COWI has been in the consultancy market for more than 75 years and with recent expansion we have more than 6,000 employees all over the world. This enables us to provide multidisciplinary engineering consultancy services, specialised in the management of large and complex infrastructure projects globally, involving multiple disciplines and stakeholders. Railway organisations have undergone strong privatisation in the last 10-20 years within the design and implementation of railway projects. COWI has been at the forefront in providing these services and is a leader in the sector.

Today, COWI is a highly technical and focused company. We provide strong expertise within the basic railway disciplines covering all project phases. We currently have railway specialists managing projects all over the world, combining our comprehensive railway expertise and excellent project management skills.

On the following pages, we present a general description of our company, our railway expertise, selected project references and our contact details.
COWI is a leading consulting group operating globally. We provide state-of-the-art services within the fields of engineering, environmental science and economics with due consideration to the environment and society.

COWI was founded in Denmark. The company has grown over the years developing a wide range of services and establishing a presence in many countries becoming a globally operating group of companies - the COWI Group.

The COWI Group is organised in a close, mutually binding network - a one company network. This organisation ensures that all business units can draw on the entire Group’s extensive expertise while working in close dialogue with our national and regional clients.

COWI’s head office is located at Kongens Lyngby, 12 km north of Copenhagen, and is supplemented by 12 regional offices throughout Denmark. Further, the COWI Group maintains 34 branch offices and affiliated offices in Asia, Europe, the Middle East, Africa and the Americas.

COWI has carried out more than 65,000 projects in over 175 countries. The company is currently engaged in some 6,700 projects within a wide range of disciplines.

COWI retains absolute independence from contractors, manufacturers and suppliers and is not associated with any interest which might interfere with its work as consultant.

With a turnover rapidly approaching EUR 500 million, COWI maintains its position as one of European and indeed global leading consulting companies.
Railway consultancy

**Services**
COWI provides strong expertise within the railway disciplines such as permanent way, signalling systems, power supply, catenary systems, telecommunication and infrastructure for all civil works disciplines. Our services cover the whole project life cycle from feasibility study through preliminary and final design, supervision, operation and maintenance.

We combine this with extensive project management, strategic planning, risk and safety management, procurement and tender management, environmental, social and climate assessment, transport economy and traffic projections, economic and financial studies and quality assurance.

The above services can be offered for high speed and main lines, suburban rail transport, metros, light rail and tramways.

**Railway specialists**
Due to the wide range of services provided by COWI our consultants have extensive experience in undertaking complex multi-disciplinary railway and infrastructure projects with an emphasis on synergy of the expertise and efficient technologies.

Our staff are used to working together across diverse professional areas, across national borders and cultures, different educational backgrounds and collaborate efficiently on multidisciplinary assignments.

**Clients**
COWI works for public railway infrastructure owners, national railway authorities as well as international donor organisations including the European Union, the European Bank for Reconstruction and Development, the World Bank, the Asian Development Bank, African Development Bank and the Nordic Development Fund. Furthermore COWI also works as a consultant for private railway organisations, railway operators and contractors.
## Consultancy services

### Project management
- Project management
- Programme management
- Design management
- Contract management
- Interface management
- Configuration management
- Resource management
- Quality assurance management
- Management of time and economy
- Environmental management
- Risk management
- Value management
- Cost estimation

### Design and procurement
- Design specifications
- Systems – and conceptual designs of railways and civil works
- Detailed design of railways and civil works
- Project approvals
- System integration
- Tender documents
- Tender evaluations
- Contract negotiations

### Feasibility studies
- Generation and development of concepts
- Capacity/demand analysis
- Studies of infrastructure needs
- Cost estimation
- Construction and procurement scheduling
- Environmental impact assessments (EIA)
- Risk assessments
- Rolling stock analysis
- Traffic planning
- Risk and socio-economic comparison
- Reliability, availability, maintainability and safety (RAMS) analysis
- Safety cases and verifications
- Norms and standards

### Operation and maintenance
- O&M management
- Asset management systems
- Operational risk assessment
- Inspection and condition assessment
- Ranking of maintenance and reinvestment needs
- Strengthening and repair design
- As-built services

### Construction management and supervision of works
- Project follow-up
- Construction management
- Safety assessment
- Progress monitoring
- Interface coordination
- Site supervision
- Programme and budget control
- Contract and claims management

### Selected competence areas presented in our brochure
- Time schedules and capacity analysis
- Tracks
- Traction and power supply
- Telecommunication
- Signalling
- Rolling stock
- Risk and safety management
- Stations, terminals and depots
- Civil works

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Photo: Rene Strandbygaard
Project management

Project management is one of COWI’s core competences acquired through many projects over many years. Our experience covers all aspects of project management relevant to all complex large-scale projects such as the Copenhagen Metro, mid-size projects such as the feasibility study for the high-speed railway line in Sweden and minor projects such as station renewal.

Monitoring - a prerequisite for success
COWI views monitoring as a prerequisite for successful project management. And when the project has started, monitoring of progress, time, economy, reporting, quality, environmental, risk, configuration and interface management, and system integration are vital tools to achieve an internal project organisation that works smoothly and effectively. COWI also ensures that systems for knowledge sharing such as technical operations and information systems work effectively as a whole when managing railway projects.
Bringing Poland up to speed

One of COWI’s most challenging railway assignments to date – in terms of both cost and scope – is the modernisation of 500 kilometres of Polish railway in the E30 corridor which connects large parts of Eastern Europe. The E30 corridor is an important railway link for goods and passengers. The main objective of refurbishing the link was to enable freight trains to increase speed up to 120 km/h and passenger trains up to 160 km/h.

The E30 project was divided into two subsections: one stretching from Opole to Krakow; and, the other further to the east from Krakow to Medyka on the Ukrainian border.

Integrated team approach

The successful execution of a project depends, to a large extent, on the collaboration between the consultant, the client and the stakeholders. We carry out our assignments as ‘one integrated team’ assuming the involvement of all interested parties in a close, open and loyal collaboration based on mutual respect and understanding. This cross-fertilization has proven invaluable in a wide rage of our projects and was recently applied on Copenhagen Metro and Qatar – Bahrain Fixed Link projects.

International and multidisciplinary project teams

One of COWI’s core competences is the management of international project teams and projects incorporating many different disciplines. Almost all our projects are multidisciplinary and frequently contain an international approach. Typically, there are many different nationalities and disciplines represented, and each one has their specific focus areas and approach to implementing the project. Nonetheless, all these nationalities and disciplines are the key to the best solution.

Benefitting from cultural differences

On the E30, COWI assisted the Polish National Rail Authority in cooperation with three Polish companies and COWI’s German subsidiary ETC. As project manager COWI brought together the different groups of specialists and work methods spanning cultural differences.

