Applying Engineering Society Standards in Transit

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Standardization is currently enjoying an unparalleled renaissance in the transit industry. The Institute of Electrical and Electronics Engineers, the Institute of Transportation Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the Society of Automotive Engineers are all actively drafting transit standards. Standardization activities are under way for all transit modes, including bus, rapid rail, light rail, commuter rail, and automated people movers.

A key role in this renaissance has been played by Transit Cooperative Research Program Project G-4, Developing Standards for System and Subsystem Interfaces in Electric Rail Passenger Vehicles, which was initiated in January 1996. The objectives of this project have been to design a process that can be used to develop consensus standards for system and subsystem interfaces for light rail, heavy rail, and commuter rail vehicles, and to use that process to produce one or more standards. The project has promoted the formation of rail transit standards committees within both IEEE and ASME, and has been one factor behind current interest in applying the consensus standards process to the bus industry.

Background

Historically, the transit industry in the United States, with a few notable exceptions, has lacked standardization. Unlike mainline railroads, which require interoperability for freight shipments and have had standards in place since 1867 (*1*), the rail transit industry has been balkanized, with each agency establishing its own requirements. There have been some limited attempts at standardization in other transit modes. Bus and light rail have seen sporadic standardization at the car level. Through its market dominance, General Motors was able to establish its "new look" coaches as a de facto bus standard for 18 years from 1959 to 1977 (*2*). Light rail standardization was accomplished by a group of street railway companies that developed the well-known PCC (Presidents' Conference Committee) car in the late 1920s (*3*). Between 1935 and 1972 more than 5,000 PCC cars were built in North America. With these notable exceptions, however, transit agencies have tended as a matter of policy to prepare their own equipment specifications on a procurement-by-procurement basis. A variety of federally funded standardization efforts undertaken during the 1970s to change this situation bore little fruit (*1*).

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Through market dominance, General Motors' "new look" bus became a de facto standard in the bus industry from 1959 to 1977.

Why Standardize?

Widespread introduction of microprocessors and other modern technologies is transforming both bus and rail transit, providing opportunities to improve performance and reduce costs. On the other hand, implementation of these technologies poses the challenge of maintaining complex new systems and the possibility of increased costs due to customized, one-of-a-kind designs. Thus standards are needed if technology is to lead to cost savings.

Having standards makes it possible to save money that would otherwise be spent to purchase, operate, and maintain equipment; purchase and inventory spare parts; and train personnel. It is estimated that railcar standards being drafted under TCRP Project G-4 can result in cost savings of a third of a billion dollars annually (4). In comparison, total federal operating assistance to the entire transit industry (bus and rail) in fiscal year 1996 was $417 million.[1] Transit currently faces a major cost squeeze, and there is simply no other readily identifiable way to achieve this level of savings.

Transit is small relative to other ground transportation industries. In 1993 the United States purchased 8.5 million passenger cars and 360,000 diesel trucks, compared with only 2,900 transit buses and 320 transit railcars (5). Because of this small volume, transit suppliers seek to sell to a world market, as is evidenced by the recent wave of international mergers. It is essential that any standardization effort keep open the possibility of standardization at the global level, where the larger market size permits greater savings.

Limitations of Prior Efforts

It is possible to learn from past efforts at transit standardization. The bus and light rail standards mentioned earlier were at the level of vehicle design. As long as the same vehicle remained acceptable in the market, those standards worked quite well. However, the existence of the standards created institutional resistance to design changes among both suppliers and operators, and ultimately acted to discourage further innovation.

New Approach to Standardization

In January 1992 the emerging automated people mover (APM) industry embarked on a new approach to standardization (6). Since the early 1970s the APM industry had been supplying fully automated, driverless fixed-guideway transit systems for use in airports, shopping centers, and other activity centers. APMs had also been used as regular transit systems, with notable installations in Vancouver, British Columbia; Lille, France; and Miami, Florida. The industry was concerned about the custom nature of its products and their consequent high cost. Because of the unusual variety and high rate of technical innovation associated with APM products, design standards would not work. Instead, the industry petitioned ASCE to inaugurate a standards committee under the Society's auspices to establish APM safety and performance standards. This completely voluntary, engineering society-sponsored effort led to the release in 1996 of the first comprehensive performance standards governing a transit mode in the United States.

