Digital railway

Consultancy services for the
railway systems of the future



RAMBØLL

Bright ideas.
Sustainable change.

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ABOUT RAMBOLL

Ramboll is a leading engineering, design and consultancy company founded in Denmark in 1945. The company employs 18,000 globally and has especially strong representation in the Nordics, UK, North America, Continental Europe, Middle East and Asia-Pacific.

With more than 300 offices in 35 countries, Ramboll combines local experience with a global knowledgebase constantly striving to achieve inspiring and exacting solutions that make a genuine difference to our clients, the end-users, and society at large.

Ramboll works across the markets: Buildings, Transport, Planning & Urban Design, Water, Environment & Health, Energy, Oil & Gas and Management Consulting.

www.ramboll.com

Digitalizing the railway

The introduction of a common European Rail Traffic Management System (ERTMS) throughout Europe aims at improving the connectivity between European cities and capitals and allow for seamless travel within the European Union. Therefore, all European countries will need to operate signalling systems based on the European standard over the next 10-15 years.

Denmark is the first country in Europe to upgrade its entire signalling system, and Ramboll is leading the international team for what is one of Europe's most ambitious infrastructure projects. In 2019, following 6,000 hours of testing, the Early Deployment Line North began running commercial operations with passengers, marking the first time an ERTMS Level 2 Baseline 3 signalling programme has run anywhere in the world.

Ramboll is a partner that offers professional services enriched by +10 years lessons learned and hands on experience from large and complex signalling programmes. Our international rail systems services, includes programme management, specification, operational integration and support the business transformation of railway systems with training and process redesign. Ramboll enables successful and efficient project execution and rail operations for our clients.



What is digital railway and signalling

Transport is an essential part of our everyday lives. It enables access to employment, business, education and health services. The prosperity and growth of people and business depends on efficient transport systems.

Unfortunately, transport is a major contributor to global warming, nearly 30% of the EU's total CO2 emissions stem from transport. If we want to arrest climate change, we need more sustainable transport systems. Rail transport represents a significant part of the solution. 72% of transport emissions comes from road transportation and rail is a climate friendly alternative with a much lower CO2 footprint than cars or lorries.

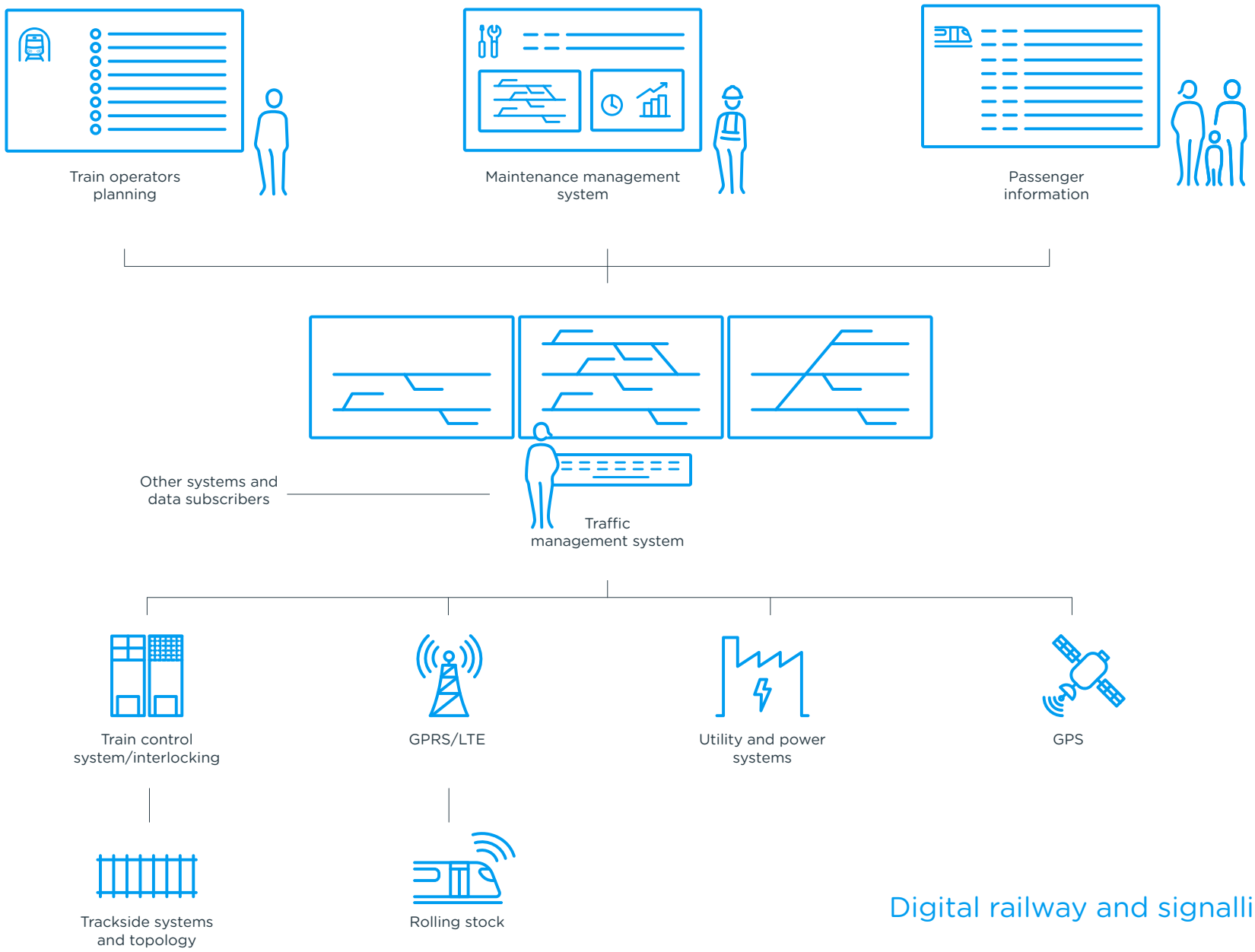
Railways can be the backbone of sustainable transport systems. Rail freight and passenger services have for many years struggled to compete with road and air transport plus adapt to new customer requirements. However, the European Union have pursued several initiatives to modernise the rail sector and enable it to fulfil its potential.