“No companies are the same. We all have different cultures, different ways of doing business. And if you are prepared for this scenario and accept the challenge, you can only benefit. We are putting a lot of work in, but we are also gaining much valuable experience here through learning from each other,” explains COWI Deputy Business Development Director Preben Juul Mikkelsen.

Turning challenges into advantages

Linguistic differences occasionally led to unforeseen challenges. However, being an international company COWI is familiar with managing such differences and converting challenges into advantages.

<table>
<thead>
<tr>
<th>E-30 Opole - Katowice - Krakow-Medyka/State Border</th>
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<tbody>
<tr>
<td><strong>Location:</strong> Poland</td>
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<tr>
<td><strong>Period:</strong> 2006-2008</td>
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<tr>
<td><strong>COWI services:</strong> project management, feasibility study, cost benefit analysis, traffic forecasts, preliminary design and environmental impact assessment, tender documents, application for EU funds,</td>
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<tr>
<td><strong>Client:</strong> PKP PLK (Polish State Railways)</td>
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<tr>
<td><strong>Project value:</strong> approx. EUR 3.3 billion</td>
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Feasibility studies

COWI’s feasibility analysis tool box is very effective for decision making clients all over the world. Our tool box covers not only engineering aspects but also environmental socio-economic and financial issues.

The advantage of a consistent feasibility analysis is that it provides a clear-cut strategic assessment of the overall need and potential for developing railways. COWI has carried out feasibility and pre-feasibility studies in a variety of locations and has considerable experience in this field.

Generic software tool

COWI’s experts have designed many economic and financial decision-support software tools. The economic and financial appraisal models are based on state-of-the art economic theory and meet the requirements in the guidelines of International Financing Institutions such as the European Commission, EBRD, EIB and the World Bank and can be adopted to include specific national guidelines.

As well as revealing potential risks, the model set-up ensures a consistent assessment of various selected scenarios and can be used to optimize the timing and size of investments from both an economic and financial perspective. In fact, on this basis, the model analysis recommend the most suitable and feasible option in terms of alignment, technical standards and organisation, thus making it an ideal tool for railway and other large construction works.

Promoting dialogue

COWI performs traffic analysis of both passenger and freight traffic, investment cost analysis and financial and economic assessments for both operators and managers of infrastructure and particularly transportation.

Furthermore, the use of feasibility studies promotes dialogue and consensus building among key stakeholders. In this way they adjust potential gaps between policy development and implementation.
Railway promoting European integration

COWI was responsible for the strategic feasibility study for the railway modernisation project known as Rail Baltica which is an infrastructure project sponsored by the European Commission. The trans-European railway connection, linking Helsinki and Warsaw and continuing to Berlin, is an important element in the development of sustainable modes of transportation in the Baltic region. Improvement of balance and interoperability between different means of transportation and establishment of links with the rest of the EU rail network, promotes economic growth and integration.

New gauge or switch coaches

“This feasibility study considered long-term development aims rather than short-term needs. In light of this, the major tangible challenge in Lithuania, Latvia and Estonia was that the existing rail network’s gauge is broader than the European standard,” says COWI Project Manager Karsten Sten Pedersen.

A COWI feasibility study of the project revealed that it will cost between EUR 1 and 2.4 billion to modernise the railway between the Polish capital Warsaw and Estonia’s Tallinn – a total section of 1,200 km – to bring it up to an international standard with trains running at a minimum speed of 120 km/h.

Consequently, the study resulted in three different financially viable proposals each of which calls for significant EU funding and places emphasis on a solution to the gauge problem.

Focus on sustainability

“The cheapest solution involves switching coaches and bogies in Lithuania. On the other hand, there is the possibility of laying new, standard European-gauge track along the entire route, which will reduce operating costs in the long term. The identified and analysed options were discussed with the governments of each country, and detailed upgradings have, on the basis of an agreement between the three Baltic states, commenced on the first of the corridors in Southern Lithuania.”

Rail Baltica
Location: Estonia, Latvia, Lithuania, Poland
COWI services: project management, economic and financial feasibility analysis, demand analysis and investment strategy assessment
Client: European Commission DG REGIO
Project value: between EUR 1 and 2.4 billion
High speed city links

The Swedish Government has initialised studies for developing a double track high speed railway line between Stockholm and Gothenburg called Götalandsbanan. The first part, 150 km, situated near Stockholm is called Ostlänken. The Ostlänken line is designed for a travel of speed of over 300 km/h and it will be the first high speed railway in Sweden reducing transport time between Sweden’s fourth largest region Östergötland (Norrköping-Linköping) and Stockholm.

COWI (former FB Engineering) carried out a feasibility study for a 50 km section between Norrköping and Linköping including market and traffic analysis, placement of stations, analysis of three alternative alignments, environmental consequences, and facilities such as bridges, tunnels, public utilities and signalling systems.

Three alternative alignments
“COWI analysed three alternative alignments. The existing conventional line will be retained for conventional and goods train and two new high speed tracks will be built alongside” says COWI Project Manager Johanna Rödström. “The options have different lengths and transportation times. There are also differences in environmental consequences, tunnel length and costs.”

Combining various wishes, needs and interests
“A very important part of the project was identification of all stakeholders and establishment of an open dialogue and communication with all involved and affected parties” continues Johanna. “We identified and established contact with all relevant stakeholders, carried out public hearings, prepared information material in
order to create a common understanding of the project, listening to different points of view and interests of the various stakeholders. It was a very challenging process, especially investigating the stations in Norrköping and Linköping. The location of stations is always an important issue. In this case it was even more important as the passenger traffic will increase up to three times for each station. We identified all wishes, needs and interests and proposed space for all facilities and infrastructures.”

**Environmental and social impact assessment**

An important part of the project was assessment of environmental and social impact, especially health and safety issues as well as the physical influence on culture, nature and landscape.
Design
Throughout the years, COWI has continuously strengthened the company’s design profile and gained excellent experience in railway and railway related projects. Emphasis has always been on the design of all railway infrastructure elements including the permanent way, telecommunication, traction and power supply, signalling, rolling stock, stations, depots, terminals and civil works etc.

Regarding requirement specifications and system design, COWI offers technical consultancy services in areas such as system selection and approval procedures of components. We coordinate and carry out design basis, conceptual and preliminary designs as well as detailed designs.

Tangible and optimised solutions
COWI prepares designs according to our clients’ conditions and requirements. We group our clients’ ideas according to functional requirements which are analysed with regard to traffic, technology, time and economic benefits as well as consequences. In this process, initial project ideas are analysed for profitability and durability.

