

LRT CAPABILITY STATEMENT





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GENERAL

COWI aims to be at the forefront of global megatrends and challenges, and we believe that all transportation projects must consider the inevitable changes imposed by a world undergoing rapid development in order to be viable and future-proof. Globalisation, increasing urbanisation and population growth as well as climate change and digitalisation will continue to shape our society. As a result, the size and complexity of infrastructure projects will multiply, bringing into play multiple objectives and success criteria. The rapid increase in urban populations results in increased congestion, air pollution and economic losses caused by delays through poor transport links.

Light Rail has become increasingly popular for city centres across the globe. It offers significant benefits over other forms of public transport in this environment, improving connectivity and linking communities. LRT is more cost-effective than metros and monorails, which require extensive tunnelling, or major structures. They assist in the regeneration of city communities and promote increases in the value of properties along the route.



GLOBALISATION



URBANISATION
AND POPULATION
DEVELOPMENT



SUSTAINABILITY



PROJECT
COMPLEXITY
AND SIZE



DIGITALISATION



COWI

As a multidisciplinary company, COWI provides all the knowledge and expertise you need to achieve a complete, integrated railway solution. Regardless of the project size and phase, you can count on our expertise and high-quality services to obtain a sustainable transportation solution that matches your needs today and tomorrow.

The COWI Group has approximately 7,300 employees including 600 railway engineers and specialists in 25 countries. With a turnover of approximately EUR 831m in 2018, COWI Group maintains its position as one of the leading consulting companies in Northern Europe as number 10 on the ENR ranking list for mass transit. Based in Denmark, we build on Scandinavian values and a long tradition of creating smart and reliable transportation solutions that are economically, socially and environmentally sustainable.

Innovative methods, new technologies and digital tools support close dialogue with our customers and partners to enable us to meet your challenges. Our world-class specialists deliver integrated solutions throughout the entire project lifecycle, from feasibility studies and design to operations and maintenance, always catering for our customers' individual requirements.

SUSTAINABILITY

If we, in unison with our clients, want to build a better world project by project and create coherence in tomorrow's sustainable societies, we must not only realise this vision through our projects but also integrate it into our internal business processes. This means that sustainability is one of our focal points and comprises integrating social, environmental and business ethics concerns in our business operations.

COWI is committed to the universal sustainability principles and UN goals to minimise negative environmental impact and contribute to environmental diversity. Our main contribution to sustainable development lies in the services we provide for our customers.

We take into account environmental and social aspects in connection with the tasks we perform and seek to further contribute to sustainable development through constant improvement of our services, through our operation, and through dialogue and co-operation with the world around us.

Our commitment to sustainability and Corporate Social Responsibility (CSR) is an extension of our fundamental values and is reflected in our support to the UN Global Compact, the FIDIC Code of Ethics and the UN Caring for Climate.



LRT

Urbanisation is accelerating, requiring new transportation solutions. Today, more than half of the world's population already lives in cities and towns and the proportion is increasing. At the same time, the world is facing the challenging consequences of global climate change. Increasing congestion and pollution calls for fast, reliable, clean and safe multi-modal transportation systems that can take vast numbers of people from one point to another, while creating strong coherence within and between cities. Urbanisation and the demands of modern society are posing significant challenges for infrastructure in cities across the globe. More than half of the global population live in cities and towns and by 2025, 37 cities alone will house 10 per cent of the world's population, equalling around 800,000 million people. Urbanisation calls for smart transport solutions as a part of the urban development.

Presently, we are involved in the planning and design of the four new light rail systems that have been completed, are being constructed, or planned in Denmark and the new light rail system in Bergen, Norway. COWI has been involved in all phases of the projects from initial feasibility studies to detailed