The rollout of the European Railway Traffic Management System (ERTMS) is a key component of this ambition. The new digital signalling system will lay the foundations for an integrated European railway area based on compatibility between national systems and high levels of performance and safety.

ERTMS is part of a modern, competitive railway that will facilitate the operation of rail services within Europe and the enable the development of a sustainable transport system.

WHAT IS ERTMS AND WHY NOW?
ERTMS is a major project being implemented to enhance cross-border interoperability throughout Europe by creating a single standard for railway signalling.

Today, more than 20 different national signalling and speed control systems exist in the European rail system many of them not compatible to the other, creating obstacles for the free flow of rail traffic. Besides removing this technical barrier to cross-border passenger and freight movement. ERTMS saves maintenance costs, improves safety and increases traffic capacity. It reduces the headway between trains and allows for a maximum speed up to 500km/h and has the potential to increase the current capacity on the tracks by up to 40% without the need for any infrastructure upgrades.



Digital railway and signalling

Digital railway and signalling consultancy

Ramboll's value adding professional services combined with our collaborative and client centric approach ensures successful and efficient project execution and rail operations for our Nordic and international clients.

Ramboll offers value adding professional services through transfer of +10 years lessons learned and hands on experience from large and complex signalling programmes. This includes programme management, specification, operational integration and implementation of driverless rail systems. Our collaborative and client centric approach and expertise with business transformation, ERTMS, CBTC, TMS and UTO – enable successful and efficient project execution and rail operations for our Nordic and international clients.

STRATEGY, ANALYSIS AND PLANNING

Strategy
- Strategic and feasibility studies
- Business case development

Analysis
- Conceptual designs
- Capacity analysis and simulation

Planning
- Strategic master planning and roadmapping

PROGRAMME MANAGEMENT, PROCUREMENT AND BENCHMARKING

Programme management
- Programme management, governance and planning
- Stakeholder engagement and collaboration

Procurement
- Commercial procurement and contracting strategies

Benchmarking & Project health checks

SYSTEMS INTEGRATION, SIGNALLING AND ERTMS CONSULTING AND DESIGN

Systems Integration
- Systems engineering and Integration
- Field interfaces and migration

Signalling and ERTMS Consulting
- System Subject matter expertise
- Train control systems
- Trackside systems
- Onboard systems
- Railway IT systems
- Communication systems
- Norms and standards

Design
- Engineering and design of Electronic interlocking systems
- Engineering and design of Relay interlocking systems
- Track side cable design

PROJECT MANAGEMENT, OPERATIONAL READINESS AND BUSINESS CHANGE

- Project management
- Engineering and approvals, process and optimization
- Contract and supplier management
- Operational readiness and business change management
- Business change
- Commercial and contract management

