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by

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Summary

Software is increasingly being embedded in technical and organizational systems and is progressively taking on safety-critical tasks. At the same time, the (European) railway industry is under great pressure to innovate, partly because of the (still) increasing international competition, and requires the consideration of optimization potential also in the area of software development.

This study takes up this question and describes current trends and challenges that software development in the railway sector will have to face in the coming years. It addresses future product structures, standards, methods and processes as well as training issues. Based on an analysis of the trends in the neighbouring domains automotive, avionics, telecommunication and industrial automation, proposals for the railway sector are developed. These are substantiated by two examples: The integration of RBC and STW, as well as the integration OBU and TCMS. The results can be summarized as follows:

Product structures: The digitisation of rail-bound transport will continue to increase. Rail technology can benefit from many developments in other areas, which should be carefully monitored. Accordingly, the use of commercial and freely available standard components in the rail industry will continue to increase. This applies to both software and hardware. Railway-specific communication standards (e.g. GSM-R) will play a lesser role, the trend is "all-IP".

The computational power and networking capabilities of control units and other information processing systems will also increase. In the future, essential functionalities will mainly be provided by software components. New, more flexible architectures will make it easier to distribute software components to hardware according to system requirements. This can lead to a reduction in the number of ECUs; however, the trend towards more and more system functions is counteracting this.

When designing components and systems, both the long-term evolution capability and the ability to update hardware and software at short notice must be given even greater consideration. There are essentially three reasons for this:

- new requirements,
- dealing with obsolescence, and
- security gaps in IT systems.

The processes for quality assurance and approval must therefore provide even better support for the rapid updating of components.

Standards: The splitting of security standards for software development according to the various application domains cannot always be justified in terms of content. It should be examined whether certifications from other specialist domains can increasingly be considered for railway applications. In particular, it is not necessary to have further different standards within the railway domain (e.g. for control and safety technology and vehicle software). The interviews showed that in most cases three (instead of five) safety integrity levels (none, medium, high) would be sufficient.

Important "new" methods and techniques such as IT security, model-based development and agile processes are not adequately represented in EN 50128. Here the "supplement mechanism" of the DO-178C could be used.

Methods and Processes: Model-based development requires a conscious decision for the appropriate modelling language. Even safety-oriented systems can be developed with agile methods, provided the processes are sufficiently granular. Functional security and IT security must be considered together (since

some conflicting requirements must be met). In principle, technologies for IT security in data transmission and data storage are available but are not yet fully established in the railway industry. In most cases, an integrated IT security architecture and associated processes are lacking.

Training: Railway systems are increasingly being transformed into IT products, which is why there is an ever-increasing demand for IT specialists and system engineers. Software security aspects are rarely considered in general engineering studies. According to industry representatives, the lack of knowledge and skills in testing is a serious problem. In the competition for the best brains, the railway industry competes with IT companies; in this competition, the railway industry also has to rely on modern working methods and software technologies.