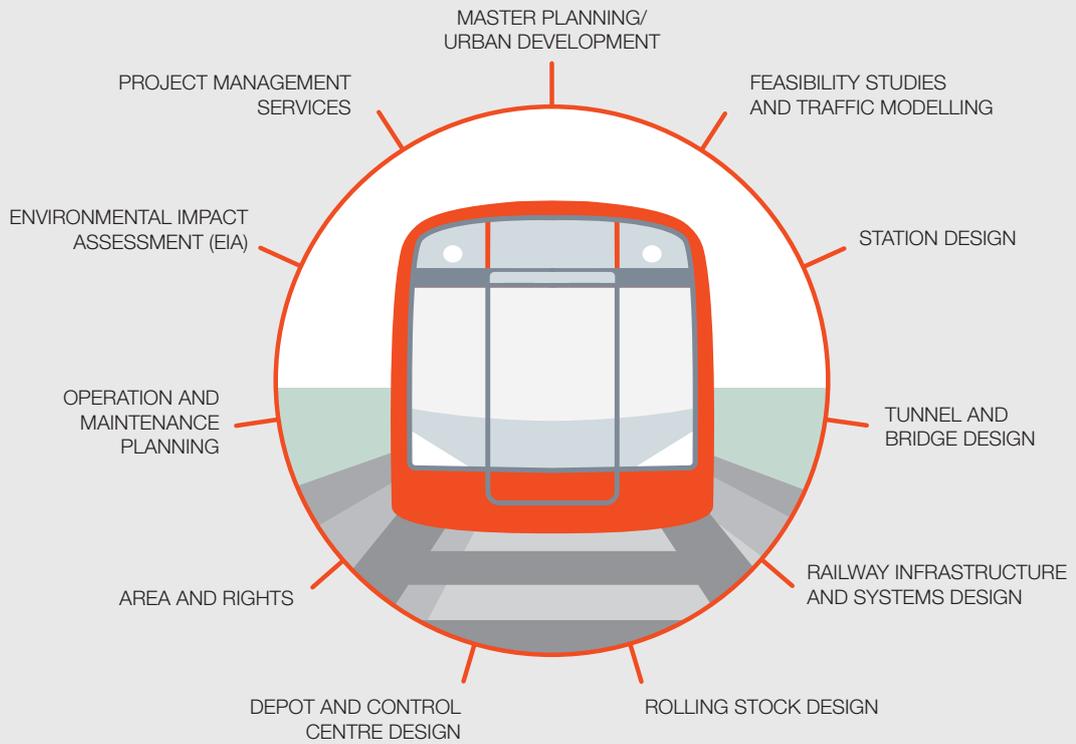


design, technical specifications, supervision of construction works and adjustment of the existing infrastructure that is affected by the light rail line. In close cooperation with our customers, we endeavour to find optimum solutions that balance construction and operational costs as well as limiting social, environmental and climate impacts.

Light rail solutions offer significant benefits over other forms of public transport providing high capacity movement of people in a space efficient, zero emission and sustainable solution. Throughout the world the growth of modern light rail transit systems has been a powerful enabler in driving urban development in those areas.

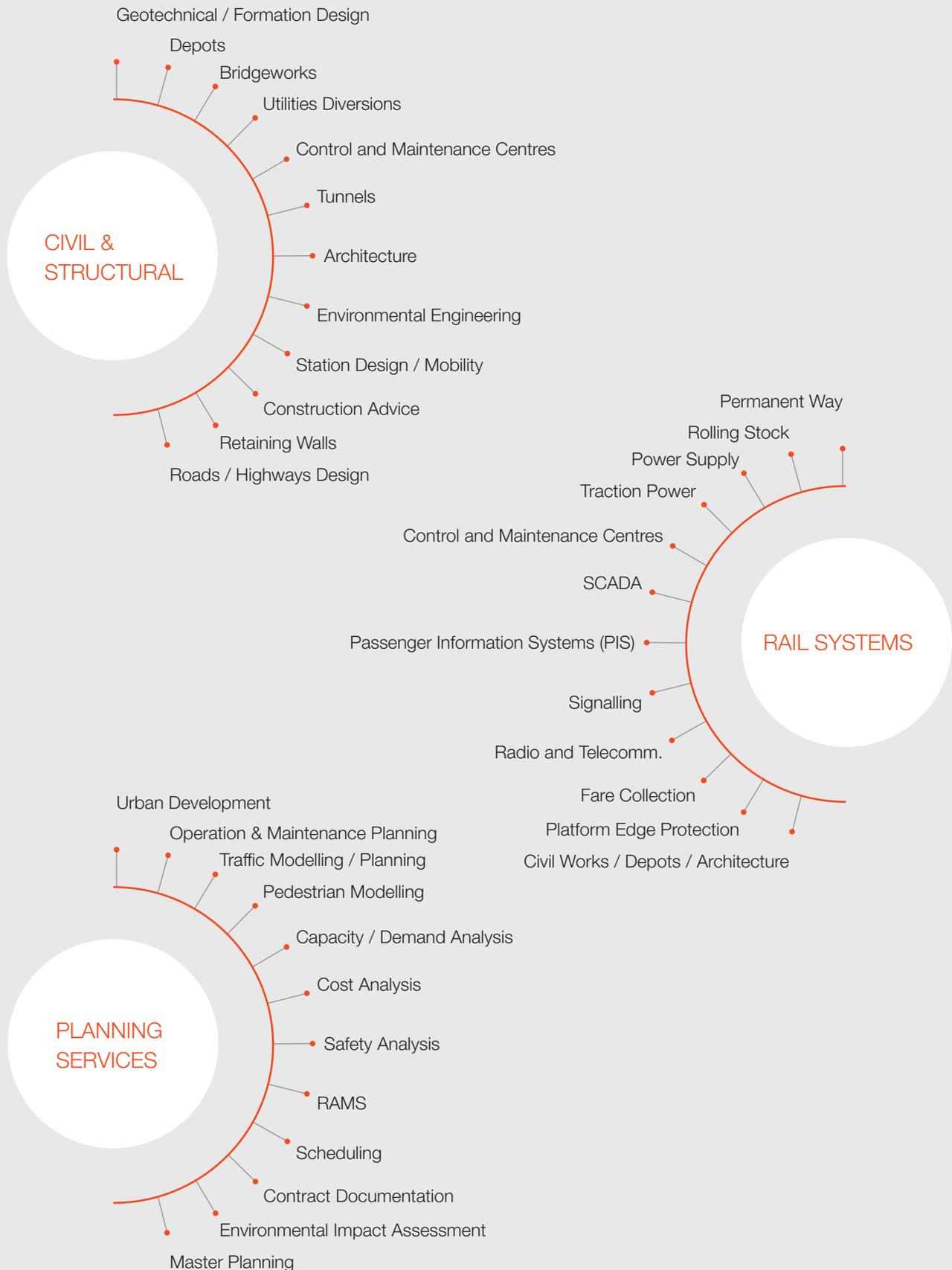
COWI draws on years of experience from major mass transit projects to deliver the right solutions for you and your stakeholders. To us, this means ensuring seamless integration to existing systems and networks, optimising end users' travel experience and using state-of-the-art technology to add value that is viable not just today, but also in the long term. We set up our teams of railway specialists, based on their competencies to meet our customers' specific challenges at all times, scaling our efforts to meet peak demands as well as daily operational needs.