TEST, OPERATIONS AND ASSET MANAGEMENT

Test

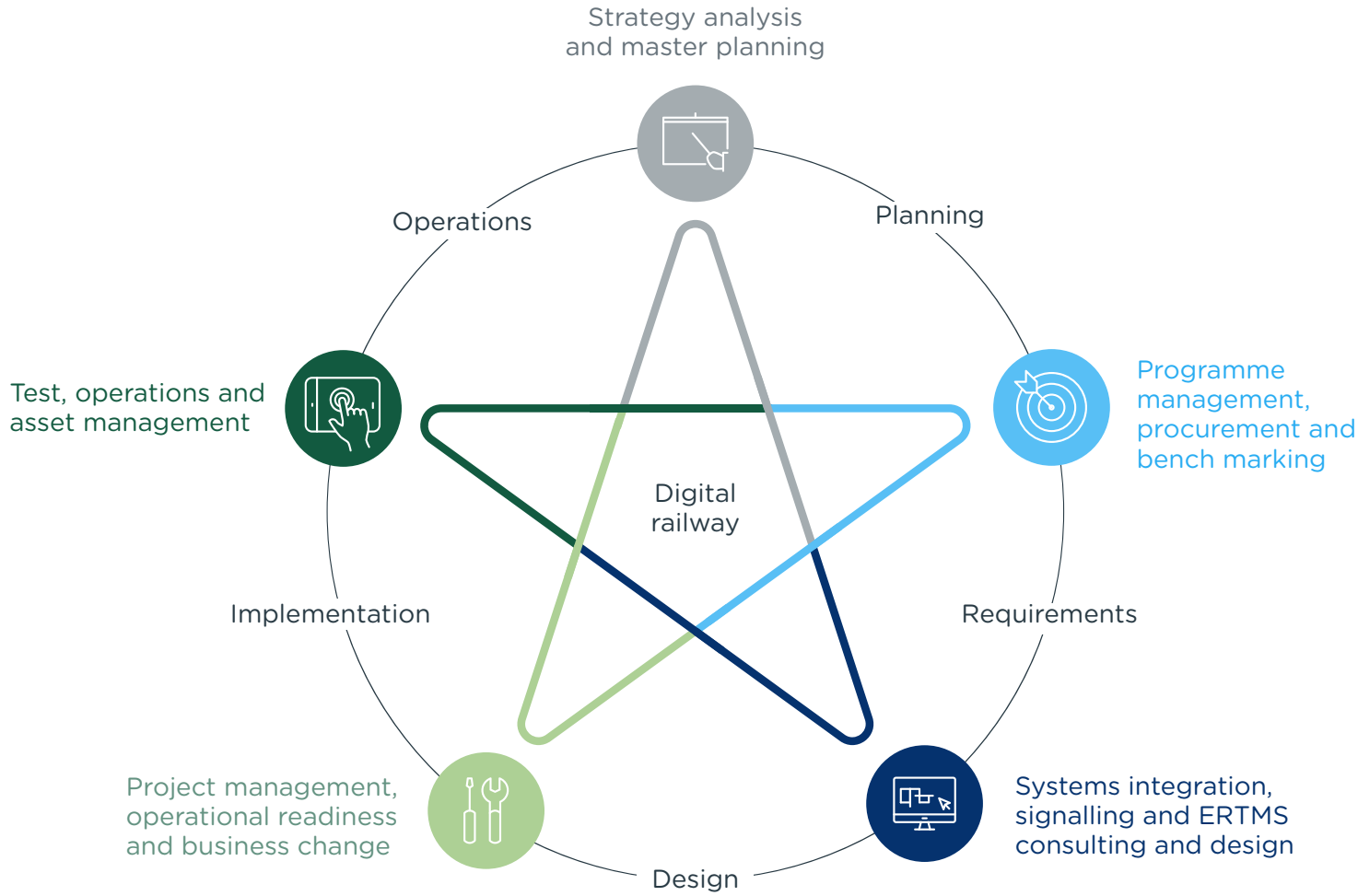
- Test, rollout and migration strategies and management
- Lab testing and lab management
- Test procedures

Operations and maintenance

- Traffic management and development of operational rules
- RAM strategies and studies
- Maintenance programme and strategies
- Maintenance planning and maintenance manuals

Asset management

- Asset management strategy development and roadmaps
- Asset and topology data strategy and management
- Life cycle cost and profit analysis



Lessons learned

New signals cause change: 5 things we learned from the ERTMS implementation in several European countries

Technological requirements are not the only prerequisite for successfully introducing the new ERTMS signaling systems. Establishing the new technology is an all-encompassing organizational task that affects both core business functions and staff. After completing the first ERTMS projects in European countries, Ramboll has collected the five most important aspects for a successful introduction of ERTMS systems.

