THE NORDICS ARE ON THE MOVE

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BOOSTING NORTH AMERICAN INFRASTRUCTURE

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SUBSEA INNOVATION

FEHMARN BELT FIXED LINK

DRIVING MOBILITY
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Creating the perfect framework for seamless mobility is a puzzle. Together, infrastructure and transport solutions serve to enhance mobility in society, connecting people and goods, knowledge and innovation, cities and regions. Mobility is a key to developing efficient liveable cities and to attracting top talents and investments. If infrastructure was a buzzword of the 20th century, mobility and connectivity have surely become keywords of the 21st. They are closely tied and scalable – from bike lanes and pedestrian paths to air infrastructure, highways, bridges, tunnels, ports and optical fibre cables.

The International Monetary Fund (IMF) and the World Economic Outlook (2014) agree: There is no time like the present to invest in public infrastructure. Low loan rates combined with stagnant growth in many advanced economies make investments in infrastructure – the backbone of everyday life – more relevant than ever.

Greater mobility also represents a paradox. While enabling growth globally and locally, it also increases environmental challenges, e.g. air pollution. Ambitious air quality strategies to reduce this mounting health threat are necessary to provide a balance that ensures sustainable society development. As sustainable society consultants, we plan and design holistic solutions that create value in a lifecycle perspective. We call it value engineering. It’s not a science or a service. It’s an essential feature of all engineering projects today. We have selected a few of these stories for your inspiration.

Enjoy this 3rd issue of Response and feel free to share any comments or feedback at response@ramboll.com.

Jens-Peter Saul
Group CEO
It’s time for a paradigm shift. If infrastructure was the buzzword of the 20th century, mobility and connectivity are the keywords of the 21st.

Infrastructure in its totality – whether roads, railways, bicycle paths or fibre-optic cables – should serve as a means of enhancing mobility in society. Of connecting people and goods, knowledge and innovation, cities and regions.

“We need to put the concept of mobility at the top of the agenda. Mobility is required not only for developing efficient liveable cities but also for attracting top talents and investments,” says Neel Strøbæk, Ramboll’s Group Market Director of Planning & Urban Design.

The last-mile barrier
There is no time like the present to invest in public infrastructure, concludes the International Monetary Fund (IMF) in
Above: Europe’s basic infrastructure is generally satisfactory. The weak point is short-distance connectivity, also known as the last-mile barrier – people’s need to get to public transport from their homes and offices and vice versa.

Left: Since 2010, the Copenhagen Metro has experienced massive passenger growth, and users have also become more loyal. The positive trend can be traced back to a commercial strategy based on an extensive study of transport and travel habits in Copenhagen.
A large number of significant infrastructure projects have been initiated in the Nordics within the past year. Ramboll is prominently involved in several of them. The infrastructure projects now underway will upgrade all major modes of transport across the Nordic countries, with highways, railways, light rails and metro lines being built or improved between the region’s largest cities. The Nordics are on the move.

Selected Nordic infrastructure projects

**Denmark:** Rail speed upgrade Aarhus-Hobro (Rail Net Denmark), EIA design for rail bridge, Vejle Fjord (Danish Road Directorate), Light rail along Ring 3, Greater Copenhagen (Metroselskabet), Planning and design for a new road tunnel ‘Nordhavnstunnel’.

**Sweden:** Metro extension in Stockholm (Stockholms Län), Molnby depot for 70 train sets, Valgentuna-Stockholm (Stockholms Län), Reconstruction for bus and light rail depot, Tomteboda (Zero Chaos/SL).

**Norway:** Intercity railroad Sandbukta-Moss-Såstad (Jernbaneverket), Ring highway project in Kristiansand (Statens Vegvesen), Signalling design, Follo Line, Oslo, (Jernbaneverket).

**Finland:** Extension of Helsinki-Espoo metro (Länsimetro Oy), Highway 6, Taavetti-Lappeenranta (Finnish Transport Agency), Project plan for light rail, Helsinki-Espoo (Finnish Transport Agency).

Oslo is focusing heavily on public transport, new metro lines and bikes in its development strategy.

He adds that the basic infrastructure across Europe is generally satisfactory. The weak point is short-distance connectivity, also known as the last-mile barrier – people’s need to get to public transport, the train station, for example, from their homes and offices and vice versa.