Innovative methods, new technologies and digital tools support close dialogue with our customers and partners to enable us to meet your challenges. Our world-class specialists deliver integrated solutions throughout the entire project lifecycle, from feasibility studies and design to operations and maintenance, always catering for our customers' individual requirements.



The complexity of light rail projects requires a wide range of design services and complex integration of rail systems and infrastructure with urban development. Our approach brings together strong technical competencies from concept design, through preliminary design and development of tender material to management and supervision of construction and testing and commissioning. COWI have expertise in rolling stock and in operation and maintenance and are able to advise on the appropriate depot and maintenance organisation.

LIGHT RAIL PROJECTS REQUIRE A WIDE RANGE OF SERVICES, ALL OF WHICH CAN BE DELIVERED BY COWI IN-HOUSE



FEASIBILITY STUDY AND EIA CONCEPT

- › Concept development
- › Capacity/demand analyses
- › Organisational and financial analyses
- › Infrastructure requirement studies
- › Cost estimation
- › Sustainability and lifecycle cost
- › Construction and procurement scheduling
- › Environmental impact assessments (EIA)
- › Risk assessments
- › Rolling stock analyses
- › Traffic planning and modelling
- › Risk and socio-economic comparisons
- › RAM analysis
- › Safety management, safety cases and verifications
- › Norms and standards
- › Operational standards.

CONCEPT

- › Conceptual design of transportation systems, rolling stock, structures and buildings
- › Operation and maintenance concepts
- › Reference design and durability assessments
- › Sensitivity analyses
- › Ground investigation, geotechnical studies and geotechnical baseline reports
- › Lifecycle considerations: inspection and maintenance, lifecycle cost optimisation and sustainability
- › Cost estimation and project planning
- › Risk and opportunity analysis.



TEST AND COMMISSIONING

- › Inspections
- › Test planning
- › Test witnessing and auditing
- › Integration management.

COWI are able to deliver all services throughout the life-cycle of the project

DESIGN

- › Preliminary and detailed design of railway infrastructure, tunnels, stations and bridges, mechanical and electrical installations
- › Specific individual studies and advice as regards settlement prediction, ground treatment and groundwater control, noise and vibration
- › Design management
- › Worksite design and traffic diversion planning
- › Tunnelling methodology
- › Integrated temporary and permanent works design
- › Rail systems design.



DESIGN

- › Procurement strategies
- › Tender documents
- › Programming
- › Evaluation and contracting
- › Contract documentation and management
- › Third-party validation.