Currently, the new railway signalling system, ETCS Level 2, is already being implemented in other countries. The new system will significantly increase passenger capacity, reduce delays and improve safety at the same time. The complete renewal of the signalling system is a complex process. Since the entire railway network is to be equipped with the ERTMS system in sections, trains have to be temporarily diverted to other routes with different signalling systems. This is a major challenge both technically and bureaucratically.



Based on the Europe-wide experience, we can give the following tips when implementing ERTMS signalling:

01

Working together reduces resistance to change The implementation of a project with the scope of the signalling programme is a complex large-scale project. It can therefore be difficult for the client to understand the needs of the internal and external stakeholders. The need to keep the existing system running makes it difficult to learn about the newly introduced technology. Experience from the other ERTMS projects shows that it is therefore beneficial to entrust experienced operators with the task of leading project and business change activities in order to effectively manage a smooth transition into operation. Involving various users and interest groups in the project also creates trust in the new technology. In their role as ambassadors, these users create a clear link between the benefits of the new system and the technological and business changes, thereby reducing resistance to change.

02

Flexible training

Due to the many interdependencies in the implementation of the project draft, the permits and the implementation of training courses, it is not very efficient to carry out these one after the other. Instead, since unforeseen delays can occur, it is advisable to invest in a flexible training plan and modular training that also includes efficient refresher training. We advise you to run the respective steps in parallel so that the status and maturity of all work processes can be monitored.

03

Focus on the learning curve effect

Managing a large change project like an ERTMS program has shown that it has a larger learning curve effect than separate smaller projects. As you move from one step to the next, newly acquired knowledge and experience (good and bad) are carried over into the commissioning plan to ensure continued strong leadership of the project.

04

Transition to business as usual

It takes time to master the new ways of working in live operation. Experience from other ERTMS projects shows that it makes sense to involve maintenance experts in necessary activities at an early stage. This allows them to develop an understanding of the new system and avoids unnecessary work based on the requirements of the previous system. The same applies to the operating staff. Since the new system will require significant changes to operations, maintenance, and troubleshooting procedures, it is crucial to involve staff in the operations at an early stage. This ensures that you are able to perform the required procedure during the testing and commissioning process.

05

Prioritise to deliver

Product and software development are a significant part of ERTMS projects. If only the basic functions for normal train operations are implemented, the risks of project implementation can be reduced at the expense of an increased time frame. Therefore, it is imperative to establish a clear link between the expected benefits and the deliveries and features of the technology change in order to make informed decisions about possible delays in product deliveries for the benefit of the entire business and project. This can be achieved by weighing the benefits in the early stages of the project.

Key projects

Through our experiences from developing and implementing ERTMS projects over the last 10-15 years we have professionalised and developed our services.

As a Digital Railway Partner Ramboll is a one-stop shop capable of delivering on all aspects from hardcore technical consulting to business change and organisational transformation consulting.

01 ERTMS signalling. Countrywide replacement of existing signals, Denmark

- Designing, planning, specifying, tendering and engineering the national rollout.

Denmark is the first European country upgrading all its signalling systems to ERTMS therefore strengthening rail connections between Denmark and all European cities. Ramboll is leading the consortium and will be responsible for the ongoing delivery of one of the largest ERTMS signalling and CBTC system implementation programmes in the world. After completion the project will result in improved capacity, deduced delays, high uniform safety levels, speed upgrades and it will be possible to monitor exact train positions in the rail network.



01

02 Digital railway programme in the UK

- Signalling and ERTMS services, technical leadership; engineering solutions; project and risk management; stakeholder engagement; business change and industry training; data and asset management

Delivering the foundations for Network Rail's Digital Railway programme will help realise significant network widebenefits for the railway by improving safety and punctuality, helping to maximise capacity, enhancing the customer experience and supporting future economic growth. In the role of Delivery Partner (Systems), Ramboll is working with Arcadis to help shape the Digital Railway programme that has been established by Network Rail to bring European Rail Traffic Management System (ERTMS) to the UK as is being rolled out in Denmark. Ramboll will also be leading the development of the Digital Railway Toolkit. This is a set of requirements, specifications and processes, along with competency and training requirements, that will support the roll-out of the Digital Railway across the UK rail network.