“In my view connectivity is more important than mobility. Because connectivity can maximise the use of all our various transport systems and cover the majority of those short-distance trips, which are the core of liveable, sustainable cities,” says Alan Pauling.

**When congestion stifles growth**

And the challenge is democratic in the sense that both developed and developing countries are struggling with connectivity at different levels.
With one million inhabitants, the greater Oslo region in Norway has already reached its full rail and road capacity. The population is projected to swell another 30% by 2025, a projection that has the local government already hard at work improving mobility, for instance, by promoting bicycle use and developing new mixed-use city districts.

“We’re focusing heavily on public transport, new metro lines and bikes. Plus a city development strategy that promotes the notion that walking and using your bike or public transport can improve mobility even though the population is growing,” says Bård Folke Fredriksen, a member of Oslo’s city council.

An integral part of these efforts is the Follo Line, a 23-km railway that will allow much faster and more frequent trains to Oslo from the south, thus enhancing connectivity between Oslo proper and the commuter town of Ski.

Until now, this south line has caused a huge bottleneck in metropolitan traffic. The Follo Line, Norway’s largest transport project, will boost rush-hour capacity by 63%.

As one of the world’s most densely populated areas, Manila in the Philippines has 12 million people crammed into a space of just 638 km². The ensuing congestion, heavy pollution and lack of infrastructure limit the city’s potential, thus stunting the economy of the East Asian tiger for which it is capital.

A large-scale transport plan for Manila Bay – encompassing overall infrastructure, a new airport and a seaport – could untangle this megacity’s mobility jam, better interconnecting air- and seaport facilities.

Richard Florida, Director of the Martin Prosperity Institute at the University of Toronto and Global Research Professor at NYU, coined the phrase “the creative class” and was named one of the world’s most influential thinkers by MIT Technology Review.

“The driving force behind any effective economic strategy is talented people. We live in a more mobile age than ever before.”

Richard Florida, Director of the Martin Prosperity Institute at the University of Toronto.

Smart mobility is the bedrock of sustainable cities

With six out of every ten people on earth expected to live in urban areas by 2030, urban mobility is key to the sustainable development of our cities. Historically, infrastructure has defined, and limited, cities, but technologies such as sensors and wireless communication enable new smart mobility solutions that let us walk away from the urban sprawl of the previous century. Solutions like contactless payments in the London Underground, Hamburg’s single citywide Wi-Fi network or real-time monitoring of traffic flows in Dublin.
“Infrastructure is the bedrock of a smart city. Going forward, cities must ensure that the infrastructure they install or upgrade has the in-built “hooks” to be smart. For instance, it’s less expensive to build in slots for sensors and communications than to come back later and retrofit,” says Jesse Berst, chairman and founder of the Smart Cities Council, an industry coalition dedicated to making cities sustainable. He adds: “Technology is our best hope for better urban mobility. Think about a single app that plans your trip and gives you step-by-step directions to the buses, trams or metros you should take. Or think about connected cars that form a caravan to reduce congestion and travel time. Or smart parking that eliminates that need to circle the block searching for a spot.”

Thinking smart
Over the past few years, the City of Copenhagen has spent around DKK 500 million – USD 75 million - on smart technology like intelligent traffic lights and street light systems to increase the city’s efficiency.

“It’s not just about smart technologies, but arguably more about smart choices. About creating mobility solutions that improve liveability and quality of life in our urban areas by boosting the efficiency of our cities,” says Neel Strøbæk.

It is also a matter of attracting the right people.

“The driving force behind any effective economic strategy is talented people. We live in a more mobile age than ever before. People, especially top creative talent, move around a lot. A community’s ability to attract and retain top talent is the defining issue of the creative age,” explains Richard Florida, Director of the Martin Prosperity Institute at the University of Toronto, Global Research Professor at the New York University, founder of the creative class phrase and named one of the world’s most influential thinkers by MIT Technology review.

Mersey Gateway: More than just a bridge
In many ways the upcoming Mersey Gateway captures the essence of mobility and connectivity. Not only will the bridge improve the flow of vehicles, people and goods – it will also connect the two communities on either side of the river, thus stimulating economic growth and investments in the local district of Halton.

