END-TO-END CRITICAL SOFTWARE ENGINEERING

Capgemini Engineering at the forefront of
software industrialization

Introduction

Railway operators today are required to increase transport capacity, safety, and regularity. At the same time, they also need to renew the existing aging network and rolling stock fleet. Meeting these demands is a huge challenge for the railway industry in light of increased cost pressures, technical competition, and borderless operations.

Digitalization and new technologies are the enablers to make it happen, however, and software is now the key engineering discipline to deliver these changes. Capgemini Engineering is at the forefront of software industrialization across many industries – we utilize new technologies to left shift verification and validation, use our cross-sector experience to bring technologies from other industries to the railways, and lean on our global capability to deliver all this both locally and at best cost.

Digital changes in the rail industry

The rail industry is under enormous pressure to change, with some key drivers accelerating the transformation. These include:

- A growing number of passengers due to increased urbanization

- Higher expectations around comfort and safety

- Increasing competition among operators

- A move towards anything as a service (XaaS) business models

Many drivers are pushing railway operators to replace or modernize their rolling stock, and to build efficient and modern signaling systems. Consequently, operators have to ensure that they can:

- Handle an increase in traffic – higher usage of existing infrastructure and increased safety requirements drives the need for improved signaling equipment. Modernization is key to improve network safety and capacity

- Deliver cost savings through digitalization. This applies to new and advanced systems, as well as autonomous trains

In light of the higher usage of existing infrastructure and signaling equipment, modernization seems to be the key to improve network safety and capacity.

The future is software defined railway signaling

Enhanced requirements are pushing the need for better integration, and a higher degree of automation, data sharing, and multipurpose systems inter-connection. Improved communications are key to achieving these enhanced requirements but so too are new digital tools.

The enhanced requirements are as follows:

- Automatic Train Operation (ATO) delivered over European Train Control System (ETCS) and Communications-Based Train Control (CBTC), or autonomous driving

- Radio-transmitted trackside signaling data, or radio-operated object controllers

- Push for more sustainability

Improved communications:

- Future Railway Mobile Communications Systems (FRMCS) or 5G advanced comms

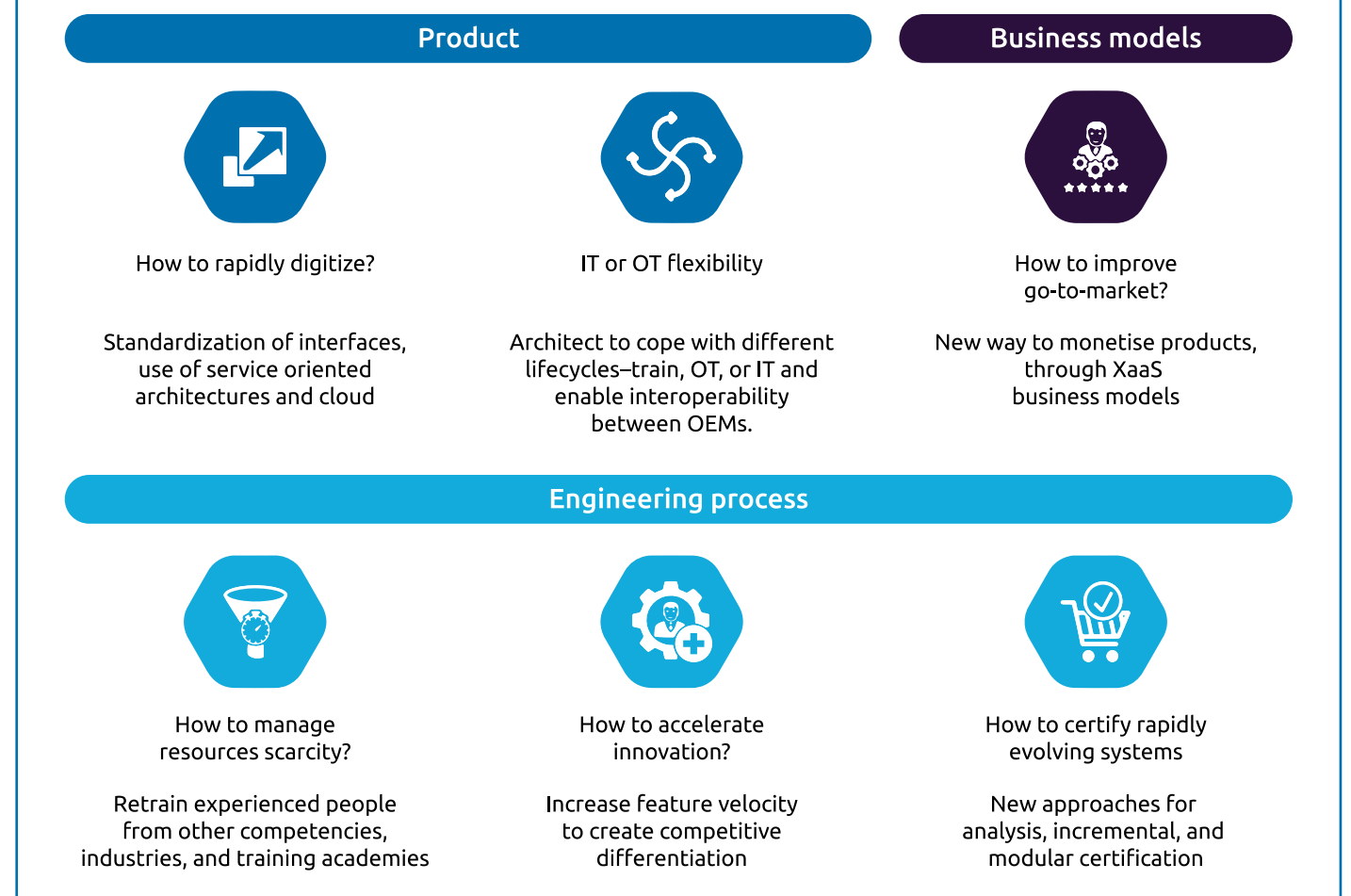- Eulynx interfaces

- IoT connectivity

More digital tools than ever—train signaling systems with (AI), Light Detection and Ranging (LIDAR), video for train location and object detection, infrastructure digitalization, cloud services for architecture for Safety Integrity Level (SIL) 2, 3, and 4 systems – simulators and digital twins to left shift verification and validation

Market challenges

The rapidly increasing importance of software is shifting the paradigm for the rail industry. This requires organizations to transform their current way of doing business.

Key challenges to make the change

Product

How to rapidly digitize?

Standardization of interfaces, use of service oriented architectures and cloud

IT or OT flexibility

Architect to cope with different lifecycles–train, OT, or IT and enable interoperability between OEMs.

Business models

How to improve go-to-market?

New way to monetise products, through XaaS business models

Engineering process

How to manage resources scarcity?

Retrain experienced people from other competencies, industries, and training academies

How to accelerate innovation?

Increase feature velocity to create competitive differentiation

How to certify rapidly evolving systems

New approaches for analysis, incremental, and modular certification

Value propositions

To help our clients realize the digital transformation of railways, we have industrialized software development.

We can standardize the processes, procedures, and tools of software development to ensure adherence to norms and standards for certification, support the rapid mobilization of teams, and increase efficiency.

	To think and design	To build and implement
Railway industry contextualisation	End-to-end, on-board or track-side to signal-box architecture	Electronics to cloud development and integration
Product	Technology and architecture Design for verification Strategy and roadmap	Software-centric system architecture Software application and platform Development and Verification & Validation (V&V) Compliance and certification
Engineering process	Software factory design Strategy and roadmap Advisory services	Processes and tool automation Build and integration Physical and virtual labs Support services

Product – think & design

We help our clients to define and develop systems and software architectures that build upon technology developments from a broad range of sectors to create robust and future proof products.