02



03

03 Norwegian ERTMS national implementation, Norway

- Designing, planning, specifying, tendering and engineering the national ERTMS rollout.

The national rollout of ERTMS on the entire Norwegian rail network consists of total renewal of existing trackside signalling system, a new Traffic Management System and an ERTMS Onboard solution to be installed in a variety of rail vehicles operating in Norway. Ramboll delivered technical consultancy to the project in all ERTMS disciplines, trackside, TMS, onboard, system integration, migration planning, RAMS, business case, project management. Additionally, Ramboll supported Bane NOR in the tendering, design and migration process.

04 ERTMS capacity, Finland

- Desktop analysis, cost-benefit analysis, capacity analysis.

Finland is considering to implementing ERTMS level 1 or level 2. Ramboll investigates the capacity improvement of ERTMS level 2 capacity on double track lines (compared to level 1). Based on desktop and case studies as well as theoretical and cost-benefit analysis Ramboll delivered recommendations for the best suited ERTMS solution for double track sections.

05 Analysis of driverless operation on the S-bane, Copenhagen

- Economical, technical and organisational evaluation.

The next generation of rolling stock on the Copenhagen S-bane is scheduled to take place between 2026-2036. In relation to this, an analysis of the impact on service-level and economy of a potential driver-less s-train operation was evaluated. Ramboll, in collaboration with Parssons, are leading advisors on the project, and responsible for mapping all technical aspects of rolling stock specifications, development of the business case, the socio-economical analysis, and estimations of consequences regarding personnel. The final analysis nominated two scenarios, which were both better than the 0-scenario: One with the same level of service and better economy, and the other with better service level and same economy.


04


05







06 ERTMS support for Queensland Rail, Australia

- Project planning and ERTMS expert support

Ramboll provided ERTMS consultancy services to Queensland Rail on transforming the inner-city network around Brisbane to ETCS level 2. Ramboll provided ERTMS and traffic management expertise, detailed report of lessons learned from the Danish Signalling Programme, planning of implementation phase and RBC borders definitions. Ramboll was also involved in review of requirements, and evaluating proposal from suppliers.

Queensland Rail has invited Ramboll to continue as ERTMS client side advisor in the implementation phase. This includes ERTMS services within preparing safety approvals, operational readiness and operating rules. Ramboll provided support from experts who have already been through the transformation to ETCS leading to more efficient railway operations.

07 Rail Baltica

- Feasibillity study, procurement and deployment strategy, operational plan and future station layout, simulation

Ramboll has been appointed by Rail Baltica AS to conduct a feasibility study of the control-command and signalling subsystems procurement and deployment strategy as a preparation for implementing ERTMS and to develop an operational plan and future station layout for Riga node for both 1435 mm and 1520 mm infrastructure including a RailSys simulation.

Rail Baltica is a joint project of three EU member states Estonia, Latvia, and Lithuania, and concerns the building of a double track railway line on the route from Tallinn, Riga (LV), and Kaunas (LT) to the Poland border. In the longer term, the railway line could potentially be extended to include a fixed link between Helsinki and Tallinn as well as integrate the railway link to Warsaw and beyond.

08 ETCS Schleswig-Holstein, Germany

– Traffic engineering, transport planning & safety

The Lübeck-Fehmarn and Hamburg-Flensburg routes in Schleswig-Holstein and Hamburg are to be equipped with ETCS by 2028 and 2030, respectively. In order to maintain the existing performance of the routes and to be able to implement long-term timetable concepts, a comprehensive analysis of the effects of ETCS on rail traffic is necessary. The investigation is intended to represent the infrastructure requirements for ETCS that can be derived from the long-term offer concept, so that the offer concept can be implemented with the introduction of ETCS. Stable operation must be demonstrated. If no solutions are available due to the technical development, appropriate solution proposals are derived in the investigation.


09

09 World's longest rail tunnel Switzerland with ERTMS

- Safety, interoperability and RAM consultancy for proposal

St. Gotthard railway tunnel is the world's longest rail tunnel – and part of the nationwide ERTMS implementation in Switzerland. Ramboll provided safety, interoperability and RAM consultancy support and documentation to the proposing consortium to demonstrate the proposed system-design would fulfil safety requirement, interoperability and the dependability (RAM). This comprised ERTMS signalling, Train management system and power systems. Ramboll also deliver project management, automation and energy projects from our permanent office in Switzerland."

