to the transit industry?
- 6. How would your suppliers in the major subsystem area benefit from TRIP? Do you see possible dangers to them?
- 7. Please add any comments on questions which were not addressed in this questionnaire but in your opinion are important in assessing TRIP from an institutional opportunity or cost/benefit point of view.

The The State of Conserve

July 8, 1981

Dr. Richard A Uher Rail Systems Center Schenley Park Fittsburgh, Pa 15213

Dear Dr. Uher:

In response to your request for aid in producing an impact assessment of the Transit Reliability Information Program (TRIP), please find below comments, keyed to your questionnaire:

A MEMBER DIMINION REPORTED BY NOTING A REPORT OF A STREET AND A REPORT OF A RE

1. "What do you regard as the present and future benefits of TRIP to the supply industry?

The present benefits of TRIP to carbuilders and suppliers are practically zero, due to the experimental status of the data bank and the inability to publish the data for supplier review and usage. Even if it were published, correlation "K" factors would have to be established to achieve a commonality base for comparison.

Future benefits of TRIP are exciting to contemplate. For the first time, a real-world data base could be used to quantitiatively compare, assess, and predict the various reliabilities of vehicle configurations using different supplier's equipment. Trade off studies could be performed, resulting in optimization of vehicle and vehicle systems for new car orders and re-orders of existing equipment. The much maligned term of "Service Proven" equipment could finally be quantified.

2. "How would you as a carbuilder use the information which is on file in the TRIP data bank?

Current usage of TRIP data is extremely limited. Future usage could be as described in the response to your first question, with the additional capability of comparing Budd vehicles to those of our competitors. This opportunity would allow us to direct resources toward the solution of problem areas or to develope product imprevements where they are most needed. If the data is correlated in proper fashion, it could also allow us an assessment for identical equipment performance in different geographical locations.

If we could prove via TRIP data that performance of Budd vehicles

THE BUDD COMPANY

(page 2)

was satisfactory, it could decrease our Bid Costs and respective risks of formal Reliability Demonstration Tests (RDT). This could be a definite advantage for us in the competitive bidding process.

- 3. "In considering the expansion of the TRIP data base, which now covers three vehicle subsystems (propulsion, brakes and door) on five U. S. transit properities (BART, WMATA, NYCTA, CTA and PATCO), please state the priority you would place on extensions of the data base.
 - a) Other vehicle 'subsystems,
 - b) Other transit properities,
 - c) Other vehicle series on the same property,
 - d) A combination of a-c.

Please discuss the reason for setting the priorities."

Our first priority for expansion of the data base would be (b) for other transit properties such as Rio de Janerio and Sao Paulo. Because we are a heavy user of Westinghouse Electric equipment and Westinghouse has developed their designs progressively from BART to Sao Paulo to Rio de janerio to Miami/Baltimore, we would be most interested to receive TRIP data from these areas.

Our second priority would be to include other vehicle subsystems such as air conditioning.

4. "It has been said that a healthy supply industry contributes to the healthy operation of the transit industry. Please state the opportunitites and possible dangers which you see in the continuation of TRIP."

We have already stated the exciting opportunities for utilization of TRIP data at the subcontractor/supplier level.

Some possible dangers that could arise are revealed by less than desireable relations between suppliers and transit authorities where litigations are taking place (NYCTA/WMATA/MARTA), where the transit authorities may not be able to divulge the type of data necessary for utilization. Even if litigations were not occurring, the classic confrontation between "failure" of a supplier item and claims of inadequate, improper or misapplication of maintenance information is always present. Careful and precise correlation K factors must be a part of TRIP for it to be effective, and in some cases, agreement beforehand by suppliers, carbuilders, and transit authorities of these factors.

5. "How can you participate in TRIP to enhance its benefits and decrease its cost to the transit industry?"

At the present time there is very little the carbuilder can contribute other than continue to voice the concerns of the carbuilder and suppliers in the formation of the TRIP data. When TRIP personnel reach the point of establishment of K factors for correlation, the carbuilders and suppliers could be heavy contributors, describing the relative design details, rationale, and effects of user activities on the

THE BUDD COMPANY

(page 3)

equipment. Each organization would have a vested interest in this adventure, to insure fair and equitable comparisons.

6. "How would your suppliers in the major subsystem area benefit from TRIP? Do you seel possible dangers to them?

