An Assessment of the Business Case for Communications-Based Train Control

Background

The Federal Transit Administration (FTA) has an ongoing research program to promote the research and development of new technologies that will improve the safety and efficiency of rail transit system operation in the United States. Communications-Based Train Control (CBTC) is the latest evolution in train control technology and is becoming widely accepted as a *de facto* standard for both "new start" mass transit projects, as well as older transit properties that need to upgrade their earlier generations of signaling/train control systems. The implementation of CBTC on an existing operating transit line does, however, present a number of significant challenges. As such, FTA recognized the value in documenting the experiences of those transit properties in North America that have already addressed these challenges to realize the benefits offered by CBTC.

This study examines the retrofit of CBTC on two North American transit properties, namely, New York City Transit (NYCT) and the Southeastern Pennsylvania Transportation Authority (SEPTA).

Objectives

To achieve a comprehensive evaluation of CBTC technology, several objectives were established, including identifying the main benefit drivers for CBTC; assessing enabling technologies; evaluating the specific CBTC functional, performance, and safety requirements against industry standards; identifying implementation challenges and lessons learned; determining the ability of CBTC to supplant the functionality (operational, safety, etc.) provided by track circuits in conventional rail signaling systems; and providing a qualitative analysis of the capital costs associated with CBTC implementation.

Findings and Conclusions

CBTC offers benefits that cannot be achieved with prior generations of signaling technology, but there significant challenges and potential risk, schedule, and cost consequences in upgrading existing signaling/train control systems.

The study reaches two major conclusions. First, the study validates broader industry experience that CBTC offers benefits that cannot be achieved with prior generations of signaling technology. Second, the study highlights that the challenges in upgrading the signaling/train control systems on an existing high-capacity mass transit system should not be underestimated, and any shortcomings in project planning and execution can have significant risk, schedule, and cost consequences. To this end, the study recommends that an increased emphasis on a systems engineering process be adopted throughout the life-cycle of a CBTC upgrade project. Other findings include the following:

- Enhanced safety was the major driver for implementing CBTC for both NYCT and SEPTA. Improved state-of-good-repair and improved service delivery, including an increased grade of automation, were also major factors in NYCT's decision to adopt CBTC. However, NYCT did not consider the potential additional benefits of driver-less or unattended train operations.
- The enabling technologies used in CBTC systems evolved from designs, equipment, and devices that had been employed in conventional signaling installations for many years. What distinguishes these technologies from prior installations is the way they are applied to achieve the unique functional requirements of CBTC. As such these enabling technologies do not represent a fundamental technology risk to successful CBTC project implementation.
- With respect to the use of secondary detection/protection equipment with CBTC installations, the research team concluded that in the absence of an operational requirement to support "mixed-mode" operations, or other operational or failure management requirements, there is no mandatory, overarching requirement to include a secondary train control system with CBTC.
- Both case studies highlighted that the capital costs associated with CBTC implementation include many site-specific factors, as well as the core costs of designing, supplying, installing, testing, and commissioning of the CBTC specific equipment. As such, the CBTC business case that is applicable in one application is unlikely to similarly apply to another application.
- The case studies of the PTC systems demonstrate the similarities in technical issues and implementation challenges between PTC and CBTC projects, including the need to adopt a structured systems engineering approach.

Benefits

The data generated from this research study will provide transit operators and local officials contemplating an upgrade program to the signaling and train control installations with a better understanding of all aspects of CBTC technology, including applicable standards, design issues, procurement methodologies, implementation challenges, safety certification, migration strategies, and project management approaches. In addition, the final report provides a set of best practices that are useful for the planning and successful implementation of CBTC projects. It is believed that transit operators will use the information, findings, and recommendations presented in this report as a useful tool to assist in the planning and management of CBTC projects. It is also believed that FTA can use the results of this research study to establish a benchmark for evaluating funding requests and performing oversight on CBTC projects.

Project Information

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