In the conceptual design phase, the project is outlined schematically and its impact on the physical changes in infrastructure is electronically visualised. Consequences are thoroughly analysed and alternative possibilities assessed.

In the detailed design phase we work closely with our clients to obtain the best tangible and optimised solutions, considering execution methods and financial aspects.

International and national design procedures
COWI applies the latest in computer-based design tools to design rail systems in 2D and 3D. Rail systems are designed according to international and national standards and adapted to the estimated traffic load, to ensure a reasonable construction method and coordination of the different disciplines of the project.

Tendering and contracting
COWI is experienced in tendering and contracting in compliance with national and international procurement rules (EU, WB, NDF, and ADB). In cooperation with the client COWI determines how the project should be tendered with regard to time schedule, financial aspects, competition as well as contract special conditions and negotiations.
Track renewal and speed upgrade

The intercity railway line ‘Kystbanen’ in Denmark - is an electrified 50 km long double-track line - running along Øresund from Copenhagen to Elsinore in northern Zealand. The complete railway line was one of the first railway sections in Denmark to be electrified in the early 1980’s. The railway line is today one of the most important in Denmark as it connects both the regional traffic in northern Zealand and the international traffic to Sweden with the metropolitan area at Copenhagen. Part of the line is as such classified as a Trans-European TEN-corridor.

Optimised velocity profile

Some years ago, it was again time for modernisation. The tracks were to be renewed and prepared for speed increase. Also due to speed requirements cross-sections had to be renewed. Further it was necessary to review all sections and make track adjustments - including sections not renewed - to fulfil track requirements for the new higher speed. A conceptual design was prepared in which the project was schematically outlined with visualisations of the changes. Project Manager Leif Brandt sums up COWI’s part of the project: “As consultant, we handled the preliminary design, the detailed design, tendering and project follow-up. We established an entirely new optimised velocity profile between Hellerup and Elsinore increasing the speed up to 140 km/h .“

Low maintenance drainage system

“The main challenge in the project was the distinct need to upgrade drainage facilities along the tracks with water overflowing from springs and flooding trenches. Establishment of the necessary ‘as-built’ documentation and conditions surveys was performed by COWI before the design could be prepared. The design of the new drainage system was performed in close cooperation with the client’s maintenance procedures - to establish a new low maintenance regime”.

Extensive replacements of subsoil and sub-grade

“The sub-ballast was also deficient along the complete line. This missing layer of sub-ballast was causing track problems - since the sub-ground primarily consists of clay which in many places was very soft. Based on an analysis, it was decided to perform major earth works with replacement of both subsoil and sub-grade on extensive sections of the line”.

Track renewal of the Coastal Line

Location: Denmark
Period: 2005- ongoing
COWI services: conceptual, preliminary and detailed design, tender documents and tendering assistance, supervision of works
Client: Rail Net Denmark
Project value: EUR 47 million
In Saudi Arabia, a gigantic 2,400 km railway project known as the North-South Railway is being implemented. The new railway will link the Saudi capital Riyadh with important harbour cities such as Jubail as well as industrial mineral mining, farmland and residential areas across Saudi Arabia.

COWI was in charge of the overall project design review with construction works being carried out by Saudi, Chinese, Russian and Australian contractors. Besides challenges with the length of the railway line, the Saudi Arabian climate and natural environment have presented additional challenges to the project team.

**Wide scope**

“We were reviewing the entire project design including the operation plan which establishes, in part, the number of trains and maintenance depots as well as the design basis on which maximum speeds, geometric requirements, etc. were established. Furthermore, we were reviewing alignment embankment designs and design of structures” explains COWI Project Manager Peter Reinholdt.

“Bridges were particularly required where the railway line crosses the characteristic Saudi riverbeds known as ‘wadis’. The wadis are normally dry, but can carry substantial amounts of water during flash floods, and therefore railway tracks need to be placed on bridges in wadi areas. COWI also worked on other bridges, where for example the railway crossed roads and so-called camel crossings which allow camels to cross the railway without risk of accidents.”

**Loose sand will bury the tracks**

The loose sand in the desert was another challenge to the project. Large sand dunes move, and can potentially, bury the tracks. In some places, the railway traverses large depressions or extremely high embankments. When constructing the embankments, substantial quantities of sand are transported before slopes of the embankments were lined with clay transported over long distances. The cohesive clay material protects the embankments from wind erosion.
Construction management and site supervision of works

COWI has many years of experience with construction management and site supervision of railway and metro projects and is established as one of the leading consultants in the field.

Wide range of services
COWI’s services embrace all aspects of construction management and site supervision.

With regard to construction management COWI services cover contract and risk management, progress monitoring, cost control as well as authority handling, third parties management and technical follow up.

The experience of site supervision covers all aspects of the supervision from project review with the contractor through site meetings, variations to the contract, payments certificates, progress reports, claims management, as-built documentation, defects liability period, performance and final payment certificate.

Construction management and supervision of works

Often, large railway-related construction and planning works are temporarily obstructed by archaeological findings, groundwater complications or infrastructural dilemmas. Situations like these call for good, construction management and supervision to secure that civil works, technical installations and public information systems work efficiently.

COWI is capable of setting up a management team with all the necessary qualifications in engineering, economics and environmental science and will deal with both project outlining, coordination of design planning, environmental management, coordination of cords, cables and conduits and other services.

The start, implementation and termination of a project are always carried out in close cooperation with clients. COWI considers thorough planning, good systems for knowledge sharing, management and monitoring of progress and economics as prerequisites for success – both internally and externally.
Copenhagen Metro – an international inspiration

COWI was responsible for the overall design coordination, project and construction management of 21 km of a driverless metro system in Copenhagen including 10 km underground and 11 km surface sections with 22 stations in total. The metro runs through twin 4.9 m diameter tunnels bored by TBM. All stations are unmanned and platforms are provided with automatic screen doors for passenger safety. The driverless train sets have capacity for 300 passengers.

Further, COWI was also specialist design consultant for structures and civil works. COWI also coordinated project and construction management and supervised tasks such as tunnel works, stations and emergency shafts carried out on this large-scale project.

Interface management put to the test
“The management team drew on multi-disciplinary cooperation skills to meet the challenges of such a large and complex project. Among the challenges were the meticulous registration and coordination of underground utilities such as cables and pipes, the conceptual design of civil works as well as various geotechnical tasks including recharging of groundwater in order to protect the wooden foundation of old buildings” explains COWI Interface Manager Lars Tulinius.

“We successfully managed the supervision of mitigation procedure against potential damage to neighbouring buildings as well as other very specific construction management challenges related to the Metro project. Generally all large construction projects are basically organised in the same way – whether we are talking about bridges, tunnels, airports or other kind of projects and our wide experience from similar construction sites has proved highly valuable.”