We believe railway systems will move away from independently operating embedded systems that respond to mechanical changes to highly interconnected digital systems that utilize high-bandwidth comms, service-oriented architectures, and safety-critical cloud infrastructure to reduce trackside infrastructure and enable OEMs to deliver services rather than products.

We provide technology and architecture, strategy roadmap, and advisory services to enable our clients to develop future-proof product architectures that take account of likely future changes to railway systems.

Product – build

Critical software development is difficult. EN 50128, the railway standard for software development, is very rigorous. Demonstrating the highest level of integrity is much more involved than developing software in non-regulated industries. This important and costly software needs to be outsourced carefully and only to businesses with significant experience.

Capgemini Engineering's high-integrity and agile approach combines waterfall and agile to create a process that is perfect for railway critical systems software development. This, combined with automatic test generation, simulators, virtualization, and advanced tooling reduces cost and time-to-market and maintains quality.

We agree to fixed price, and fixed schedule projects, which enable our clients to enjoy surety of delivery, providing:

- Design, build and test services with a warranty

- Support to certification

- Monitoring and maintenance of software systems once they are operational

Process – think and design, build and operate

Software development costs take on an ever larger percentage of the total R&D development costs for systems across all industries.

As systems grow more complex and take on greater responsibility, the costs associated with certification increases exponentially. It requires advanced development techniques that use model-based, lean approaches, and automation to control cost increases.

Capgemini Engineering has been at the vanguard of software development techniques and approaches for many decades and is able to share its experience through a four-step process:

- Operational strategy—assess as-is situation or develop roadmap for improvement

- Design and engineer new methods and tools built on Capgemini Engineering's own methods and tools

- Operate the tools providing first, second, and third-line support

- Accelerate delivery – apply DevOps techniques to rapidly accelerate the development and deployment process

We enable our clients to:

- Modernize their software development approach

- Take advantage of technologies used in other industries

- Take advantage of the latest developments from academia, and tools and techniques applied across a range of industries

We provide:

- Software development process and tooling enhancement services. These include the analysis of inefficiencies in existing processes, the identification of new techniques and tools to increase efficiency, and road mapping to enable you to incrementally develop your approach and roll-out

- DevOps services to build, operate, and enhance DevOps pipelines for high-integrity software

Capgemini Engineering offers railway signaling systems development. It brings together wide railway industry expertise, leading skills in embedded and digital native development, best practice, and transformative operation models.
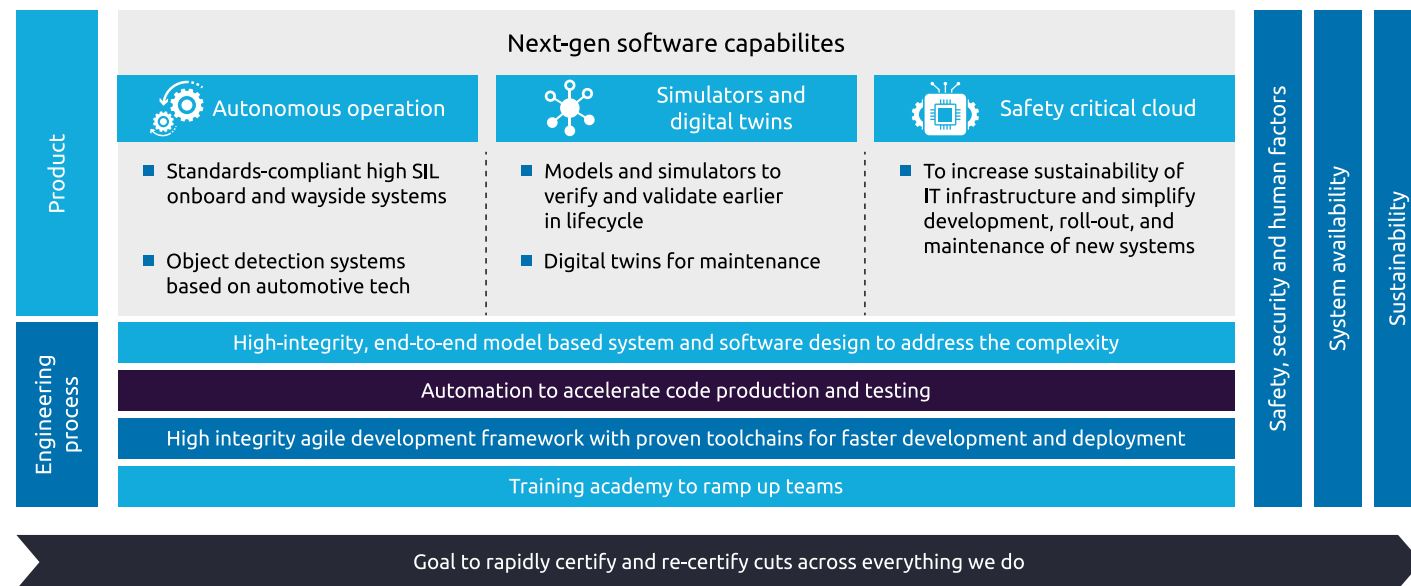
Why Capgemini Engineering?