Suppliers eventually stand as the organizations to receive the most benefit from TRIP data not only from a product improvement point of view and competitive comparison, but decreased costs for accumulating data for reliability predictions and reliability testing activ-

Possible dangers would be the obvious, that is if their equipment were shown to the unreliable for one reason or another. This could have a devastating effect on their pricing in the market place.

7. "Please add any comments on questions which were not addressed in this questionnaire but in your opinion are important in assessing TRIP from an institutional opportunity or cost/benefit point of view."

The current TRIP output reports are limited to subsystem levels. It would be of much greater benefit to the carbuilder and suppliers if the accountability could be extended to the Line Vehicle Replacement Unit (LVRU) level, i.e. Traction Motors, Gearboxes, Air Compressors, etc.

In conclusion, The Budd Company is supportive regarding the continuation of TRIP particularly in the arena of increased public acceptance of Mass Transit in the U. S. Market. Any activity which promotes increased reliability while eliminating subjective statements is viewed as a positive step towards that end.

G. L. Goldberg

Chief Engineer

Sincerely,

W. I. Wilson, Sr. General Manager

/dz RMSH/RWB/11745/0522/

CANADIAN CAR DIVISION . BOX 67, STATION 'F', THUNDER BAY, ONTARIO P7C 4V6

June 19, 1981

Mr. Richard A. Uher
Carnegie-Mellon University
Rail Systems Center
Schenley Park
Pittsburgh, Pennsylvania 15213
U.S.A.

Dear Sir:

Subject: TRIP Impact Assessment

Our reply to your letter and questionnaire, dated May 13, 1981, is as follows: -

- 1. The main benefits of TRIP to HSCI is the ability to derive failure rate and maintainability data in terms of MTBF/MMBF, MTTR, etc. Unfortunately, the derivation of these figures from TRIP output reports is tedious and will discourage use of this data base.
- 2. HSCI would use MTBF/MMBF, MTTR figures and failure mode information derived from TRIP for the purpose of
 - (a) selecting reliable, service proven, components for inclusion in new vehicle designs,
 - (b) assessing the practicality of meeting procurement specification requirements pertaining to Reliability, Maintainability, Availability and Dependability (RMAD),
 - (c) predicting the RMAD of new vehicles, and
 - (d) identifying failure modes in FMEA's which are becoming common requirements in new vehicle specifications.
- 3. HSCI puts priority on expanding the data base to include other vehicle subsystems because little or no objective failure rate and maintainability information exists on such items as couplers, HVAC systems, current collectors, lighting equipment, communication equipment, etc.
- 4. The main opportunity HSCI sees in TRIP is the identification of reliable components for inclusion in new vehicle designs. The main danger is the possible escalation of RMAD analyses for the sake of justifying the costs of TRIP.

Mr. Richard A. Uher Carnegie-Mellon University - 2 -

June 19, 1981

- 5. At this time HSCI is not in a position to participate in supply data for TRIP because as a carbuilder we do not collect this data.
- 6. This question should be put to our suppliers. HSCI does not presume to answer on their behalf.
- 7. TRIP would be much more useful if it directly provided failure rate and maintainability statistics at the subsystem and component level. The considerable labour required to extract these statistics for the routine TRIP reports is a deterrent to its use by a carbuilder.

We trust the foregoing answers will be of some benefit to you.

Yours truly,

J. W. Ferguson

Director of Engineering

JWF: cw

cc Mr. K. G. Chapman



Philadelphia Branch SmithKline Bldg. 6F, One Franklin Plaza, Philadelphia PA 19104 Phone: (215) 568-5370 Telex: 84-5194 (WU)

Carnegie—Mellon University Rail System Center Schenley Park Pittsburgh, PA 15213

Attention: Dr. Richard A. Uher

Subject : Trip Impact Assessment — Carbuilders Questionnaire

Dear Dr. Uher

We apologize the delay of reply for your questionnare.

KHI would like to reply them as generally as follows.

We would like to use the TRIP data for the purpose of selection of suitable and reliable equipment during the new car design process.

We believe that carbuilder should use the most reliable equipment which will meet with the customer specification.

So we would receive the data such as Transit properties, their car type, system failure record, reliability analysis data (failure mode, ration and MTBF Etc.).

After we receive the abovementioned data, we will be able to know the previous failure mode and request to improve the system equipment as the view point of carbuilder.