World’s Best Metro
In April 2008, the Copenhagen Metro was elected The World’s Best Metro inspiring international professionals.
Operation and maintenance

Operation and maintenance of railway systems is important to ensure that structural, functional and safety requirements are kept up to date and that time related and financial limitations set by the client are not exceeded.

Asset management system
COWI has comprehensive knowledge of asset management based on practical experience from planning, budgeting and handling of both short and long-term operation and maintenance and rehabilitation works.

Operation management
COWI can offer the latest knowledge and know how when it comes to systematisation and optimisation of operation and maintenance work. We are skilled in setting up organisations covering: the operation and maintenance activities and relations to external parties; inventories with a systematic filing system for all inventory data; and systems to fulfill the need for information to the management authorities and third parties.

Manuals for operation and safety
COWI assists railway authorities in establishing specific manuals and local regulations such as general operation and safety manuals. We also assist with time, economy, quality and environmental issues, preparing procedures and instructions for the daily operation of railways.

Maintenance and reinvestment analysis
COWI has extensive experience in designing maintenance works to be carried out during railway in operation, in urban environments and traffic near the capacity limit. Furthermore, COWI's experience covers inspection and maintenance activities with a focus on preventive maintenance with a minimum of corrective maintenance and monitoring, advice on necessary maintenance equipment and tools with instructions about use and servicing.

COWI can provide railway administrations and infrastructure owners with analysis of their entire infrastructure in order to assess the need for maintenance and reinvestment within a given period.

Identifying savings
During the process of preparing manuals for operation and maintenance we have often identified potentials for considerable savings in the organisational set-up, in the use of equipment or in operational and maintenance procedures.
Good trains for all  COWI is assisting the Danish State Railways in getting a number of Danish train stations ready in time for the launch of a new national train type, the IC4. The project is part of the Danish State Railways’ strategy known as GTA (good trains for all), initially launched in 1998, to strengthen Danish public transportation through a general improvement of railways.

The first part of the project consists of pilot research and design followed by supervision and construction management. COWI manages all these tasks for the five stations of Helgoland, Kalundborg, Aalborg, Aarhus, and Fredericia. The stations are planned to be refurbished to accommodate the Danish State Railways’ (DSB) new mix of rolling stock.

Strengthening public transportation
The first station to be refurbished is Helgoland in Northern Copenhagen.

“The task here is to establish facilities that can discharge waste material from trains and replenish with oil and water. It is probably the most challenging of all stations because we are working in a very limited space, and we also have to take train power supply into serious consideration,” explains COWI Project Manager Niels Henrik Kjær Jensen.

Comprehensive planning
The work at Helgoland and the other stations is to be carried out while the stations remain in operation. This calls for detailed and comprehensive logistic planning.

“We need to identify all stakeholders and maintain a good dialogue with authorities, personnel and the public. In this project, we are drawing on the knowledge of many of our specialised experts. It is a complicated assignment that requires substantial interdisciplinary cooperation.”

Good trains for all
Location: Denmark
Period: 2007-2011
COWI services: pilot surveys, conceptual, preliminary and detailed design, construction management and supervision of works for all railways disciplines
Client: DSB
Project value: approx. EUR 28 million
Time schedules and capacity analysis

Our experience shows that the development of exact time schedules and correct capacity analysis are extremely important tasks before laying down new tracks, building new terminals, depot areas, train and metro stations or other railway related construction works. Exact time schedules are highly advantageous because they help clients to focus resources and implement the correct procedures at the correct time.

COWI’s time schedules for railway projects are based on empirical experience from our large back catalogue of railway-related projects. COWI’s capacity analysis in railway projects is usually based on pairing certain amounts of goods or passengers with a certain amount of trains with correlating tracks, depot and loading areas and other facilities. The challenge is to predict appropriate solutions by assessing the client’s wishes on the basis of solid data collection and feasibility studies.

Determining feasible solutions
Factors such as acreage, geographical location of tracks, stations, depots, etc. and prospects of operation costs can be processed into concrete time and capacity analyses which again can help the client in determining feasible solutions.

COWI uses tools such as traffic simulations and visualisations when effecting time schedules and capacity analyses. This gives the best results - to the benefit of our clients.

Rapidly growing container terminal

Alnabru, one of Norway’s largest container terminals, ties together railway and road cargo traffic from all over Norway and abroad. Every year, 600,000 TEU (twenty-foot equivalent units) pass through the premises and large re-allotments are scheduled for the future. The Norwegian cargo strategy expects 1 million TEU to pass through the terminal in 2020 and 1.5 million in 2040.

COWI carried out control of surrounding roads and railways by drawing on traffic simulations as well as extensive capacity and traffic analyses to make room for the projections.

Working in limited space
The need for more TEU capacity is measured against the number of trains and tracks. A certain amount of TEU requires a certain number of trains, and, consequently, a certain number of tracks. Tracks take up space which is limited at Alnabru.

“Our job is to create a terminal that can develop according to the Norwegian cargo strategy. One of the big challenges for this plan is that the terminal lies in a limited space, encircled by both industrial activities and houses,” explains COWI Business Development Manager Geir Vidar Bratli.

Property options – key issue
He stresses property issues as vital for the extension plans of the container terminal. Earlier, plans were put forward to moving the terminal, but with its close vicinity to Oslo it has a perfect location.

“Instead of relocating the terminal, we have created space for another entirely new terminal in the southern part of the area. As soon as the new terminal is ready we will be able to temporarily discontinue the old one in order to optimise and modernise it without losing capacity.”

Alnabru container terminal
Location: Norway
Period: 2007 - 2010
COWI services: pre-project terminal layout and civil works, simulation of rail traffic, road traffic and terminal handling system.
Client: Norwegian National Rail Administration
Project value: EUR 310 million
Tracks

With specialists stationed around the globe, COWI can set up a strong team regarding track construction or renewal and maintenance projects. We have experience in handling the latest technology and components, and we also manage document handling and management.

COWI undertakes all elements of track analyses, estimating and evaluating the durability of each component separately. We advice on track construction, renewal and maintenance of rails and sleepers, cleaning of ballast stone and gravel and manage re-profiling and upgrading. We are also specialised in drainage calculation and implementation.

Ingenious utilisation

One of COWI's key competencies is track technology in general and more specifically ingenious utilisation of components - new and old, from subsoil to the top of the rail.

We offer technical design services (often based on computer-aided design), geotechnical surveys, capacity calculations, running time analyses, switch modifications, drills, ballast probing, feasibility studies as well as a number of other services in metro and rail projects around the world.