What makes us unique?

Systems level

- High-integrity systems demand a highly detailed analysis of the system context and use-cases including a thorough analysis of the failure scenarios

- Requirements for high-integrity systems need to be incredibly precise and completely unambiguous. For the highest integrity systems, specifications are written using formal methods

Software level

- Every aspect of software development – from the processes, through the architecture, to the code and static analysis and verification – need to be more precise.

- Bug finding tools are not good enough for the highest levels of integrity – proof is the only way of guaranteeing no defects

Cross lifecycle

- Lifecycle models and tools all need to be tailored for high-integrity development.

- Agile becomes high-integrity agile

- Change and fault management tools need to collect extra evidence

- Software teams need to work closely with systems, safety, security, Risk Assessment and Method Statements (RAMS), and human factors teams

Business level

- Experience is key. Project technical leaders need at least 10 years of high-integrity experience

- Strong governance is key to ensure a safety-first attitude and to keep projects on track despite the additional burdens of high-integrity development

Our differentiators

- Accelerating the digital transformation of railway, through industrialized software development

- Deep experience in rail safety critical systems

- Our decades of experience developing and assuring safety-related, train-borne, and trackside systems enables us to develop, test, deliver, and maintain safety critical systems components and software worldwide.

Efficient project delivery model

- Specialists and a sub-team in a front office embedded client-side works as part of an Integrated Project Team (IPT)

- Front offices (onshore), technology engineering centers, globalshore centers, and offshore specialized offices

- Full-lifecycle hardware and software engineering, from time and material, up to full work package fixed price delivery

- Fixed number of sprints to refine customer requirements

- Flexibility and adaptability to project specifics, and dynamic end-to-end governance to deliver cost-effective and timely solutions

Cross-sector fertilization for faster digitalization

- Software development innovation at the heart of fast and agile teams.

- Cloud-based and telecom services, R&D and networks services, autonomous driving, connectivity features development, IoT, and data analytics services all contribute to accelerate the transformation

- Find out more about what Capgemini Engineering can do for your company around end-to-end critical software engineering

Get in touch to set up a call or meeting with a Capgemini Engineering expert today:

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Capgemini engineering

About Capgemini Engineering

Capgemini Engineering combines, under one brand, a unique set of strengths from across the Capgemini Group: the world leading engineering and R&D services of Altran – acquired by Capgemini in 2020 – and Capgemini's digital manufacturing expertise. With broad industry knowledge and cutting-edge technologies in digital and software, Capgemini Engineering supports the convergence of the physical and digital worlds. Combined with the capabilities of the rest of the Group, it helps clients to accelerate their journey towards Intelligent Industry. Capgemini Engineering has more than 52,000 engineer and scientist team members in over 30 countries across sectors including aeronautics, automotive, railways, communications, energy, life sciences, semiconductors, software & internet, space & defence, and consumer products.

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