In addition, the actual data which will be taken during the revenue service and vehicle maintenance instead of the lab. data is most beneficial for new car design as the carbuilder.

We wish to thank you for your cooperation.

Very truly yours

Kawasaki Heavy Industries Ltd.

K. Segawa, SEPTA LRV Project Engineer

APPENDIX 11.6 INTERVIEWS WITH THE DOT-UMTA AND APTA

INTERVIEWEE:

Robert Haught

Director, Office of Safety and Product Qualification

ORGANIZATION:

Department of Transportation, Urban Mass Transportation Administration

PLACE:

Washington, D.C.

DATE:

June 18, 1981

SUMMARY OF INTERVIEW

Question 1 What are the present and future benefits of TRIP to the Federal Government?

Answer 1

- Determine resource allocation for research and development by quantifying problems for best return on investment.
- Improves efficiency and productivity of the property thus reducing relative subsidies required.
- Monitors new equipment during warranty periods, which have been a continuous problem to the industry.
- Question 2 Should TRIP continue indefinitely, or would there be a future time when TRIP would no longer be necessary?
- Answer 2 TRIP should continue indefinitely but remain carefully monitored for obsolescence.
- Question 3 Does the Department of Transportation intend to cut back funding on TRIP?
- Answer 3 There is no intent to cut back government funding. TRIP will continue with full funding.
- Question 4 What are the priorities, which you see, in the expansion of TRIP?
- Answer 4 The priorities are beginning with highest.
 - 1. Expand major assemblies on monitored vehicles.
 - 2. Add new fleets on present properties.
 - 3. Add other properties.

APPENDIX 11.6 (continued)

Question 5 If TRIP is operational five years from now, what major changes would you introduce now to enhance its benefits or reduce its cost?

Answer 5 - Add bus data.

Question 6 Do you have any other comments?

Answer 6 - Anything that can be done by the Federal Government to help transit properties help themselves is beneficial. Having comparable information on equipment, as is provided by TRIP, is beneficial.

APPENDIX 11.6 (continued)

INTERVIEWEE:

Theodore S. Gordon

ORGANIZATION:

American Public Transit Association

PLACE:

Washington, D.C.

DATE:

June 18, 1981

SUMMARY OF INTERVIEW

Question 1

What are the specific benefits of TRIP to APTA as an organization?

Answer 1

- TRIP is not beneficial directly to APTA as an organization but to its members. Its main benefit to them is to make needed information available for future procurements. It also becomes one of many inputs into the national cooperative research program.

Question 2

If Federal Government reduced its cost support of TRIP, are there any plans to continue it?

Answer 2

- No suggestions of any alternative cost support for TRIP have been made.

Question 3

How does APTA view the expansion priorities of TRIP?

Answer 3

- The expansion should follow:

- 1. More vehicle systems on monitored fleets.
- 2. More vehicles series on monitoring properties.
- 3. More properties.

APPENDIX 11.7 LETTER FROM BOOZ-ALLEN & HAMILTON

BOOZ · ALLEN & HAMILTON Inc.

Transportation Consulting Division

SUITE 307
400 PENN CENTER BOULEVARD
PITTSBURGH, PENNSYLVANIA 15235
824-8920
AREA CODE 412

October 9, 1981

Dr. Richard A. Uher
Director of Rail Systems Center
Carnegie-Mellon University
Schenley Park
Pittsburgh, PA 15213

Reference: Your recent interview with Booz, Allen concerning the UMTA sponsored TRIP program and how Booz, Allen util-

ized that program

Dear Dr. Uher:

In our discussions I outlined the Door Improvement Program Booz, Allen is conducting for UMTA. This program was established to assess the door systems in use by the rail transit industry and recommend to UMTA continuing door improvement programs that UMTA should consider undertaking in the future to improve the rail transit industry door systems.

Our engineering assessment of the door equipment focused on determining the causes of door equipment malfunction. During our investigation the TRIP program was reviewed and a special printing of specific information was provided by the TRIP contractors in expectation of reducing our investigation activities to isolate root causes of malfunctions.

Upon completion of our review of the TRIP program and the TRIP information we concluded the following:

- 1.) The TRIP program <u>was</u> programmatically capable of providing detailed cause and effect information in a variety of output formats.
- 2.) However, the input information supplied by the TRIP contributors varied widely in format and level of detail. Therefore it would have been necessary to analysis each of the contributors data input to determine if the data were verified, accurate, and of sufficient detail to identify the root causes of malfunction. Instead, we chose to view the problems first hand at selected rail transit properties because of the low confidence in the TRIP cause and effect data.