No two sections are alike

Track renewal is always relatively more complicated and costly in urban and densely built-up areas than in rural areas with more space for machines and other resources. We also know that no two sections are alike, and that apparently identical sections may have different conditions and need different degrees of track maintenance or renewal. Therefore, we always make decisions that are carefully adapted to the specific nature of the rail renewal project in question and the needs and wishes of our clients.
The world’s longest rail link

The multi-billion dollar project to build the Qatar–Bahrain Causeway has been underway since the late 90’s. The causeway was originally designed to accommodate a dual highway. During the work on the design basis for the road link, the proposal to add a rail link was put forward and accepted.

Mixed traffic rail link

“The fixed rail link between the two countries will be approximately 40 km in length and will include over 17 km of embankments and 23 km of viaducts and bridges, including two bow-string arch bridges soaring up to 40 m above shipping channels,” says COWI Permanent Way Specialist Jan Falster-Hansen. “It includes the infrastructure to support mixed freight and passenger traffic. It will be a double track line designed for high speed trains (250 km/h) as well as heavy freight trains at max speed of 120 km/h and 25 t/axle.”

Variety of railway engineering services

COWI was employed to carry out the design basis for the entire railway connection including alignment, track construction in ballasted track on embankments, slab track on all viaducts and bridges, catenary system, signalling system (ERTMS level 2 system) and derailment protection.

High speed based on freight alignment

“The uniqueness of the project was that the Client decided that the rail alignment should be based on required specifications that apply to freight trains but at the same time it will be possible to make necessary adjustments to high speed rail at a later date. Usually, in the case of mixed traffic, it is the other way round: The required specifications that apply to high speed are the basis for the design.”

The main rail link for the Arabian Gulf countries

The rail link, which will reduce the time of journey between Bahrain and Qatar from five hours to thirty minutes, will be the world’s longest fixed rail link. It will be part of Qatar’s national rail system and will connect Bahrain to the planned Qatari railway network. The rail link will also be a part of the rail connection from Kuwait to Oman and a part of the Gulf Corporation Council rail link connecting the Arabian Gulf countries.
Light rail solutions
For many years COWI has supported traffic decision making in Aarhus. Mainly in the development of public transport, where the light rail project is a top priority. The project will link existing and new light rail sections as well as major suburban municipalities in Aarhus. COWI is the Client’s consultant on the project and carried out preliminary investigations and general evaluation of the infrastructure and has defined the overall alignment, implementation process and tender etc. COWI has also developed the conceptual design of the project as well as detailed design of certain complicated sections comprising alignment, pavements, stops, power supply etc.

Total solutions
The project is expected to be carried out in stages. The first stage of 12 km covers the most important and trafficked parts of the city of Aarhus. Other stages, which are expected to be between 50 and 100 km in total, cover the remaining areas of the city and some of the more important suburban municipalities.

“Planning and establishing a light rail line is a time consuming process. It takes 15 years from the initial ideas until the project is completed and the light rail trains are running,” says COWI Project Manager Hans Raaskou Grønne. “The particular challenge for light rail is that it cannot be established in small sections as for example bus lanes. You have to work with total solutions and as a minimum implement a complete stage of the light rail.”

Bus lanes to light rail lines
“In the intervening period the city has decided to establish bus lanes e.g. at Nørrebrogade – Randersvej. In the future, these lanes can easily be modified to light rail lines. Today, there are two traffic lanes for cars in each direction plus bus lanes on each side of the car lanes. During future changes to the light rail, the existing bus lanes will be converted to ordinary lanes, while the middle lanes will be reserved for the light rail lines without the need for any major reconstruction of traffic lanes, bicycle path, pavement, cables or buildings. The unique aspect about this project is that we constantly have light rail projects in mind while establishing bus lanes.”

In balance with other transport modes and urban space
“One of the challenges was to create a balance between light rail and other transport modes in the city. We had to incorporate light rail alignment in the constricted urban space and narrow streets. In places where the city will be opened towards the harbour there are certain requirements for design, pavement and the interaction with the other traffic.”
Light rail in Aarhus
Location: Denmark
Period: 2000-2015
COWI services: planning, development, design and tender of light railway
Client: Municipality of Aarhus
Project value: approx. EUR 147 million
Travel time has always been an important issue in public transportation as well as comfort, convenience, climate and environment. In recent years, more and more diesel driven trains are replaced by electrified rolling stock. This calls for specialists in the fields of traction and power supply – and COWI can supply this expertise in full.

Our experience covers tasks related to stationary and mobile facilities as well as the electrification of high-speed train projects – on an international level. This profile is a great advantage because different countries have different systems with potential differences.

**Interdisciplinary work a trademark**

COWI can manage the power supply, train station facilities, telecommunications as well as heating of switches that can freeze in sub-zero weather conditions. We also have experience with electrical transformer stations and overhead wires.

COWI’s trademark is work methods that rely heavily on interdisciplinary cooperation. We are familiar with all steps of design, and work with traction and power supply in feasibility studies, tendering, reviewing and supervision.

**Safety and security systems**

COWI also has substantial power supply related experience with structures. For example the powering of the many large railway bridge construction projects in which we have been involved, technically ingenious solutions and environmental matters often walk hand in hand.

In these projects, we have also worked with safety and security systems where reliability is required. These systems will monitor the physical impacts on bridges caused by, for example, wind, temperature changes and humidity.
Empowering railway connection

The Great Belt Fixed Link is one of Denmark’s main arterial connections. It links the Danish capital of Copenhagen with mainland Europe. The connection consists of a combined road and railway bridge to the west and an elevated bridge and a railway tunnel to the east.

COWI has been awarded a framework contract embracing power supply of the entire railway connection across the Great Belt, including the train stations on each side, tunnel areas, bridges and ramps and specialised areas such as traction power supply.

Unique sectionalisation of traction power supply

“COWI has been involved in the development of a new advanced concept for sectionalising of traction power supply for the Great Belt railway link,” says COWI Power Supply Specialist Joana Rasmussen. “It is the first major application of fully sectionalised indoor equipment, based on SF6 circuit breaker technology in traction power supply in Denmark. The concept is unique because it introduces compact switching stations that are associated with extremely high reliability and power supply security. At the same time the need for track blocking in relation to revision and restoration works is eliminated.”

New switchgear stations

“COWI assisted in the planning, tendering and procurement of new indoor switchgear stations equipped with remote control. COWI also assisted with commissioning and testing of the equipment as well as detailed design of high voltage cable routing, calculation of the traction power supply system, preparation of documentation for cable connection and overhead contact line works. The project was based on the analysis of functionality and vulnerability of the existing switchgear and catenary system.”