CONSTRUCTION

- › Construction management
- › Supervision
- › Mitigation and alternatives advice
- › Monitoring and instrumentation
- › Interface management
- › Requirement management
- › Scheduling
- › Design verification.



OPERATION AND MAINTENANCE

- › O&M planning and mobilisation
- › Condition and construction inspection services
- › Refurbishment and decommissioning
- › Asset management systems
- › Operational risk assessment
- › Ranking of maintenance and reinvestment needs
- › Strengthening and repair design
- › As-built services.

SELECTED PROJECTS



FACTS

- › PROJECT NAME:
Aarhus Light Rail
- › PROJECT PERIOD: 2000–2019
- › CUSTOMER: The City of Aarhus
(subsequently Aarhus
Letbane I/S)
- › PARTNER: SYSTRA
- › OWNER: Aarhus Letbane I/S

SERVICES

- › Project management
- › Stakeholder management
- › Preliminary investigations
- › Conceptual and preliminary
design of all railway disciplines
- › Environmental impact
assessment (EIA) for stage 1
- › Tender strategy
- › Functional requirements for
transportation system
- › Tendering and contracting of all
works and supplies
- › Detailed design of certain
critical sections
- › Support during design
and construction
- › Construction management
and supervision
- › Land acquisition and relocation
of utilities

AARHUS LRT

The City of Aarhus is growing, in terms of both population and workplaces. To handle the growing pressure on existing transportation infrastructure and offer its citizens an attractive, greener transportation option, a light rail system has been constructed in the city – the first of its kind in Denmark.

In addition, the new light rail system connects Odder in the South and Grenaa in the North by converting the 98-kilometre existing rail line to light rail. A new 12 kilometre light rail alignment has been built in the city centre. The tram-train will run at up to 100 km/h outside the city centre with conventional trams in the city.

COWI has been lead advisor at all project stages from early planning to final construction supervision, proposing changes to road standards and preparing new, supplementary regulations on the establishment and operation of light rail in Denmark. Accepting the challenge of incorporating light rail into constricted urban spaces and narrow streets, COWI seeks to create balance between the light rail, the dense urban infrastructure and the city's existing transportation modes.



ODENSE LRT PHASE 1, DENMARK

In the City of Odense – home to some 200,000 inhabitants – a new tramway will become the backbone of the traffic system and provide access to the city's brand-new university hospital. Around 60,000 people are expected to commute to the hospital's campus each day, and when the tramway is up and running, the number of daily car rides is expected to be cut by 3,900, which will help the city become more sustainable. The new tramway will connect the new hospital, the university, large shopping centres, a stadium, the city centre and Odense Central Station.

COWI acts as technical consultant throughout the project. Many aspects must be handled, such as technical and functional requirements, design, interfaces to neighbouring projects, interaction with other transportation modes and comprehensive relocation of utility lines.

Odense Tramway will tie the city closer together and be crucial to Odense's urban development, serving 35,000 citizens, 33,000 workers and 23,000 students within a five-minute walking distance.

FACTS

- › PROJECT NAME: Odense Tramway, stage 1
- › PROJECT PERIOD: 2012–2021
- › CUSTOMER: Odense Municipality, (subsequently Odense Letbane P/S)
- › PARTNERS: SYSTRA and ETC
- › OWNER: Odense Letbane P/S

SERVICES

- › Technical consultancy
- › Environmental impact assessment (EIA)
- › Planning and preliminary design of relocation of utility lines
- › Detailed design of all civil works
- › Functional requirements for transportation system
- › Design of railway disciplines
- › Tender strategy
- › Tendering and contracting of all works and supplies
- › Supervision
- › Operational planning.
- › Test and commissioning



FACTS

- › PROJECT NAME: BRT Aalborg
- › PROJECT PERIOD: 2010–2023
- › CUSTOMER: Aalborg Municipality
- › PARTNERS: SYSTRA, Henning Larsen Architects, Kirstine Jensens Tegnestue as sub-consultants for the study phase
- › OWNER: Aalborg Municipality

SERVICES

- › Transport study
- › Environmental impact assessment
- › Local plan
- › BRT technical development

AALBORG HIGH CLASS PUBLIC TRANSPORT, DENMARK

Aalborg is Denmark's fourth largest city, with rapid growth in the population and it is expected that there will be 25,000 more residents by 2025.

COWI's initial brief was to look at options for improving public transport in Aalborg. Analysis of demand and future growth led to the selection of a 12 km route from Mølholm to East Aalborg and an investigation into both light rapid transit (LRT) and bus rapid transit (BRT) options. The Municipality rejected the option of LRT in favour of a BRT system, which would use a dedicated bus lane to allow fluid movement through the city, using the existing road infrastructure. The line will include 22 stops with buses running at intervals of 7.5 minutes.

