

Internationalization of Safety and Transportation Control



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A high level of safety and reliability have been demanded for railway systems in Japan, and currently, such demand is being met to a certain degree. This is attributed to adequate functioning of the signal system, which secures safety, and the transport management system, which controls smooth operations. Meanwhile, development is continuing toward a higher level of safety and functionalities with technologies that progress day by day. These new technologies and systems use general-purpose technologies such as IT and radio transmission that had not been used in conventional railway systems, and therefore, further thorough and adequate considerations are necessary to ascertain their safety and reliability. Also, there has been an increasing number of discussions about international standardization of new technologies and systems in the field of railways, and the situation has been changing in such a way that awareness of overseas systems must be raised within the network of the Japanese domestic railway system. This is another example of the environmental changes in the field that had not been observed before. Thus, establishment of a method of assessing safety and reliability for new technologies and new systems, and conformity to the corresponding international standards will become important keywords when planning future railway systems.

The signal system is important for ensuring railway safety, and needless to say, its greatest task is to secure fail-safe capabilities, and now, a system that uses software to realize the fail-safe logic or a system that secures fail-safe capabilities through digitalization is being created, in addition to conventional systems that use relays which are essentially the fail-safe elements. Practical use of these newly created systems will enhance functionality and safety in general, but Japan does not have any unified method for evaluating such new technologies and systems. Therefore, railway operators or committees including third parties conduct running tests, FMEA, or FTA to assess these systems. These systems are then used if they are evaluated as being able to secure the same level of safety as currently used systems do.

With "digitalization" as a keyword, the digital ATC is a new signal system that has been attracting a lot of attention in recent years. This system uses track circuits to send digital signals containing information on the location of a preceding train from the grade-level so that optimal brake control can be made by the vehicle while taking track conditions into consideration. Since this is a digital system, it can send a large volume of information at high speed. Also, since this is an onboard vehicle brake control system, it can not only improve safety but is also expected to enhance riding comfort. This system was first used in 2002 by JR East on the Tohoku Shinkansen line (between Morioka and Hachinohe), and then it was also put into

Profile:

- 1955 Born in Tokyo
- 1978 Graduated from the Department of Electronics Engineering, Faculty of Engineering, University of Tokyo
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service on the Keihin Tohoku line, Kyushu Shinkansen line (by JR Kyushu), and the Tsukuba Express of the Metropolitan Intercity Railway Company. As seen from the above, although this system is being more and more widely used, its safety and reliability evaluation was conducted by railway operators, and as the system continues to be implemented even more widely, it is desirable that the evaluation be conducted by using unified indices.

Now, with "radio transmission technology" as a keyword, there are IMTS and ATACS.



Fig.1: IMTS running at the Expo 2005 Aichi Japan site.

IMTS stands for Intelligent Multi-mode Transit System, which is an automated bus system developed by Toyota. This system uses radio transmission to run buses in a road-train fashion. The vehicle uses an onboard magnetic sensor to read magnetic nails laid in the ground, and the onboard computer automatically operates the bus and controls steering. Radio transmission communication between the vehicles controls the distance between two buses or issues a halt command in case of emergency. It commenced service in March 2005 at the Expo site to transport visitors, as a magnetic induction trackless system in accordance with the Railway Business Law.

Meanwhile, ATACS (Advanced Train Administration and Communication System), developed by JR East, transmits location information detected onboard to the system control device via radio transmission, uses radio transmission to inform the vehicle of the closest allowed stop position in relation to the preceding train, and creates onboard a speed check pattern for brake control. Therefore, radio transmission serves as an important

means of transmitting information, and its safety and reliability have been checked by a committee through running tests and were evaluated as being sufficient for practical use.

Since these systems use radio transmission, a technology conventionally believed unsuitable for use in train control, sufficient checking has been done in terms of securing fail-safe capabilities and reliability. However, these systems are still evaluated separately, and establishment of a unified method of examination or evaluation guidelines will therefore become an important theme in the future.