Compatibility of the system

“One of the main challenges was incorporation of the new switchgear system in the national power supply control centre. The main task was to secure system compatibility of the new switchgear system at Great Belt with the existing sectionalisation of the traction power supply in the rest of Denmark.”
Telecommunication

With the two worlds of telecom and datacom in the process of merging because of technological developments, the demand for knowledge in both areas is growing. COWI is at the forefront of the evolution, and has been working in different areas of information communication technology for many years.

COWI’s experience comes by way of very different projects, from large international projects to local networks. Concerning railways, COWI’s experts are highly skilled in the field of electrical and mechanical installations and working with systems for monitoring and control, e.g. control centre facilities.

Monitoring is vital

COWI’s telecom and datacom engineers are also skilled in working with triple play services combining televisions and telephones with high speed internet access. When working with relatively complex equipment on railways, monitoring and error management is vital. COWI has wide experience in customising and centralising supervision technologies – not least when it comes to transmission networks that are often the backbone of a system.

COWI also operates with different kinds of buffers or emergency networks to secure that projects avoid system failure, and that the safety of railway passengers is not compromised in any way. In reality, this is sometimes done by laying down additional cables to create a ‘fail-safe’ system.

Modernising telecommunication on the corridor

The Lithuanian railway network plays a central role in freight transport in the Baltic region, and developing information technologies and modernising telecommunications are central elements. COWI assisted the Lithuanian Railways (LG) in their effort.

After preparing tender documents, COWI’s project team supervised laying down the new fibre optic transmission networks along the 275 km of railway tracks linking Klaipėda and the Lithuanian capital of Vilnius, the Railway Corridor IXB. COWI also assisted in setting up a new telecommunication management system.

Transporting data as well as cargo

“We made sure that the system is easily monitored centrally from Vilnius. This is a great advantage in terms of operation and management. Another part of our job in Lithuania was to upgrade transmission lines and supply new telephone switches on the stations along the route as well as installing data communications equipment,” explains COWI Project Manager Arni Klein Jacobsen.

“Of course, it can be challenging to work abroad because of differences in organisational cultures and linguistic barriers. In this project, however, we had an very strong cooperation with our Latvian contractor, and we actually managed to have completed all works ahead of schedule.”

“Thanks to this project, the Lithuanian Railways are now capable of transporting data as well as people and goods. It is our hope that this new ‘information highway’ will add to the growing business of the Lithuanian Railways and their customers by providing attractive, efficient, and sustainable business partnerships.”

Modernisation of telecommunications on Corridor IX B

Location: Lithuania


COWI services: feasibility studies, tender design, environmental impact assessment screening and supervision of supply and installation.

Client: Lithuanian Railways

Project value: approx. EUR 31 million
Signalling

COWI has profound experience when it comes to signalling. We have worked with requirement specifications, detailed design of interlocking systems, digital automatic train protection systems (ATP), train integrity supervision, ERTMS, and data monitoring of signal system functionality.

Based on individual concepts of traffic rules, we offer our services of trafficable and technical solutions in planning and engineering to national authorities and suppliers, consultants and contractors of signalling systems. We are particularly experienced in the commissioning of signalling systems.

On the basis of thorough analysis, we can help our clients in optimizing solutions when planning, installing and building total interlocking and command control systems to secure safe and reliable train traffic.

New technologies

COWI also manages tenders and supervision as well as customised “executional planning” – the manufacturing of handbooks tailored exactly to each individual client’s needs. We assist companies in purchasing the appropriate equipment in an ever changing market place.

The trend in worldwide signalling is away from stationary trackside signals and towards contact circuits directly on tracks, with systems such as CBTC and ERTMS that secure an increased degree of safety and interoperability throughout the European rail network. It also offers users long-term cost reductions.

COWI advises clients on the latest technological trends and equipment and we can also advise our clients on how to optimise personnel performances with new technologies.”
Sending the right signals

Norway, like many other countries in Europe, has decided to introduce a new signalling system. Jernbaneverket (the Norwegian National Rail Administration) has chosen the ERTMS Level 2 system as the future platform for signalling systems in Norway.

A pilot railway section – the East line of Østfoldbanen – has been identified and the preparation of a tender design for the supplier’s contract has commenced. This will cover a specification of the requirements and the development of the operational scenarios for the pilot section line and the entire railway network in Norway has begun.

Operational scenarios
“COWI is employed by the client to develop operational scenarios. The operational scenarios describe how the ERTMS Level 2 system should work in operation, include references and define needs for national regulations. They consist of a text, a figure and a flowchart that explain the actions for the participants,” says COWI Signalling Specialist Kjell Åge Hagemoen.

Common understanding among stakeholders
The goal is to establish a common understanding among stakeholders of how train movements are managed in the ERTMS Level 2 system. “The implementation of the new signalling system requires the involvement of many stakeholders who do not necessary need to have in-depth technological understanding and knowledge of signalling systems. With this in mind we develop the scenarios where the level of technological detail, the presentation itself included visual aids/drawings are balanced to help create a common understanding among stakeholders.”

Challenging EN50126
The development of operational scenarios must follow the rules, norms, standards and procedures described in EN50126 (European standards and procedures regarding RAMS requirements). “It is a very challenging task as it requires thorough registration, documentation and traceability of each step. COWI’s knowledge and practical experience with signalling, ERTMS and EN50126, has helped us to meet this challenge successfully and develop the operational scenarios in compliance with the EN50126 ensuring sending the right signals.”

ERTMS level 2
Location: Norway
Period: 2009- ongoing
COWI services: development of operational scenarios
Client: Jernbaneverket
Project value: multi million EUR project
Rolling stock

COWI has carried out many railway projects with emphasis on rolling stock covering all aspects such as cost and financing, quality of operation and relevant experience in infrastructure. We are integrating all these aspects in a project – whether it concerns light rail, metro or conventional railways.

What ties most rolling stock projects together, is the operators’ and users’ demand for the ability of rolling stock to provide a required level of operation, and for criteria such as reliability, safety and punctuality to be foremost. We provide operators with valid information which enables them to make the correct decision before they acquire rolling stock.

Variation as a rule of thumb

One of COWI’s major challenges as a consultant is to present an overview of the advantages and disadvantages of different types of rolling stock. Operators have different ideas of what kind of rolling stock suits their particular requirements such as diesel rolling stock, electrified rolling stock, multiple units or traditional rolling stock, all depending on the client’s infrastructure and conditions of operating. COWI can assist in selecting the appropriate stock for the client.

We compare different types of rolling stock that may be of value to our clients. This provides the client with a broad selection and at the same time counteracts the probability of clients setting up too specific parameters for selection in the early phases of a project.