In 1995 it was decided by the TCRP Oversight and Project Selection (TOPS) Committee to apply a similar consensus approach to the development of

[1] Fiscal year 1996 obligations for operating assistance under the Urbanized Area Formula Program as reported by the Federal Transit Administration.

James C. Hogan, National Capital Trolley Museum

PCC (Presidents' Conference Committee) cars, developed in the late 1920s, were an early success in light rail standardization.

Automated people movers, such as this one in Miami, Florida, represent the first effort of the U.S. transit industry to apply engineering society standards on a large scale.

standards for rail transit. The rail transit vehicle is a mature platform, having established interfaces with major subsystem elements such as the track and the signaling and power distribution systems. Interface standards are needed to permit interoperability among the equipment of the various subsystem suppliers, and to prevent technological advances from undoing the de facto interface standardization accomplished to date. It was therefore decided that rail transit should use the voluntary consensus process employed by the APM group, but applied to interface rather than performance standards. A performance standard specifies the capability of the vehicle, such as its speed, reliability, and safety features. An interface standard makes it possible to "plug and play"—to interchange subsystems made by different suppliers. It would be a mistake to force the distinction. If plug and play is to work, there must be certain performance similarities, but these tend to be limited to the interface.

Under TCRP Project G-4, interface standards were developed through IEEE. Meanwhile, the U.S. Department of Transportation's Joint Program Office for Intelligent Transportation Systems awarded a contract to the Institute of Transportation Engineers for the development of communications interface profiles for the transit industry. The project is building on work by SAE on developing communications standards for trucks and buses. With the recent decision by ASME to form a rail standards group, there are now at least five engineering societies active in formulating transit standards.

Key Legislation

The National Technology Transfer and Enhancement Act (P.L. 104-113), signed into law in March 1996, greatly enhanced the importance of consensus standards within the legal and regulatory structure of the United States. The new legislation states that "...all Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities." In addition, federal agencies are required to consult with and, if possible, participate with voluntary, private-sector consensus standards organizations in developing technical standards.

The act gives the force of law to previous Office of Management and Budget (OMB) directives encouraging government agencies to adopt private, voluntary standards and participate in their development. OMB Circular A-119, *Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities,* has been revised to reflect the provisions of the act. Circular A-119 requires agencies to use existing voluntary consensus standards in their regulatory activities unless those standards are inconsistent with applicable law or otherwise impractical. A key provision of Circular A-119 is that "a voluntary consensus standards body observes principles such as openness, balance of interest and due process" and operates by consensus.

To obtain the benefits of the new legislation and meet its definition of a "voluntary consensus standards body," those developing standards must adhere to a number of principles enumerated in Circular A-119:

◆ **Openness**—Everyone with a legitimate interest must have a chance to participate in the standards process. Meetings must be open and the results of all deliberations made publicly available.

◆ **Balance of interests**—The group voting on the standards must represent a balance of interests; there must be no domination by any one group or company.

◆ **Due process**—Publicly available procedures must be followed, including formal procedures for appeal of decisions.

◆ **Consensus**—Consensus implies more than majority rule, but not unanimity. Within IEEE, for example, 75 percent of those not abstaining must approve the standards.

Unique Advantages of Engineering Societies

It is no accident that engineering societies are being used as the vehicle for many current transit standards efforts. Engineering societies offer a number of important advantages for those interested in developing consensus standards.

American National Standards Institute (ANSI) Accreditation

A key advantage accrues to engineering societies that are accredited members of ANSI, the central U.S. body responsible for voluntary standards activities. ANSI accreditation ensures that the principles of openness, balance of interests, and due process will be followed in standards development, and that a consensus among those directly and materially affected by the standards will be achieved. ANSI accreditation thus means that the standards developed will be considered voluntary consensus standards under OMB Circular A-119, so that federal agencies will be required under the National Technology Transfer and Enhancement Act to use those standards in their regulatory activities. Any industry attempting self-regulation would be well advised to make use of an ANSI-accredited process to ensure that the significant investment involved will result in consensus standards that are recognized as such by federal regulatory agencies.