When this new six-lane toll bridge is inaugurated in 2017, it will relieve the congested Silver Jubilee Bridge,
currently providing the only means of crossing the river and handling traffic ten times heavier than originally intended. From 2017, the Mersey Gateway will reduce journey times by as much as 10 minutes in peak periods while also enabling local residents to walk or bike across an almost traffic-free Silver Jubilee Bridge. This improved connectivity between the two towns of Runcorn and Widnes and access to safe, direct pedestrian and cycling links to the national rail network will remove the connectivity barrier. The local authorities hope to create 4,600 permanent new jobs, bringing GBP 61.9 million - USD 96.2 million – in Gross Value Added per annum by 2030.

Rein Ahas, professor and researcher at the Academy of Sciences of Estonia, predicts that the existence of intelligent urban systems will define the third generation of smart cities. These systems will be able to forecast the need for mobility, punctually dispatching transport to the required route and solving the last-mile connectivity problem at the same time.

“With just 3% of journey-to-work trips being made by bicycle in the UK, there’s much to do.”

Alan Pauling, Group Director, Transport, Ramboll.
AIR POLLUTION
THE DOWNSIDE OF GREATER MOBILITY
Air pollution is a major environmental health problem affecting everyone around the world, from Manila to Sao Paolo to London. In 2014, WHO released new estimates showing that exposure to air pollution killed around seven million people in 2012 – one in eight of total global deaths. This finding was more than double the previous estimates, and air pollution has now become the world’s single greatest environmental health risk.

Although emissions from industries and private households impact urban air quality, traffic bears the brunt of the responsibility. The globally rising demand for instant mobility has led to a 57% increase in the number of motor vehicles worldwide. Today, more than

‘Although there are no universal air quality management strategies applicable to every city in the world, evidence suggests that a comprehensive, sustainable urban mobility approach would have a significant impact on emission reductions and result in extensive co-benefits through local improvements,’ says Julia Lester, Principal and air quality expert. Such approaches include providing cycling and walking facilities or attractive and reliable alternatives to the private vehicle.

Every year, air pollution kills millions of people globally. Emissions from heavy traffic and congestion are among the biggest culprits. Ambitious air quality strategies are needed to reduce this growing health threat.

By Martin Zoffmann
1.1 billion cars congest the earth, causing the same pollution that would come from burning all the coal on a fully loaded train stretching 304,000 miles or 12 times around the equator.

**Proactive rather than reactive initiatives**
The problem is most pressing in the megacities of India and China, places like Beijing and New Delhi, but smaller cities in the USA and Europe are also suffering from increasing air pollution. How do cities tackle this challenge - and are they doing enough?

“Over the last 20-50 years, mobility and road safety have far and away been the predominant objectives of most large transportation and infrastructure projects conducted worldwide. Some countries have implemented legislation and other initiatives aimed at reducing air pollution from traffic. Most of these initiatives, however, tend to be reactive, not proactive, and we rarely see air quality as an end in itself when new large transportation and infrastructure projects are being developed,” says Julia C. Lester, PhD, a former air regulator, now a principal and air quality expert at Ramboll Environ.

**Co-benefits**
Some cities are trying to reduce human exposure to harmful pollutants from urban transport sources by reducing pollutants from mobile sources, limiting the

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**FROM INDIVIDUAL ACTIVITY DATA TO CROWD-SOURCED PM2.5 CONCENTRATION MAP**

Elevated concentrations of PM2.5 (particulate matter with an aerodynamic diameter of less than 2.5 microns) and the associated health impacts have been very serious public issues in China in recent years. While heavily polluting industries significantly increase PM2.5 concentrations, individual residents’ day-to-day life choices also have an impact.

China’s air quality control and management market is expected to be one of the fastest growing in the world, but consulting services are typically difficult to sell domestically in China. Ramboll is developing a revolutionary three-phase PM2.5 tool that meets China’s immediate needs for air pollution information and reduction. The initial development of this tool is focused on Beijing, China’s often smog-choked capital.