Apart from the technical specifications, price is a very important factor in selecting rolling stock. In addition to the purchasing price lifetime cost which includes purchase, maintenance, spare parts, overhauls and in the end disposal of the rolling stock must all be considered.
Combining needs with possibilities

The Yerevan Metro in Armenia has seen better days. In the 70’s and 80’s, the city of Yerevan experienced fast development and growth and the construction of its metro was not only seen as an improvement of the city’s transport system but also as a sign of prosperity and prestige. Over the years Yerevan Metro struggled to maintain the existing metro because of limited financial resources. Recently, they received a grant from EBRD for the modernisation of the Yerevan Metro.

Due diligence
COWI assisted the EBRD with the technical, financial, operational, environmental and social due diligence for the proposed projects. The project aims to verify and prioritise Yerevan Metro’s investments in rolling stock and related structures as depots, marshalling yards, etc.

Extensive investment needed in rolling stock
The first step was to carry out a condition assessment of existing rolling stock and related structures. “It did not take long to conclude that the client’s maintenance staff have done their best to keep things running and working,” says COWI Rolling Stock Specialist Steffen Hartig. “Parts of the existing rolling stock and structures should have been replaced a long time ago, and even a very good maintenance team would not be able to keep them working forever. Everywhere we looked we saw the need for extensive investments in rolling stock and related structures.”

Prioritisation of actual needs
The next step was to prioritise the investment needs in close cooperation with the client. “It was a challenging task as we had to combine the client’s investment wishes, the technical level of existing rolling stock and related structures together with the possible future. It is not recommended to invest in an advanced and complicated rolling stock system if the client does not have the necessary staff to operate it and tools to maintain it. However, COWI’s many years of experience in rolling stock combined with the client’s knowledge of their own critical needs helped to define and prioritise the actual needs.”
Risk and safety management

Risk and safety management is a highly developed discipline in COWI and an integral part of project management on all levels. It focuses on identification, registration and mitigation of risk and is applied to our railway projects as an ongoing process. It is a vital part of the management basis for decisions. To ensure uniform and consistently high quality, COWI uses comprehensive standard procedures for project management with respect to risk and safety issues.

The process is implemented by a very strong group of risk specialists within the company. COWI offers a broad spectrum of services within risk and safety management related to railway projects including hazard identification and hazard screening, detailed quantitative risk analyses, and safety assessments including preparation of safety cases.

Qualifications and experience

The qualifications and experience of COWI's risk specialists are outstanding in the national and international context. We have extraordinary knowledge of the existing safety standards, in part gained through assignments for authorities with the purpose of defining and reviewing such standards.

Innovative and alternative solutions

Working with safety norms and standards does not only encompass solutions securing safety based on the existing safety standard and norms. COWI experts focus continuously on the development and search for new solutions which provide the basis for adequate safety and improved value for money.

RAMS

Reliability, Availability, Maintainability and Safety (RAMS) are central issues in railway projects. COWI offers RAMS management as an integral part of our railway services. Our experienced specialists are supporting project teams with RAMS management services and advising clients on RAMS matters at many levels. RAMS management is applied in all project lifecycle phases and includes establishment of RAMS policy and programme, analysis, specification of RAMS requirements, reliability centred maintenance planning, RAMS demonstration and failure reporting and corrective action system (FRACAS).

COWI RAMS services include entire railway systems, rolling stock, railway technical installations, facilities and subsystems such as train sets, signalling systems etc. through details such as station escalators and ticket vending machines.

COWI also offers services of high priority to clients comprising reliability centred maintenance and reliability based service contract specifications for outsourcing of operation and maintenance.
Simple solutions are often best

In connection with the railway capacity extension between Copenhagen and Ringsted, two options are proposed: extension of the existing railway line with an extra track and construction of a new railway line including a tunnel section.

Risk assessment

"In connection with the analysis of the tunnel section, a hazard workshop was held where potential hazards were reviewed," says COWI Risk Specialist Niels Baden, adding “the most relevant measures for evacuation, rescue and clearance conditions in the tunnel were also been defined.”

Two railway tunnels instead of one

“The initial proposal was for a 1.6 km long railway tunnel including relevant evacuation, rescue and clearance roads and equipment and ventilation system. We studied this scenario from a risk management perspective and instead of one tunnel we proposed the construction of two tunnels, each 800 metres long, and with 300 metres of open cut between them.”

Ensuring maximum safety

“The idea behind our proposal was to ensure maximum safety by using the topographical conditions existing in the area where the tunnels will be constructed. The construction of two short tunnels will shorten evacuation and rescue roads and minimize the cost of establishing safety systems. In addition, natural ventilation will be used instead of expensive mechanical ventilation systems. It demonstrated that the simple solutions are often the best and cheapest.”

Copenhagen - Ringsted Railway Line

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<tr>
<th>Copenhagen - Ringsted Railway Line</th>
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<tbody>
<tr>
<td>Location: Denmark</td>
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<tr>
<td>Period: 2007-2010</td>
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<tr>
<td>COWI services: feasibility study,</td>
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<tr>
<td>cost benefit analysis, conceptual</td>
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<tr>
<td>and preliminary design and</td>
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<td>environmental impact assessment</td>
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<td>Client: The Public Transport Authority</td>
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<td>Project value: approx. EUR 1.3 billion</td>
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Stations, terminals and depots

As more and more people travel and more and more goods are transported demand increases for efficient stations, terminals and depots.

COWI has many years of experience and possesses all the necessary qualifications to handle railway station, terminal and depot projects. We are familiar with working in close cooperation with architects and contractors with responsibility for planning, design, tendering and contracting, follow-up and supervision as well as operation and maintenance.

Stations – places of comfort and convenience

Stations are places where passengers can change between different means of transportation. They should be ‘user friendly’. It sounds simple, but the process of designing not only functional but also durable stations is a complicated one. COWI designs stations taking the passengers’ experience into consideration and focuses on flexibility. Passengers should be able to easily find their way around and be able to locate and access the means of transportation they require.

It is also vital that passengers feel safe when using, entering and leaving the station premises. COWI implements safety planning as a natural part of station design so that aesthetics meet functionality. A railway station should be a place of comfort and convenience that provides users with easy and secure access to facilities and transportation.

Terminals – facilities requiring space

COWI has many years of experience in the field of railway terminals. When terminals include railways they require much space. Consequently, good coordination between different stakeholders is essential and comprehensive.

Depots - facilitating trains and stations

Depots are fundamental to railway operation. Trains have to be washed and take fresh water and oil onboard. Toilet tanks need to be emptied, and used water must be changed for clean water. Many different kinds of trains pass through depots, and therefore COWI focuses on flexibility and universality when designing depots to provide good service to everyone.