Global Reach

Another advantage of ANSI accreditation stems from the Institute's role as the U.S. member of international standards organizations such as the International Organization for Standardization, the International Electrotechnical Commission, and the Pacific Area Standards Congress. Development of standards under ANSI becomes especially important if future adoption by any of these international standards groups is considered possible. Of course any group can apply for ANSI accreditation, but making use of an already accredited engineering society is faster, simpler, and less expensive than starting from scratch.

In-Place Procedures and Expertise

Among the advantages of using ANSI-accredited engineering societies for standards activities are their well-established procedures. These societies have in place operating procedures, bylaws, balloting procedures, and appeal mechanisms. They also have experienced professional staff who can answer questions and help familiarize the volunteers developing the standards with these procedures.

Legal Stature

Standards, unlike technical papers and reports, are quasi-legal documents. In courts of law, standards are used as evidence to substantiate or refute points. They also become legal documents as they are adopted by various governments and regulatory agencies. When this happens, the decisions embodied in a standard carry more weight, and the process by which the standard was developed falls under more intense scrutiny. Because engineering society standards have been widely employed in building codes for many years, there is a large body of case law governing their use. Given that the requirements of the National Technology Transfer and Enhancement Act with regard to citing standards in federal regulations have been in effect for just a few years, the availability of this extensive body of court precedent is reassuring.

Liability Concerns

If an industry operates under an accredited engineering society and follows that society's rules and procedures, all professionals involved in standards development will usually be covered by an "umbrella of indemnification." This means they are legally protected for actions taken in creating the standards, and that if their personal actions are called into question, the engineering society will defend them in court.

This engineering society protection is in addition to the significant new legal protection offered standards volunteers under the recently passed Volunteer Protection Act of 1997. This new law exempts volunteers of nonprofit corporations (such as engineering societies) from civil liability for harm caused by an act or omission on behalf of the organization. To obtain this exemption, the volunteer must have been acting within the scope of his or her responsibilities and must have been properly licensed or otherwise authorized to perform the activity. In addition, the harm must not have been caused by willful or criminal misconduct, gross negligence, reckless misconduct, or a conscious and flagrant indifference to the rights or safety of the individual harmed. This new law provides significant added protection to professionals involved in standards activities.

"Real" Standards

All of the above advantages can be summarized by saying that standards developed by an ANSI-accredited engineering society are "real." They are developed by consensus among those with a material interest, can be adopted worldwide, and have legal standing, and as a result they will be used. No one writing transit specifications is likely to assume the legal risk of ignoring an approved engineering society standard, because errors and omissions insurance requires the use of accepted engineering practices.

Status of Rail Transit Standardization

Recognizing the many advantages of accredited engineering societies, a Rail Transit Vehicle Interface Standards Committee was created under the Land Transportation Division of IEEE's Vehicular Technology Society. The 50-member committee held its first meeting in May 1996. At that meeting, the committee identified key areas for standardization and formed the following eight working groups to begin drafting IEEE standards:

- Communications Protocol Aboard Trains
- Communications Based Train Control
- Propulsion, Friction Brake and Train Master Control
- Vehicle Auxiliary Power Systems
- Vehicle Passenger Information Standards
- Environmental Standards for Electronic Equipment
- Monitoring and Diagnostic Systems
- Safety Standards for Software

Three additional working groups have since been formed:

- Transit Communications Interface Profiles for Rail Transit Systems
- Rail Transit Battery Standards
- Motor Control Standards

Together the 11 working groups comprise more than 250 participants and have held more than 80 working meetings to draft standards. Four standards have been successfully balloted: IEEE 1477, Standard for Passenger Information System for Rail Transit Vehicles; IEEE 1475, Standard for the Functioning of and Interfaces Among Propulsion, Friction Brake, and Train-borne Master Control on Rail Rapid Transit Vehicles; IEEE 1473, Standard for Communications Protocol Aboard Trains; and IEEE P1482.1, Standard for Rail Transit Vehicle Event Recorder. Several other standards will complete the process in the near future.

Participation in IEEE committees is voluntary, and either the members or their companies donate the time spent in attending meetings and working on the standards. The result is an outstanding example of public–private cooperation. It is estimated that private money spent by suppliers, transit agencies, and others on committee work leverages every public dollar spent by TCRP Project G-4 to produce a total of $8 of research and development effort (see Figure 1). This arrangement not only effectively leverages limited federal research and development funds, but also provides a reality check on the standards effort: if the effort ceases to be perceived as cost-effective, private-sector support can be expected to be withdrawn.