**An innovative PM2.5 Tool**
The three phases include: 1) development of a mobile app to gather user-provided data, analyse PM2.5 emissions resulting from users’ daily activities and promote a low-impact lifestyle by improving awareness and providing emission reduction as well as health impact tips, 2) develop a second tool to provide a data resource for air pollution reduction and 3) develop a PM2.5 storage and archival database to incorporate crowd-sourced PM2.5 data made rapidly available via hand-held monitors and thus predict future PM2.5 concentrations in areas slated for development.
number of people exposed to elevated concentrations of these pollutants and minimising the duration of their exposure. Cities can reach these goals by implementing air quality management strategies that target automotive technology and fuels and by improving urban transport management as a whole.

"Although there are no universal air quality management strategies applicable to every city in the world, evidence suggests that a comprehensive, sustainable urban mobility approach would have a significant impact on emission reductions and result in extensive co-benefits through local improvements," says Julia Lester.

Such approaches include providing cycling and walking facilities or attractive and reliable alternatives to the private vehicle. Another option is to institute restrictions on car use or to produce cleaner technology and fuels for vehicles. Good land-use planning practices and advanced goods movement and logistics systems could also make significant contributions, as could monetary incentives created through the appropriate economic instruments. The latest WHO estimates and multiple national/state air initiatives will spur companies to devise further measures to improve air quality.

CLEANER POWER SOURCES FOR CRUISE SHIPS IN HAMBURG

Located on the River Elbe, the Port of Hamburg is Germany’s largest harbour. A rising demand for luxury cruises means that up to 200 cruise ships visit the city every year – and cruise ships need a lot of power.

At the same time, Hamburg is in the process of converting the fringes of its harbour into business and residential areas, with the so-called Hafencity project now being Europe’s biggest construction site, an area covering 127 ha of land.

Most ships use their own combustion engines to produce power, but since they run on dirty bunker fuels that emit harmful substances, residents and workers are not too keen about having the ships in their backyard.

Sustainable business case

Cleaner fuel or external power sources could help resolve the conflicting interests. The City of Hamburg has asked Ramboll Management Consulting to conduct a study to evaluate various concepts for providing electricity externally and to identify the most sustainable business case.

The best scenario is on the brink of being realised. The Hamburg government has proposed shore-side electricity, “Landstrom”, as an interim solution at the busiest cruise terminal. However, a permanent solution will most likely be developed on the ships themselves.

As Hamburg’s situation is far from unique, other harbour cities around the world can potentially benefit from the findings and use them to explain the public benefits of large investments.

NO FLARE, NO FIRE, LESS POLLUTANTS IN THE AIR

Qatar has focused sharply on controlling and reducing emissions from oil and gas plants by, e.g., introducing zero-flare systems that reduce carbon dioxide emissions to the atmosphere.

For years, flares on the Dukhan oil field on the west coast of Qatar pumped out their polluting smoke.

By remodelling and enlarging an existing flare system, improving combustion technology and finding a method of reclaiming some of the gas that would otherwise be burnt in the tower, the Fahahil Stripping Plant succeeded in minimising its adverse environmental effects. Today, the flare has been extinguished, and fewer pollutants fill the air.
The Long Beach Freeway (I-710) is a vital transport artery, linking the ports of Long Beach and Los Angeles to major Southern California distribution centres and intermodal rail facilities.

For the past 10-15 years, serious congestion and safety issues have plagued the 70-year-old freeway. In March 2005, the Los Angeles County Metropolitan Transportation Authority (Metro) completed a comprehensive study analysing congestion and mobility along the corridor, its aim being to develop transportation solutions that preserve and enhance the quality of life in the surrounding neighbourhoods and communities.

Since then, Metro and its project consultants, including Ramboll Environ, have produced an Environmental Impact Statement and Environmental Impact Report (EIR/EIS) that includes analyses exploring ways of reducing or avoiding possible adverse environmental impacts.

“The report objectives are shaped by priorities identified by stakeholders along the corridor, and they include developing transportation alternatives that will improve air quality, mobility, congestion and safety. This project is the first major US transport project to have improved air quality as a primary objective,” says Julia C. Lester, PhD, principal and air-quality expert at Ramboll Environ.

