

solved. The real problem is how to communicate and distribute this knowledge. A number of efforts have been made by special UMTA-funded manuals and studies.

Facility design manuals have tended to be a bit narrow in their results. They have been "how-to" books reasonably void of philosophy and background and have failed to supply a full range of ideas and solutions. Thus, a property using one of these manuals may find that only a portion of the document is applicable to its unique problems.

I strongly urge a continuation of this type of study and data collection. I would, however, suggest that UMTA fund an organization such as APTA to prepare a manual on facility design and equipment on an ongoing basis. The wealth of information and solutions available can then be gathered and presented in the most beneficial way to the industry.

In addition to these planning manuals, UMTA has funded a number of technical studies managed by individual properties. Although provision is made for distribution of the results on request, it is not widely used. There is no doubt that a great amount of thoughtful and useful research is available--in fact, so much that volume may be the problem. Again, having a group such as APTA collect and review these data and provide capsulized reports would perhaps be a more effective way to disseminate already available information.

PUBLICATION

Another strategy that could be expanded is a case-study presentation of ideas and facilities. APTA attempts this at its regional conferences. Friendship Publications does an excellent job once a year at its seminar.

Several bus-related magazines, most notably Friendship Publications' Bus Ride, also carry stories in their issues. Several architectural magazines such as Architectural Record and engineering magazines such as Construction Specifier have developed techniques and include facts and details that give a better, more rounded view. I am sure that, if sufficient interest were expressed in in-depth stories on facilities and equipment, they would be forthcoming from the present publishers, and I believe we would all benefit from such coverage.

NEEDED IMPROVEMENTS

Bus operators do need assistance, most notably from UMTA and the bus manufacturers, in addition to an improved communication network among themselves. This will result not only in improved facilities and equipment but also in a better-maintained bus fleet. The following are some major steps that could be taken toward improving the current situation:

1. Research and field visits by properties contemplating changes,
2. Study and use new building operation technology,
3. Do thorough space and functional planning,
4. Obtain a diligent effort from the designer,
5. Analyze future needs and plan for change,
6. Temper decisions based on life-cycle cost input,
7. Provide adequate amount and type of equipment,
8. Develop an ongoing preventive maintenance program,
9. Consult with bus manufacturers on bus maintenance program and equipment needs,
10. Improve communications between properties,
11. Provide an organization such as APTA to coordinate and distribute present information in techni-

- cal studies and design manuals, and
12. Encourage more periodic case studies.

Workshop Report

Peter Wood, Chairman
Henry J. Mercik, Recorder

A broad spectrum of topics related to facility and equipment state of the art and function was discussed in Workshop 4. To focus the discussion, examples of facility design and equipment (existing and desired) were highlighted. The broad background of knowledge brought to the group by the participants was impressive and resulted in a reasonably in-depth exploration of the issues and topics. Specific actions were suggested to assist operators in making decisions about establishing new facilities and defining equipment needs. There was a consensus that there are significant differences in the requirements of large and small transit operations. Attention should be focused on the requirements for both large and small operations.

FACILITIES

The general discussion of facilities was initiated by a description of the new St. Louis Maintenance Facility by Paul Hampton. The major functions of the facility were defined, and the rationale and philosophy of operation were presented and discussed.

The needs of the St. Louis transit property and the needs of other properties were considered to be similar. The rationale used in the decisionmaking process was considered sound and similar to rationales used by other properties. However, facility layout and traffic-flow decisions were different in each case. Considerable time was spent discussing the pros and cons of facility layout and equipment. There was general agreement among the properties on the rationale for layout, but it was recognized that other, equally effective designs were possible.