Dr. Richard A. Uher October 8, 1981 Page 2

For example, one property that supplies initial statistics of door problems to TRIP does <u>not</u> supply to TRIP a subsequent report that details the resolution of those initial problems.

Keep in mind that our assignment required detail engineering information that covered design principles, maintenance concepts, operational anomalies and human factors. We believe that on-site observations and personnel interviews are the most effective methods of isolating the information for this type of equipment evaluation.

TRIP may have other valuable applications and usefulness, however if the input data is of questionable quality the output will also retain that questionable quality.

Very truly yours

BOOZ-ALLEN & HAMILTON Inc.

Robert D. Smith Senior Associate

dd

APPENDIX 11.8 CONVERSION FACTORS FOR RELIABILITY INDICES

The information used to generate 5-1, 5-2 and 5-3 in the text was obtained from the Industry Reports of the TRIP DB for the months of January, February and March 1981 and information obtained from the five participant properties.

Table 11.8-1 shows the average car-miles per car-month for the three months.

TABLE 11.8-1

Property BART	<u>January</u> 5228	February 4758	<u>March</u> 5694	<u>Average</u> 5226
CTA	4701	4203	4340	4415
NYCTA	2222	1762	1507	1830
PATCO	3084	2890	2802	3985
WMATA	3923	4278	4676	4292

Table 11.8-2 summarizes the conversion factors used to convert one index to another.

TABLE 11.8-2

Property	Average Speed(MPH)	Average Station Spacing(MI)	Average Car-Miles/Car-Months
BART	27	2.2	5226
СТА	25	0.6	4415
NYCTA	18	0.5	1830
PATCO	29	2.1	3985
WMATA	27	1.1	4292

Table 11.8-3 presents the Unscheduled Maintenance Actions (UMA) per 10K car-miles for three months, January-March 1981, for three systems.

TABLE 11.8-3

Property	Propulsion	Doors	Friction Brake
BART	1.3	0.3	0.4
СТА	1.9	0.9	0.8
NYCTA	2.2	2.6	1.8
PATC0	3.0	1.3	1.2
WMATA	3.8	0.6	2.0

Note: K=1,000

The conversion factors are:

- UMA/10K car-hours = Average Speed X UMA/10K car-miles.
- 2. UMA/10K car-station stops = Average Station Spacing X UMA/10K car-miles.
- 3. UMA/car-year = $\frac{12 \text{ months/year}}{10 \text{K car-miles}}$ X Average $\frac{\text{car-miles}}{\text{car-month}}$ X UMA/10K car-miles.

APPENDIX 11.9 LETTER FROM DYNAMICS RESEARCH CORPORATION



DYNAMICS RESEARCH CORPORATION

60 CONCORD STREET, WILMINGTON, MASSACHUSETTS 01887 TEL. 617/658-6100

SYSTEMS DIVISION

16 June 1981 SK-7293/1407

Richard A. Uher, PhD Director, Rail Systems Center Carnegie-Mellon University Schenley Park Pittsburgh, Pennsylvania 15213

Dear Dr. Uher:

The following information is provided as a result of questions raised at a meeting at DRC on 7 May 1981. Mr. Silvia furnished this information to me some time ago and I apologize for the delay in transmission.

The total value of our support contract with TSC for TRIP is \$593,214 including all modifications. Of this amount, approximately 65% was used for the development, establishment, refinement and expansion of the TRIP Experimental Data Bank (EDB). The balance of the funds was used for the EDB operation which monitors three vehicle systems (doors, propulsion, friction brakes) on approximately 1300 vehicles at five U.S. transit properties (BART, CTA, NYCTA, PATCO, WMATA).

You raised many complex questions at the May 7 meeting and unfortunately the impact to go further is quite significant. We hope this is of help in your study, and should further questions arise, please call Mr. Peter Keller or myself.