Security is another keyword in connection with depot operation. Very often, depot work takes place where space is limited and trains operate nearby. Therefore, depot platforms need to possess reasonable height, shape and construction which also take into account the handling of electric gear such as the changing and maintenance of contact wires.
Creating a new junction

Flintholm Station is an important junction and interchange station in Copenhagen, linking Metro, S-train lines and other forms of transportation from many directions. Every day, tens of thousands of passengers pass through the station.

COWI was retained as consultant on the project since the early stages of drawing up project propositions through to detailed design. Flintholm has now grown to become Denmark’s busiest train station in record time.

Characteristic shape

“This was one of the largest Danish rail projects ever. Apart from feasibility study and design, COWI delivered services within traffic management, drainage works and electricity. It was a challenging process. For instance, we had to move the tracks on the S-line to maintain operation while the work on the station proceeded,” explains COWI Project Manager Erling M. Bødker.

Flintholm has a very characteristic composition on two levels, with the metro and S-train lines crossing above another S-train line and bus terminal - all under a large monumental glass roof. This allows short and thus convenient walking distances between different modes of transportation and means that commuters save time.

Award winning design

Flintholm Station has won several design awards, including the European Steel Design Award. A total of 3,000 tons of steel has been used on the station, a large part of which can be seen suspended above the station in the form of the uniquely designed 5,000 m² roof that draws on many of the advantages that steel offers as a material.

Flintholm Station
Location: Copenhagen, Denmark
Period: 1999-2003
COWI services: feasibility study, preliminary and detailed design of all works at station, environmental impact assessment, preparation of tender documents, construction management and supervision of works
Client: Danish National Railway Agency
Project value: app. EUR 60 million
Civil works

COWI has global experience of interdisciplinary civil works related to railway projects including architecture, conceptual and detailed design, tendering and contracting, supervision services and project follow-up. COWI also offers capacity assessments, feasibility studies and other analysis that may be useful in the process of creating civil works.

A broad spectrum of services

COWI can undertake all services concerning civil works. COWI is a leading consultant in the world within bridges and tunnels. Rail stations designed by COWI receive recognition and win awards. COWI also has considerable experience with facilities for the disabled, level-crossing barriers, emergency facilities, ventilation, embankments and footbridges to replace regular interchanging.

Innovative thinking

In the process of construction or rehabilitation of railways and railway areas, COWI’s specialists are often faced with the task of designing and developing entirely new construction or re-designing civil works along the tracks. New construction presents new challenges, as do alterations to existing works. This entails thinking innovatively in specialized fields such as traffic planning, electrical and mechanical installations and noise control for areas where substantial changes are made. This is most important when residential areas may be impacted by rail works.

Safety issues

COWI’s experts can devise noise mitigation strategies to reduce environmental noise generated by railway projects that may disrupt neighbours of the railway. Also, safety is always a factor to be taken into account: primarily in connection with capacity and accessibility and the interaction and co-existence of different types of traffic, both light and heavy.
Creating civil works that work

The capacity of the approx. 20 km long single track railway between the towns of Lejre and Vipperød is fully utilised during peak hours. As the section has only one track, a delay quickly spreads and not only influences trains behind the delayed train but also trains going in the opposite direction.

The Public Transport Authority has initialised technical and environmental investigations as a first step towards the capacity improvement of the section. Within civil works COWI has carried out investigations regarding the level crossings, establishment of new roads to replace the level crossings and the renovation of existing platform facilities at the stations.

Safe crossings
“The existing level crossings delay road traffic. Moreover, they constitute a safety risk,” says COWI Discipline Leader Lars Rene Iversen. “Grade separations will be constructed in order to eliminate the problem.”

Catalogue of possible solutions
COWI carried out detailed local traffic counts to find the optimum road alignments. A catalogue was prepared with three to six possible solutions for each location. Based on the catalogue and public hearings, the road authorities and the Public Transport Authority selected a solution which they believed was the best technical and economic solution for each location.

Roads replacing closed crossings
“There was close contact between the above stakeholders and various citizen groups during the entire project. The project was subject to public hearings, and particularly the alignments generated much interest and comments. The alignment of new roads is of great importance to the local society as it influences its future development.”

Stations layout
“The line section will be serviced by newer trains. COWI made an assessment of the station layout. At all stations grade separation will be established between the platforms and the height and the length of the platforms will be adjusted to the future train operation.”

COWI prepared a conceptual design of the selected solution which formed the basis for the decision in the Danish parliament about the construction bill and the implementation of the project.
African railway bridges well maintained

Concessionaire, Rift Valley Railways (RVR) took over the operation and maintenance of the main railway line from Mombasa in Kenya to Kampala in Uganda, including related rolling stock.

COWI has carried out a railway bridge study in order to determine the condition and the load bearing capacity of the existing railway bridges.

100 years old railway bridges
The 700 km long Mombasa - Kampala line is a main single track line with 1 m gauge. A train passes approximately 200 bridges on its way from Mombasa to Kampala. RVR had selected the 7 longest railway bridges, located both in Kenya and Uganda, for inspection and assessment in order to achieve an estimate on the actual condition and capacity of the railway bridge stock. Most of the bridges are constructed more than 100 years ago and most of them according to a standard British design. They are up to 200 meters long with a span length typically between 10 and 20 meters. Among them are general steel and concrete railway bridges and a few bridges with special designs.

Condition evaluation of the bridges
"COWI’s team has carried out inspections, condition evaluation and load capacity assessment of the bridges. We could very quickly conclude that the bridges were in quite good condition,” says COWI Project Manager Henning Pedersen. “They have been inspected and maintained regularly, so their condition was much better than expected.”

Assessment of load capacity
“Another issue we worked on was an assessment of load capacity. We could document that the load capacity of the bridges is according to the design criteria on which the original design had been carried out. We could conclude that the load capacity is sufficient according to the actual train loads related to the railway operations today. However there is a need for some upgrading if speed is to be increased and passenger comfort and safety improved. ”

Collaboration with RVR and the local railway staff
“The entire study was carried out in Kenya and Uganda in close collaboration with local RVR railway staff. The representatives of RVR, actually the former Kenya and Uganda Railways maintenance managers, acted as counterparts in the desk studies and in the inspections. This proved to be very helpful as we could receive any necessary and valuable information immediately. In dialogue with the RVR and International Finance Corporation and KFW Bank Group, we have defined the necessary level of maintenance, recommended the immediate remedial works (repair and strengthening works) together with making an estimate of time and costs for rehabilitation works. All this was included in our final bridge study report.”
For further information please contact COWI Business Development Director, one of our Business Development Managers or one of our offices near you. Contact details for our offices can be found on www.cowi.com

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