In the area of facility design, the workshop group agreed on the following:

1. An APTA subcommittee should be formed (Cecil Tammen and Paul Hampton volunteered to serve) to compile and disseminate state-of-the-art information related to facility construction and equipment. This subcommittee should participate in the development of the new Bus Maintenance Facility Planning and Design Study (the request for proposals for this study has been issued by UMTA).
2. A design guide that treats the building functions in modular form should be prepared. It should include the rationale and philosophy for facility decisionmaking, including trade-offs. The guidelines should include modules such as brake repair bay, engine change-out bay, paint booth, fuel island, body shop, parking, and upholstery shop.
3. The main problem in this area is the dissemination of the information developed by various transit properties.
4. A series of seminars should be conducted for the purpose of exchanging information on facility design and maintenance. These seminars could be set up by region. The format could be a case study involving the design of a facility, including the

physical plant layout and the fixed equipment requirements.

5. There does not appear to be any need for a significant R&D program in this area.

EQUIPMENT

State-of-the-Art Practice

Equipment is commercially available to perform most of the tasks and measurements that are required for bus servicing, inspection, maintenance, and repair. These include engine, chassis, and transmission dynamometers; brake-testing equipment; special-purpose gauges for measuring pressure drops; and so forth. Spectrochemical oil analysis is being used to determine the presence of conditions that could result in equipment failure and to identify the cause of that condition.

Equipment for automatic inspection and diagnosis of bus conditions is currently being demonstrated in New York City. Inspection and diagnosis are performed both at the service island and in the maintenance area. The successful completion of this program is considered important and beneficial to the industry.

A number of special-purpose tools and test and measurement devices have been developed at individual transit systems to meet specific needs. Frequently, the problem addressed exists in many transit systems but knowledge of the technique or equipment being used is limited to the system that performed the development.

Selection of the equipment to be used is very much dependent on individual system preferences. Systems that use dynamometers generally consider them to be indispensable; by testing a complete package (engine, transmission, and cooling) prior to installation in the vehicle, it is possible not only to test the capability of the complete system to meet the desired specification but also to correct minor operational problems such as oil leaks. In contrast, many transit systems do not consider that dynamometers are required. Because of the number of other variables involved, until now it has not been possible to determine any differences in maintenance performance resulting from the use of, or the decision not to use, dynamometers for test purposes.

Problem Areas

The area in the transit maintenance and servicing cycle that has most impact on maintenance costs is inspection. This is not to imply that inspection itself is a major cost item but that the quality of inspection has a major impact on total maintenance

cost. In this connection, the development of economical, reliable inspection and diagnostic equipment is considered to be the major R&D priority. However, because of the development time involved, the impact of such a system is likely to be long term.

A more immediate need is a method to determine the structural integrity of a bus chassis. Failures are beginning to appear in buses manufactured approximately six years ago, and a method of testing frames to determine structural integrity would be a major aid in preventing in-service structural failures.

Current tire inspection procedures are considered to be burdensome and subjective. A need for automatic tire inspection equipment was identified.

As in other areas, dissemination of information on techniques that have been used successfully to overcome problems has been a barrier to more effective maintenance for many transit systems.

The conclusions of the workshop discussion were as follows:

1. The R&D program that will have the most significant impact on service and maintenance costs is the development of a satisfactory method of automatic inspection and diagnostic testing. It was the consensus of the group that UMTA should give this program the highest priority and that its extension to other properties should be expedited.

2. It was also felt that bus manufacturers should consider and implement changes in vehicle design that would facilitate future retrofit of sensors needed in the use of automatic inspection and diagnostic equipment.

3. It was the consensus of the group that UMTA should immediately initiate an R&D study on methods for determining the structural integrity of bus frames by using techniques such as X-ray, ultrasonics, and magnetic detection techniques.

4. It was suggested that APTA initiate an incentive program (similar to the bus rodeo) to encourage maintenance staff to submit the results of their work in developing improved tools, techniques, and equipment for reducing bus maintenance costs. This would facilitate widespread dissemination of the information.

5. The need for an automatic tire inflation testing device was discussed and considered to be of high priority.

6. A minority of workshop participants felt that the advanced approach of X-ray technology and automatic diagnostics is premature and that emphasis should be placed on tools and fixtures to facilitate repair once a problem has been identified.