Very truly yours,

DYNAMICS RESEARCH CORPORATION

Arthur Brown

Manager, Contracts & Administration

AB/ch

APPENDIX 11.10 ESTIMATE OF AVAILABILITY INCREASE EXPECTED FOR RELIABILITY INCREASES IN VEHICLE SYSTEMS

BART is taken as the basis for this estimate because of the comprehensive data which are available (BART-Operations Performance Report, October-December 1980). Table 7.32 in the BART report, which is reproduced as Figure 1, is used as the reliability base. Four years of reliability data are summarized in this figure. A summary has been produced for each of the four years (1977-80) for nine systems of the vehicle. (Trucks and suspension are combined in one system.) This summary is shown in Table 11.10-1.

The total car availability at BART during 1977-80 was 84%. This was the operational availability A, which can be related to the failure rate (F) and the maintenance rate (M) by the expression

$$A = \frac{1}{1 + F/M}.$$

Thus, for 1980, on the whole vehicle (F = 136 assuming independent failures, which is not quite true.)

$$M = F \frac{1}{\frac{1}{\Delta} - 1} = 714$$

Thus

$$A = \frac{1}{1 + F/714}$$

If the failure rate of any system is reduced by 50%, the result on the car availability can be predicted and is presented in Table 11.10-2. Note that in the case of propulsion, a 50% decrease in failure rate means a 1.9% increase in availability.

VEHICLE SYSTEM HARDWARE FAILURE RATES, ALL-USAGE (Failures per thousand car-hours)

	AIR COND	OTA *	AUX ELEC	CAR BODY	COMM	DOOR	FRIC BRKE	PROP	SUSP	TRCK
1977 JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOY DEC	1.3 1.0 1.34 1.31 1.09 1.61 1.55 1.29 1.11 0.75 0.48 0.35	3.8 2.8 3.35 3.18 4.57 2.64 4.18 3.91 4.35 3.70 4.35 3.60	1.9 2.1 2.32 1.74 1.97 2.77 1.88 1.74 1.54 1.40 1.48	2.0 1.5 2.29 1.99 0.98 0.91 0.68 0.68 0.93 0.67 0.54	0.57 0.5 0.35 0.27 0.38 0.53 0.81 0.52 0.52 0.75 0.34 0.38	1.2 1.9 1.17 0.80 0.78 0.51 0.79 1.03 0.87 0.85 0.53	4.2 3.0 3.05 2.93 3.55 3.92 3.55 2.65 3.08 2.79 2.24 1.69	4.9 4.2 4.35 4.25 4.76 4.61 5.31 4.52 4.38 4.29 4.20 3.33	1.33 1.0 0.77 0.85 0.56 0.63 0.64 0.45 0.40 0.60 0.48	1.45 0.9 0.95 0.84 0.58 0.64 0.88 0.80 1.07 1.29 0.88
1978 JAN FEB MAR APR MAY JUN JUL AUG SEP GCT NOV DEC	0.53 0.37 0.57 0.32 0.89 0.77 0.98 0.81 0.74 0.59 0.41 0.28	4.87 3.11 3.13 3.22 3.35 2.55 2.14 3.11 2.45 2.06 2.59	1.13 1.30 1.05 1.51 1.57 1.56 1.28 1.30 1.11 1.44 0.83	0.49 0.47 0.43 0.42 0.54 0.62 0.84 0.84 1.07 0.98 0.94	0.34 0.49 0.30 0.29 0.48 0.52 0.35 0.25 0.34 0.15	0.54 0.32 0.45 0.60 1.01 0.58 0.87 0.60 0.61 0.27 0.58 0.78	1.52 1.72 1.35 1.13 1.37 1.05 1.04 0.82 0.77 0.69 0.78 0.67	4.25 4.49 4.23 3.55 3.66 3.07 2.64 3.31 3.03 2.73 2.79 2.55	0.55 0.26 0.30 0.39 0.43 0.50 0.51 0.22 0.22 0.26 0.27 0.29	1.39 1.10 1.45 1.46 1.19 1.30 1.00 1.01 1.07 1.10 1.14 0.90
1979 JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC	0.53 0.58 0.76 0.70 0.72 0.73 0.99 0.85 3.55 0.86 0.77	3.52 2.68 3.14 2.90 2.33 2.42 3.82 2.86 12.43 6.90 3.31	1.46 1.54 1.41 0.94 0.67 0.84 0.93 0.70 NO 4.04 2.16 1.39	1.00 1.59 1.72 2.31 1.84 1.61 1.46 1.17 SERVICE 3.62 1.31 1.38	0.43 0.49 0.55 0.40 0.38 0.27 0.46 0.43 1.81 0.80 0.31	0.50 0.58 0.67 0.79 1.40 1.06 0.72 0.76 4.59 1.66 0.78	1.15 1.31 1.29 0.80 1.08 0.94 0.93 0.97 2.78 1.46 1.16	2.86 3.15 3.19 2.58 2.79 3.21 2.77 3.14 9.39 5.89 3.49	0.64 0.58 0.77 0.45 0.47 0.39 0.36 0.65	1.11 1.10 1.25 0.95 0.92 0.85 0.53 0.72 1.46 0.95 0.71
1980 JAN FEB MAR APR** MAY JUNE JULY AUG SEP OCT NOV DEC	0.52 0.46 0.60 0.93 0.65 0.84 1.02 0.64 0.55 0.74 0.43 0.28	4.77 3.23 3.06 3.48 3.45 2.85 1.91 2.17 2.89 3.37 2.72 3.10	1.00 0.87 1.15 0.74 0.94 0.86 1.03 0.32 0.99 0.99 0.99	1.32 1.30 1.21 0.67 0.57 0.57 0.59 0.59 0.45 0.47	0.43 0.42 0.48 0.70 0.40 0.32 0.37 0.3458 0.39	0.83 0.75 0.76 0.71 0.68 0.95 0.71 0.695 0.77 0.62 source	1.13 0.99 0.67 1.05 0.93 0.91 0.71 0.69 0.85 0.84 0.02 : ODDS	3.70 3.04 3.55 3.44 2.80 3.18 3.43 3.31 3.49 3.29 3.01	0.44 0.60 0.70 0.55 0.45 0.51 0.50 0.44 0.31 0.50	0.86 0.93 0.83 0.67 0.78 1.09 0.71 1.24 1.16 0.85 0.78