For railway operators, a transport management system is not only an important system for smooth railway business operations, but also essential for realizing convenience and comfort for users. Note that transport management systems had been developed separately from signaling safety systems since they were not directly related to safety; however, due to the establishment of networks with optical cables and wider use of high-speed digital circuits, transport management systems are now becoming an integrated system that not only handles transport management and plans, but also handles maintenance work, operation adjustment, and vehicle and crew operations. COSMOS (Computerized Safety Maintenance and Operation Systems of Shinkansen), put into practical use by JR East, and the Autonomous decentralized Transport Operation control System (ATOS) are a few examples of such transit control systems, and in the future, more efficient and more networked system development is expected for the improvement of maintenance work management safety and enhancement of operation adjustment functions. In this case, networks will become more advanced, the volume of data communication will increase, and communication speed will also increase; therefore, functionality will increase. At the same time, however, it is important to check if such high functionality is useful for railway operators or users. This is especially the case when operation adjustments are necessary due to a disrupted train schedule. To make the system useful for both the railway operator and the users, an appropriate evaluation function is necessary because an adjusted train schedule that is convenient for train operations by railway operators may not necessarily be one that causes little or no inconvenience for users. Therefore, when deciding which train schedule is the most appropriate, it is necessary to determine whether or not its evaluation function is appropriate. In the case of the transport management system, it is important to improve functionality and network with the signaling safety system and maintenance work management more

efficiently. So, it is desirable that a method of evaluating the resulting improvement, effectiveness, and advantages generated for the users be examined.

It should also be noted that the field of transport management will become closely related to international standards in the future, and it is necessary to keep that in mind when developing systems.

Since Japanese railway systems and international standards conventionally had been domestically closed technologies and systems, knowledge of these standards was required when exporting railway-related parts or systems, or when importing foreign products, but in general, railway operators did not seem particularly interested in them. However, due to the Agreement on TBT (Technical Barriers to Trade) issued by the WTO (World Trade Organization) in 1995 and the Agreement on Government Procurement, demand for compliance with the international standards such as the IEC (International Electrotechnical Commission) has increased. As a result, when discussions began about the possibility of incorporating the IEC into the JIS, domestic railway operators could no longer maintain indifferent to the international standards for railway technologies. It is possible that foreign manufacturers may sue for compensation if new domestic railway-related technologies or systems do not conform to the international standards, or purchase of foreign products or systems meeting the international standards may be requested. This may in turn suppress Japan's unique technological development. For this reason, in the future, it will be necessary to make domestically developed technologies or systems conform to the international standards, or have these technologies or systems become the international standards.

Signal systems and transport management systems are not exceptions either. For a signal system, the signal system safety standards have been proposed as IEC 62425 (deliberation on ballot drafts started in 2005), and a method of evaluating the signal system in accordance with the concept of RAMS (Reliability, Availability, Maintainability, and Safety) has been proposed. This proposal recommends that the basic rules for safety be described and that safety plans in accordance with lifecycle be created and tested, instead of describing the method of evaluating safety conventionally used by Japanese railway operators (qualitative evaluation in which items are evaluated by referring to conventional railway systems). Also, quantitative evaluations

(such as SIL, Safety Integrity Level) are demanded in terms of safety and reliability. If the above mentioned standards are adopted as international standards, then the safety evaluation method used by Japanese railway operators will be considered "local rule;" therefore, even if the railway operators claim that their new technologies or new systems are safe, their technologies and systems will be considered not in accordance with the standards, and they thus may receive requests to modify these new technologies or systems to conform to the international standards. Thus, in the future, it will also be important to develop new technologies or systems while making decisions whether or not the technologies or systems conform to the international standards. At the same time, when new technologies or systems are invented but have never been introduced to the world, it may be necessary depending on the situation to propose and establish them as international standards.

As for transport management systems, the UGTMS (Urban Guided Transport Management and Command Control) standard has been created as IEC 62290. This standard tries to standardize functions and system establishment for railway transportation commands, operation control, management, and train operations of manual and automated train operations. This is thus truly a standard for comprehensive transportation management. Therefore, in the future it will be important for Japanese railway operators to check that the transport management systems they are developing meet this standard, and at the same time, to establish a new standard.

As seen from the above, signal management and transport management in the field of Japanese railway systems are developing towards higher functionality and safety along with technological progress, and evaluation of their safety and functionality is important. Establishment of an evaluation method that is suitable for new systems and technologies is being demanded, and furthermore, in the future, it will be necessary to check if these technologies and systems conform to international standards. I hope that signal systems and transport management systems supported by Japanese advanced technologies not only simply conform to international standards, but also become recognized as international standards in the future. This, I believe, will lead to continuation and development of safety and reliability of Japanese railway systems in this age of globalization.