First movers
Based on a series of air quality and health risk assessments, the latest proposal from transportation agencies covers areas such as electric-charging and hydrogen-refuelling stations, zero or near-zero emissions from heavy-duty trucks as well as an I-710 Corridor Community Health Program for funding local health projects, such as better school ventilation systems and health care vans.

“None of these elements have ever been proposed for a US highway project. This makes the Long Beach Freeway project a first mover that really takes the threat from air pollution seriously. I hope it will inspire city, road and traffic planners all over the world,” says Julia Lester.
The design of the Fehmarn Belt Fixed Link rethinks existing tunnel building standards and improves functionality and safety through optimisation – above and below the water. Get a few insights on one of the world’s most innovative, ongoing mega-engineering projects of our time.

By Jesper Toft Madsen
As a new design concept, the tunnel is built from 79 standard and 10 special elements to allow smooth traffic and maintenance.

110 m
The fixed link features two-lane traffic, an emergency lane and emergency doors every 110 metres to make escape routes visible and accessible.

22
Throughout the journey, travellers will pass 22 coloured zones and moving motifs that will sharpen drivers’ awareness.

79
As a new design concept, the tunnel is built from 79 standard and 10 special elements to allow smooth traffic and maintenance.
Designing immersed tunnels is all about optimising resources. After immersion, the free space in tunnel elements needs to be ballasted with concrete. For this reason, the Fehmarn Belt tunnel elements have been designed with limited space to ensure absolute minimum resource use.

As a new concept in immersed tunnel technology and design, the underwater link is constructed from 79 standard and 10 special elements to allow for a traffic deck and a maintenance deck. Systems for electricity, communication, monitoring and drainage take up space and require maintenance. These are integrated in special elements on a lower level beneath the traffic routes, thus allowing easy access for personnel without disrupting traffic.

Safety
The safety concept features two-lane traffic for motorists, a full emergency lane and emergency doors every 110 metres to make escape routes visible and easily accessible in the event of a major accident. A simple, resilient and reliable longitudinal ventilation system with jets will fan the tunnel at 400-metre intervals and is based on a new design approach that considers future EU standards for reduced car emissions.

The tunnel consists of two road tubes with a two-lane motorway in each, a central gallery for escape and service and two railway tubes. Each concrete element can float, meaning that in the immersion phase the water’s own lifting power will carry the 217-metre-long elements, each weighing up to 73,500 tonnes.

The tunnel will be sited safely below the seabed, protected against ship anchors and other collisions.

The driver experience
Throughout the tunnel, travellers will pass illuminated zones ranging from lilac to blue, green and yellow. These zones will help keep drivers alert and indicate how far they have travelled. LED lighting will also meet motorists as they enter, drive through and exit the tunnel.

The lighting will form one-minute moving motifs along one of the tunnel walls. Altogether, the lighting experience will give the tunnel a sense of open space, resembling changing landscapes along normal roads.
Above water
The design aesthetics of a tunnel concealed 40 metres below sea level can easily be overlooked. However, landscape architects have been involved to help design a natural travel experience in which commuters from both sides of the tunnel will crest a hill for a full sea view before dipping down into the bowl-shaped tunnel entrance.

RAMBOLL’S ROLE
In a joint venture with Arup and TEC, Ramboll is the main engineering consultant on the Fehmarn Belt Fixed Link, one of Europe’s biggest infrastructure projects and expected to open to traffic in appr. 2024.
The dazzling numbers call for action and have been partially met by a new signal of intent. In his State of the Union Address this year, President Barack Obama proposed a six-year infrastructure plan worth USD 478 billion.
Heavier traffic and long-overdue maintenance. Time has caught up with many North American transport networks. Large-scale public spending plans have now been announced to close the gaps and accelerate infrastructure development. Americans are looking to Europe in their quest for long-term solutions.

By Jesper Toft Madsen

A strong sense of urgency is moving across the North American continent. Already ageing roads, bridges and railways have continued to deteriorate since the new millennium, thus curbing capacity, sustainable transportation and competitiveness.

Every four years, the American Society of Civil Engineers (ASCE) releases a report card on the condition of American infrastructure. In its latest report, published in 2013, the nation barely scraped by with a "D+", and achieving a "B" would require an investment of USD 3.6 trillion over the next seven years. The ASCE estimates that USD 1.6 trillion is needed to close the gap between planned investments and the sum required to achieve an infrastructure in a good state of repair.