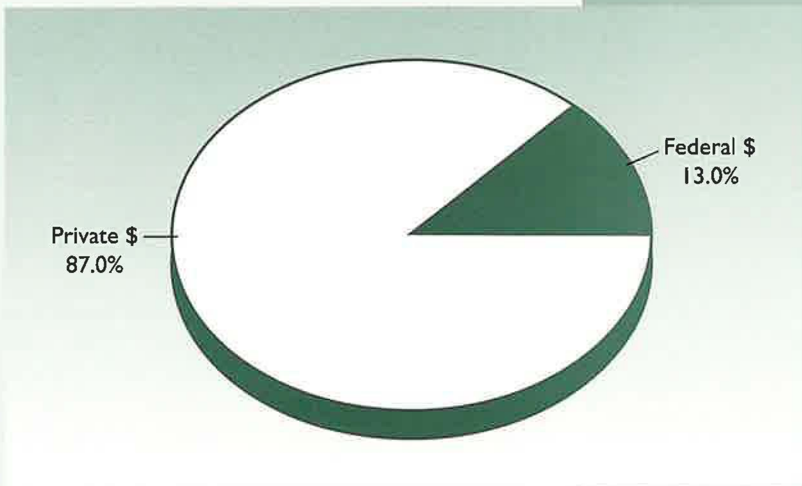

FIGURE 1 Transit Cooperative Research Program Project G-4, Developing Standards for System and Subsystem Interfaces in Electric Rail Passenger Vehicles, leverages federal funds for research and development.

New Directions

Although many of the areas in which rail standards are urgently needed are electrical, others, including braking and crashworthiness, are mechanical and therefore beyond the purview of an IEEE committee. Since its inception, the Rail Transit Vehicle Interface Standards Committee has been maintaining a

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Standardization efforts are being undertaken for all transit modes, including bus, rail, light rail, commuter rail, and automated people movers.

dialogue with ASME to encourage the creation of a parallel committee for mechanical rail standards. In April 1998 the ASME Council on Codes and Standards approved the charter for such a committee. That committee's first job will be to develop rational crashworthiness standards for light rail vehicles, reducing to practice the results of TCRP Synthesis 25, *Light Rail Vehicle Compression Requirements* (7).

Conclusion

Standardization is happening in all transit modes, including bus, rail, light rail, commuter rail, and APMs. These efforts are taking place because standards rationalize the procurement process and are one of the few areas in which major cost savings are readily achievable in transit today. ANSI-accredited engineering societies provide the logical vehicle for transit standards and are being used increasingly as the industry becomes more comfortable with this approach. As a forum for American standards is established, the U.S. transit industry will be able to speak with one voice as a full partner in worldwide standardization efforts. TCRP Project G-4 has played a pivotal role in these efforts, leveraging a small amount of federal research and development funds to help foster a major new cost savings initiative.

References

1. McGean, T. J., D. B. Eldredge, and W. Frost. *Benefits of Railcar Standardization*. UMTA-IT-06-0229-82-2, February 1982.
2. From RTX to the RTS and Points Between. *Metro Magazine*, July/August 1985.
3. Mora, J., and J. Silien. North American Light Rail Vehicles. *Special Report 161: Light Rail Transit*, TRB, National Research Council, Washington, D.C., 1975, pp. 93–98.
4. McGean, T. J. Progress Developing Standards for System and Subsystem Interfaces in Rail Passenger Vehicles. *Proceedings of the 1997 IEEE/ASME Joint Railroad Conference*, IEEE Catalog Number 97CH36047, March 18–20, 1997, Table II.
5. *Facts & Figures 1994*. American Automobile Manufacturers Association, Detroit, Mich., 1994; *APTA 1997 Transit Fact Book*. American Public Transit Association, Washington, D.C., February 1997, Table 52.
6. McGean, T. J. Standardization of Automated People Movers in America. *Automated People Movers III, Future Prospects for APMs, Proceedings of the Third International Conference*, Japan Society of Civil Engineers, Tokyo, Japan, 1991.
7. Lewalski, J. *Light Rail Vehicle Compression Requirements: A Synthesis of Transit Practice*. Transit Cooperative Research Program, TRB, National Research Council, Washington, D.C., 1997.