COWI have worked on all phases of the studies from preliminary feasibility studies, EIA, local plan and the ongoing design work for the BRT solution. COWI has assessed the additional area requirement for charging stations at the ends of the line to accommodate the buses' frequencies and the charging time that must be expected for e-buses today.

Over the next four years, COWI will, in a separate contract, assist with the project planning and design management and will form the main part of the design team. COWI will have responsibility for supervision within all technical disciplines, construction management and safety coordination.



COPENHAGEN RING 3 LRT

The City of Copenhagen has the aim of achieving CO₂ neutrality by 2025, which would make it the first city in the world to reach this milestone. They recognise that public transport has a key role in tackling congestion and reducing greenhouse gases and air pollution.

The Ring 3 light rail system is seen as vital to the future growth of the city region and links 11 municipalities providing shorter travel times and improved comfort for passengers. The route will have 29 stations over a length of 27km and will carry 43,000 passengers a day on a dual track between Ishøj in the south and Lundtofte in the north. The route links will six S-Bane stations, one inter-city stop, two hospitals and the Technical University of Denmark. Trams will depart every five minutes during the week and will travel the full distance in 55 minutes at an average speed of 30km/h.

Construction contracts were awarded in 2018 to Aarslef and Siemens and the system is intended to open in 2025. COWI's role includes the conceptual design, design of the civils works and utility relocations and associated tender documentation.

FACTS

- › PROJECT PERIOD: 2015–2023
- › CUSTOMER: Metroselskabet I/S
- › PARTNER: Niras, PB/WSP and SYSTRA
- › OWNER: Metroselskabet I/S

SERVICES

- › Conceptual design
- › Utility relocation
- › Preliminary design and detailed design of selected civil works
- › Alignment determination
- › Tendering
- › Tender documents



FACTS

- › PROJECT NAME: Byggtrin 4, Byggtrin 5 and byggtrin 6
- › PROJECT PERIOD: 2015–ongoing
- › CUSTOMER: Bergen Municipality, Bergen Bybane Utbygning and Bergen Bybane A/S
- › OWNER: BERGEN BYBANE A/S

SERVICES

- › Technical consultancy
- › Planning and preliminary design for fifth and sixth sections
- › Detailed design of a temporary station for the fourth section

BERGEN BYBANE, NORWAY

Bergen is Norway's second largest city, with rapid growth in the population and it is expected that there will be 270,000 residents by 2025. It aims to be fossil-fuel free by 2030 and the extension has high ambitions regarding sustainability in the construction phase.

The first stage of the Bergen Light Rail opened in 2010, a 9.8-kilometre section with 15 stations between the city centre and Lagunen Storsenter. A second 3.6-kilometre section from Nesttun to Lagunen was opened in June 2013 and a third 7.5km section opened to operation in 2017 from Lagunen to Bergen Airport, Flesland. A fourth 13-kilometre section is under construction and is expected to be in operation in 2023. In parallel two new sections (five and six) are being planned for Bergen North and Bergen West.

COWI is acting as technical consultant for part of the fourth section for a temporary station in the city centre and are planning the fifth and sixth sections. This covers a range of services, including technical and design, system integration, interfaces to neighbouring projects and interface with other transportation modes.



ODENSE LRT PHASE 2, DENMARK

An extension to the Odense light rail system, currently under construction, is being planned, running through Vollsmose on a 12.1km section, sharing part of the route with Stage 1. It includes 7.7km of new track.

The route linking Seden to Vollsmose in the north and Odense Zoo in the south, will connect one of the most deprived neighbourhoods in Odense with the city centre. It is planned to commence operation of this section in 2026.

COWI's role is as technical consultant throughout the project. Currently planning and EIA studies are being prepared, but the overall scope includes developing technical and functional requirements, design, interfaces to neighbouring projects, interaction with other transportation modes and comprehensive relocation of utility lines.

FACTS

- › PROJECT NAME:
Odense Tramway, stage 2
- › PROJECT PERIOD:
2020–ongoing
- › CUSTOMER:
Odense Letbane P/S
- › OWNER: Odense Letbane P/S

SERVICES

- › Technical consultancy
- › Environmental impact assessment (EIA)
- › Planning and preliminary design of relocation of utility lines
- › Detailed design of all civil works
- › Functional requirements for transportation system
- › Design of railway systems
- › Tender strategy
- › Tendering and contracting of all works and supplies
- › Supervision
- › Operational planning
- › Test and commissioning



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