These dazzling numbers call for action, and a new signal of intent from President Barack Obama has answered that call. In his 2015 State of the Union
Address, the President proposed a six-year infrastructure plan to the tune of USD 478 billion.

“Twenty-first century businesses need twenty-first century infrastructure – modern ports, stronger bridges, faster trains and the fastest Internet. Let’s pass a bipartisan infrastructure plan that could create more than 30 times as many jobs per year, and make this country stronger for decades to come,” President Obama said, referring to a Republican bill to establish the 1100-mile Keystone pipeline carrying crude oil from Canada to the Gulf of Mexico coast, that he later vetoed.

European expertise as restoration driver
The ASCE states that 32% of major roads are in poor or mediocre condition, and 42% of major urban highways are congested. This is a massive issue in view of the USA’s more than four million miles of public roads, with trucks moving some 60% of all goods.

In search of long-lasting solutions, North America is turning to European expertise. EU policymakers have traditionally taken a more expansive approach to long-term transport investments.

“North America will never become anything like the European Union. But we still might learn from Europe’s experience. EU transport policy was designed to promote economically and environmentally efficient, safe and secure transport services within the internal market and beyond. These EU plans have not been entirely successful, but we should look more carefully at what they have attempted,” argues Stephen Blank, Special Advisor to the Collaboratory on Energy, Research and Policy at the University of Ottawa, in a recent feature on opencanada.org – Canada’s hub for international affairs.
Combining aesthetics with efficiency

Delays caused by congestion and detours to avoid deficient bridges or poor pavements cost time, fuel and increased emissions. Naturally, modernising the road network is North America’s greatest transport concern. Refurbishing or replacing badly maintained, low-capacity bridges and tunnels is a key driver in this restoration phase.

Axel Emil Christensen, Senior Market Director at Ramboll, highlights projects such as the Queensferry Crossing in Scotland, the Mersey Gateway in the UK and the upcoming Fehmarn Belt tunnel connecting Scandinavia with Continental Europe as reasons that the Americans are looking overseas.

“Western Europe has a strong tradition for designing and constructing major bridges and tunnels.”

Axel Emil Christensen, Senior Market Director, Ramboll

that North America can potentially benefit from our experience within two distinct areas: First, the aesthetics – our designs have excelled because both technical experts and architects are involved. Second, design optimisation – smart resource utilisation in our designs makes our bridges and tunnels cheaper to build, and they’re more sustainable and easier to maintain,” he explains.

Ramboll specialists have already been involved in some North American replacement and modernisation projects. If more words are put into action, the ASCE expects accelerating infrastructure investments to stimulate the economy, create 2.7 million jobs, lower CO2 emissions and improve local and regional connectivity.
LOOKING TO EUROPE FOR LONG-TERM BRIDGE EXPERTISE

In the USA they are looking to Europe for expertise within bridge and tunnel design. The Queensferry Crossing (formerly known as Forth Replacement Crossing, ed.) in Scotland is Northern Europe’s largest bridge project, with world-class infrastructural solutions that are helping to inspire similar projects in the USA.

“The project will be essential in protecting and promoting Scotland’s sustainable economic growth, safeguarding a vital link in the country’s transport infrastructure, protecting thousands of jobs and securing over GBP 1 billion in economic revenue,” said Scottish Finance Secretary John Swinney at the announcement of the Forth Crossing Bridge Constructors (FCBC) consortium, for which Ramboll is lead designer.

30,000 tonnes of steel will go into building the Queensferry Crossing in Scotland - equivalent to the steel in 75 Boeing 747s.

The 2.7-km road bridge linking Edinburgh, Scotland, with the county of Fife is the largest bridge project in Northern Europe.

A catalyst for regional regeneration

In 2017, a six-lane, cable-stayed toll bridge across the River Mersey near Liverpool in northwest England will open to relieve the congested and ageing Silver Jubilee Bridge. The so-called Mersey Gateway is an integral part of the local Sustainable Transport Strategy and will be a catalyst for regeneration in the area. The scheme is expected to create over 4,000 jobs, improve travel times and reliability for millions of people and attract massive inward investment in the region.