FIGURE 1

^{*}Sased on A-Car Hours
**Car Body Vandalism Data not included starting April 1980

TABLE 11.10-1 VEHICLE SYSTEM HARDWARE FAILURE RATES (BART) (Failures Per 10K car-hours)

System	1977	1978	1979	1980	Average (1977-80)
Air Conditioning	11.0	6.1	10.0	6.4	8.4
ATO ⁽¹⁾	38.0	29.3	42.1	30.8	35.1
Auxiliary Electric	18.2	13.0	14.1	9.7	13.9
Car Body	11.8	7.4	17.2	7.7	11.0 ⁽²⁾
Communications	4.9	. 3.3	5.3	4.3	4.5
Door	9.0	6.5	12.3	7.7	8.9
Friction Brake	30.5	10.8	12.6	8.7	21.8
Propulsion	44.3	33.6	38.6	33.2	37.4
Trucks & Suspension	15.8	15.3	17.8	13.9	15.7
Total (All Car-Hours)		·			136.

⁽¹⁾ Based on A car-hours (Assumption is A car-hours/total car-hours N .4).

⁽²⁾ Vandalism incidents excluded.

TABLE 11.10-2 INCREASE IN CAR AVAILABILITY AT BART IF SYSTEM FAILURE RATE IS REDUCED BY 50%

System	Failure Rate	50% X Failure Rate	Vehicle Failure Rate	Availability Increase (△A)
Air Conditioning	8.4	4.2	131.8	.004
ATO	35.1	17.55	129.0	.007
Auxiliary Electric	13.9	6.95	129.1	. 007
Car Body	11.0	5.5	130.5	.005
Communications	4.5	2.25	133.6	.002
Door	8.9	4.45	131.6	.004
Friction Brake	21.8	10.9	125.1	.011
Propulsion	37.4	18.7	117.3	.019
Trucks & Suspension	15.7	7.85	128.2	.008

Total 136.

$$\Delta A = \frac{1}{1 + \frac{\text{Reduced Vehicle Failure Rate}}{714}} - 0.84$$

APPENDIX 11.11 REPORT OF NEW TECHNOLOGY

This report is the first independent project evaluation of the Transit Reliability Information Program (TRIP). It addresses the four program objectives achieved and the three program objectives not achieved. It gathers together for the first time the present and long-term benefits of TRIP, as well as recommendations for the program. Interviews were conducted of people working with transit properties, car builders, DRC, APTA, and DOT involved with or affected by TRIP.

No new technology has been developed as part of this evaluation.

150 Copies

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