

# Changing Trains: How to Meet the New System Design Challenges of the Mass Transportation Industry

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## Table of Contents

Executive Summary .....	1
Changing Drivers.....	1
Changing Regulations .....	1
Changing Design Approach .....	2
Changing Technology .....	2
Conclusion .....	2

## Executive Summary

The mass public transportation industry is undergoing tremendous change. The global recession, converging safety regulations, new business models, and new technologies are all influencing the way train and tram systems are being developed—with significant consequences for transportation companies. As governments push to reduce the use of cars, mass transport has never been more important around the world.

The transportation industry is facing the same pressure that the aerospace, telecommunications, and industrial markets faced over the past 10 years. While some of the solutions are the same, there are also key differences. This paper reviews the unique nature of the changing transportation landscape—and how commercial off-the-shelf (COTS) solutions and the right support and toolsets can help transportation players meet today's challenges to decrease costs and risk while meeting stringent regulations and improving system quality.

## Changing Drivers

The global recession is straining the finances of transportation system makers and their customers, the operators. Large contracts spanning many years also play a role in vital projects for local and national infrastructure development. There are extensive penalties if these projects overrun, and there is increasing cost and time pressure within the existing contracts. Developers can no longer take numerous years to bring a system to market, and they no longer have flexible budgets.

New train and tram developments involve increasingly more electronics, including automatic train-protection systems and train operations, driver and passenger information systems, and new emerging video and Internet data services for passengers. These are usually not key areas of expertise for the train maker.

The move to lower costs and shorter project time frames is driving system developers to use COTS equipment for hardware and software, rather than developing these technologies in-house. While these COTS technologies can bring lower costs and speedier development, they also have to meet the transportation market's specific needs for reliability and long-term support over the equipments' 20- to 30-year lifespan, as well as difficult-to-achieve safety-regulation compliance.

These factors are all coming together to create a new ecosystem of subsystem hardware and software suppliers with different approaches; and while there are many hardware COTS suppliers, there are fewer that concentrate specifically on software. This leaves large gaps, particularly regarding the certification of software and support for safety-critical systems.

## Changing Regulations

Safety is paramount in any mass transportation system, from local trams to high-speed cross-country trains. The standards governing safety systems have evolved over time and are starting to reflect the appropriate architectural concepts and model-based designs of markets such as aerospace. These standards are increasingly used to achieve better certifiability of systems and more effective product life cycle management.

This new set of standards in the transportation industry presents opportunities for equipment makers to use the same technologies in many global markets, bringing economies of scale and lower costs. However, the move also means that existing projects or projects under development may have to be modified to meet fast-changing regulatory requirements.

The increasing use of electronics and software means an increasing number of systems are exposed to safety require-

ments, and frequently these systems can only get implemented by reducing the cost of redundancy elements in the designs. To compensate for the increased cost of implementing a larger number of functions and applications, applications and subsystems are increasingly integrated and consolidated. Now a single unit handles multiple tasks separated in time and space through software separation concepts to reduce system costs. There is a trend toward both time and space separation: Separate blocks of software keep the actions separate and enable the independence of partitions running different levels of critical software. This allows more complex features and functions without dramatically increasing costs but also requires more emphasis on safety standards during the development process.

Regulatory bodies and insurance companies increasingly demand that operators have the latest safety systems installed to protect against large-scale accidents; this has a significant impact on development.

The CENELEC EN50128 standard defines software partitioning and the use of software COTS technology. This is converging with the IEC 61508 standard that defines the development process for safety-critical systems. In evolving markets such as Asia, many equipment makers are using the European safety standards so they can use off-the-shelf equipment. The Chinese government has mandated the introduction of the CENELEC EN standard series, requiring equipment makers to acquire this expertise from third-party suppliers.

### Changing Design Approach

The move to COTS, model-based designs, methodology-driven designs, and converged regulations does have a significant impact on the development process. Engineers need to focus increasingly more on implementing added value and encapsulating their expertise as intellectual property in the system rather than developing software such as schedulers, real-time operating systems, and often their own toolchains.

The majority of the effort is not necessarily in the software development but in the verification and validation of software required to demonstrate that the software conforms to the standards. As an alternative, commercial certifiable software can provide these certification artifacts and tools—dramatically speeding up the development process. This allows the engineer to integrate software effectively and easily into the design, eliminating the need to design around a complete solution from a third-party supplier.

This approach allows the equipment maker to quickly differentiate its design from the competition and provide more features and added value to the operator. Designers are also making more use of open source software such as

Linux in order to reduce costs. This is frequently done throughout the entire software life cycle. It can take many weeks of development time to get open source software up and running without support, and lack of long-term maintenance, longevity support, and obsolescence management can be a major problem with product life cycle requirements of the transport industry. However, COTS suppliers such as Wind River can supply supported versions of open source software such as Linux on particular platforms that prevent these problems.

### Changing Technology

New technologies are also changing the way the safety regulations can be implemented. Multicore processors can provide separation by running safety-critical routines on one dedicated core with certified software, while new features such as networking and user interfaces can be run on other processors without influencing the safety-critical elements of the system. This allows developers to use commercial or open source software and add new features—including localization for new markets—much more easily and quickly without having to recertify large parts of the system.

Key enablers for these architectural concepts are separation or virtualization technologies providing both space and time separation. This allows different operating systems to be added, but more importantly it provides safety and security to systems that need to be secure from attacks—which are a risk of increased connectivity. These software separation technologies can provide significantly higher safety and security by creating small, highly safe and secure partitions that protect access to the rest of the system and make the system less vulnerable.

### Conclusion

The mass transportation industry is going through a dramatic upheaval during one of the worst global recessions in recent history. Moving to COTS technologies provides vital advantages in terms of costs and development times, but there are still challenges in managing system complexity and maintaining conformance to safety and security standards.

Wind River is a key middleware partner in the evolving ecosystem of third-party embedded operating systems development and life cycle management tools, tackling these challenges with certifiable versions of software. Wind River provides the tools for equipment manufacturers to get the best out of their design teams and provide operators with new features in a shorter time frame with minimum risk.

For more information about comprehensive Wind River solutions for the transportation industry, visit <http://windriver.com/solutions/industrial/transportation.html>.

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