The Mersey Gateway Bridge will be an iconic landmark. The award-winning design is based on a cable-stayed structure with three towers. The 80-metre-high central tower will be shorter than the two outer towers, which will reach 110 and 125 metres, respectively. The bridge will be 2,130 metres long, with a river span of 1,000 metres.
Seaports and airports are big business. Physically, these structures enable the arrival and departure of people and goods, but they encompass so much more. A seaport gives industry access to foreign markets and facilitates the movement of products and goods. Airports make people mobile. Taking air and sea mobility to the next level requires a joint global effort.

By Sarah Katz
Connectivity enables a country to attract business investment and human capital. Airports are home to the world’s airlines, an industry whose revenues reached a record USD 708 billion (IATA) in 2013. And seaports have long been identified as important economic and social drivers as well as major employment hubs.

Ports make the world go around
Ports meet a demand for efficient and environmentally sound cargo and goods transport. “The size of vessels is increasing dramatically. This necessitates more efficient and environmentally sound transport, but port facilities must also be consolidated and expanded, water depths increased and local infrastructure like roads and railways improved. This is all part of the equation when we look at globalisation, technological innovation and the increasing concern about the environmental footprint,” explains Bjarne Mathiesen, Senior Market Director, Ports, at Ramboll.

Changing megatrends in the aviation sector
The global economy is slowly emerging from the 2008 recession, and airport infrastructure and air traffic...
The aviation sector is essential in developing a global village that connects people and markets all over the world.

Franz Buch Knudsen, Project Director, Ramboll Aviation.

Volume and patterns are changing rapidly. Airport facilities are expanding primarily in Asia and the Middle East, while growth remains modest in Europe and North America. The intercontinental hubs have moved from Europe to the Middle East, primarily Dubai and Abu Dhabi, and new innovative carriers are penetrating the market with new business concepts.

Franz Buch Knudsen, Project Director, Ramboll Aviation, has analysed the aviation market and sees airports as a crucial connector:

“The aviation sector is essential in developing a global village that connects people and markets all over the world.”

Meeting environmental challenges

According to the ATAC (Air Transport Action Group), the aviation sector accounts for approximately 2% of CO2 emissions worldwide, and it focuses strongly on reducing emissions not only from aircraft in flight but also from the large number of energy-intensive airports. Numerous new initiatives have been taken in this field, but much remains to be done.

Increasing traffic warrants new airport projects

Over the past decade, new mega-airports – airports costing at least USD 500 million – have rarely been seen outside the Middle East and Asia-Pacific. Elsewhere in the world, traffic volume, profits and financial resources have been too low to warrant new airport projects on this scale. This is changing.

Dubrovnik Airport offers an example of new business opportunities and of the significant role airports can play in the larger scheme of global and regional connectivity. The airport is a vital gateway to southern Croatia for the growing holiday market, for business travellers and for domestic traffic between Zagreb and Dubrovnik. The airport will have an even greater impact on the country’s economic and social growth now that Croatia has become the 28th member of the European Union.

Ramboll is a contract management consultant for the expansion of the airport, providing project management on the rehabilitation of the runway and taxiways, as well as on the construction of additional taxiways and a new terminal building. On the airside the project will include a fuel farm and several supply facilities, and landside facilities will also be expanded.

Helping to integrate the EU

Various EU funds and the European Investment Bank...
Manila’s new international airport will be state-of-the-art, with an ultimate capacity of 90 million passengers per year.

A multidisciplinary team of experts from Ramboll’s Aviation team, the Global Port Sector and the Transportation Planning and Urban Development Department has already conducted the feasibility studies for the combined Sangley Airport and Seaport Project in Manila.

Securing a sustainable port development
The All-Asia Resources and Reclamation Corporation (ARRC) in the Philippines – the private developer on the project – commissioned a study that includes a new international airport and seaport with supporting traffic infrastructure comprising roads, bridges, an immersed tunnel and a light rail connection. The new international airport will be state-of-the-art, with an ultimate capacity of 90 million passengers per year. The new seaport will be configured as a modern terminal with the latest logistics and equipment technology, initially handling two million containers (TEU) annually, but with the

are financing the Dubrovnik Airport project. This funding firmly promotes the view that airports can be substantial drivers of a more connected, sustainable region. Jesper Sundahl, Project Director, Aviation, says:

“This is a rare opportunity to completely renovate and update an airport that also helps to integrate Croatia and the Balkan countries in the EU family.”