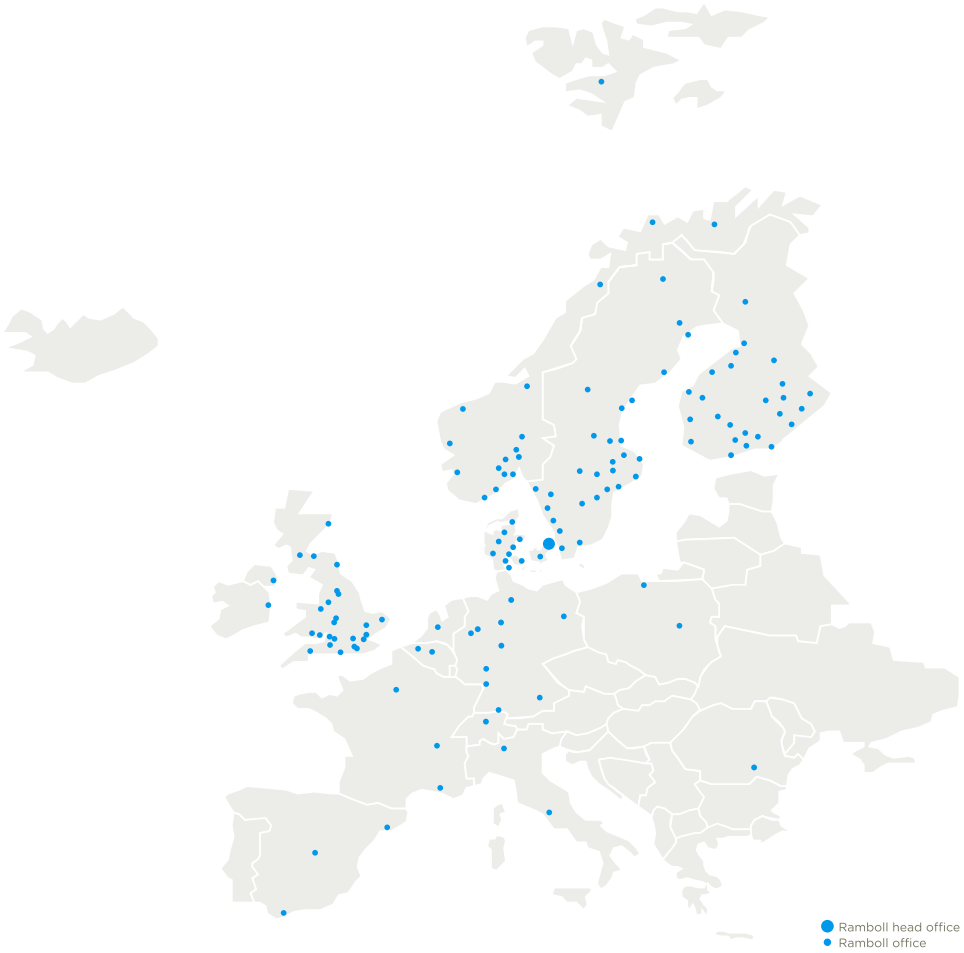
10 RBC-RBC analysis (Radio Block Control) in Sweden

– ERTMS consultancy, project management, client interface, test case and communication scenarios in RBC-RBC interfaces, mitigation recommendations.

For the Swedish Transport Auhority Trafikverket Ramboll is conducting an analysis of the compatibility of the RBC-RBC interfaces among the two suppliers chosen for the Swedish ERTMS program to install ERTMS Level 2. The analysis will sustain Trafikverket's plan to be finally equipped for full introduction of ERTMS Level 2 on the entire Swedish 11,000 km rail network from North to South by 2035. Ramboll undertakes an ERTMS market analysis with focus on lessons learned and successful implementation. Ramboll provides senior ERTMS signalling services to Trafikverket and other Swedish clients. Ramboll delivers signalling projects to SL.


10

World-class digital railway expertise



Internationally recognised, world-leading consultancy combining local presence on five continents with global knowledge

Ramboll engineers and clients - and deliver well proven integrated operational solutions for succesful implementation of complex rail projects, technology transitions and business changes

Experienced ERTMS Specialists from Ramboll International Centres of Excellence in Denmark, Norway, UK and Germany collaborate closely with local

Ramboll offices all over the world provide a local point of contact for our clients

To get in touch please visit **ramboll.com/rail**