A new gateway to Asia
With a GDP growth of 7% per year, the Philippines is among the most rapidly expanding economies in Southeast Asia. The Philippine government’s vision is clear: In the coming decades the Philippines should become an economic epicentre of Southeast Asia. Yet much of the Philippines’ economic and social potential remains untapped, and the country could play a much stronger role in the global village. Experts and politicians agree that a clogged infrastructure is at the heart of the problem.
capacity to expand to as many as ten million containers (TEU) in stages.

Ralph Guldberg Bjørndal, Project Director, Ports, explains:

“The expansion element ensures that the seaport can respond to changing needs, potential downsizing or even the relocation of the existing terminals in the city centre, thus securing the sustainable development of the port in future.”

Establishing the new airport and seaport on reclaimed land in the outskirts of Metro Manila offers some unique possibilities and advantages. The seaport will be located close to important existing and planned special economic industrial zones in the vicinity. Ralph Guldberg Bjørndal explains:

“Reducing the overall transport of containers on the Manila road network and enabling short-distance container transport between the seaport and the industrial zones will relieve some of the serious congestion problems in Metro Manila.”

Positive interaction with stakeholders
A large number of stakeholders, including the Ministry of Transport, airport and port authorities, urban development authorities, economic zone authorities and the national development board have all been consulted in the process. This extremely positive interaction has shown how dialogue can turn a set of common goals into results, in this case a multidisciplinary gateway project that will help unlock Manila’s and the Philippines’ strong economic potential while also contributing to new, sustainable developments in the city centre.

Highly complex projects
Port projects are generally becoming increasingly complex and challenging. They tend to be high profile and often entail integrated transport systems involving rail, road, seaports and airports.

“They’re projects we want to work on,” says Ralph Guldberg Bjørndal, Project Director, Ports.
REAL-TIME PLANNING WITH BIG DATA

EXPERT COLUMN

Creating the perfect framework for seamless mobility is a challenge at city, regional and national levels. How to make the right traffic plan? Big Data can be part of the answer.

By Raul Vibo, Design Manager and Leading Consultant

Creating the perfect framework for seamless mobility is a puzzle. For years urban planning has been a matter of predicting people’s behaviour and adjusting transport systems accordingly. In a city like Abu Dhabi – where I am stationed – however, nobody knows the exact number of inhabitants. So how to make the right traffic plan? Big Data is part of the answer. But only part. Statistics have to be used intelligently, but the framework of real-time data is setting the stage for an all-new way of planning. Big Data can measure people’s real-time behaviour and identify gaps in the existing connections. Traffic planning used to be based on past-time analysis and to some extent assumptions about expected behaviour. It also takes time to conduct a qualitative study of 10,000 people’s transport behaviour.

The new zoning models

Transport modelling with Big Data is based on zoning at different levels, e.g., city, metropolitan area, region, country. An origin-destination model (OD model) can be created accordingly. Conventional transport modelling provides very limited travel data, especially about origins and destinations. Big Data derived from mobile phones provides telecommunication companies with enormous amounts of data. Location data are associated with all database entries, which for these purposes are, of course, anonymised. As mobility is classified by type, an anchor point model must be established to plot the regular overnight position or positions of every phone. A second, time model provides a basis for periodic statistics and analysis. Finally, the two models are combined and all movements aggregated by movement character (transport mode) and time to the generalised mobility database. This produces the global origin-destination matrices. These matrices are then validated with different statistical data as well as with manual and automatic traffic counts of roads/streets and public transport passenger counts. Validation helps to improve the models and assess their accuracy. OD matrices can be used for transport modelling and in any analysis or planning. Highway traffic volumes can be predicted, as can the potential for public transport or even walkability in more densely built-up areas. OD matrices can be further developed with the addition or removal of land use to zones to create prediction models, development scenarios and more.

Utilising mobile positioning techniques has proven its accuracy in several projects, including the Eastern Bypass of Tartu City in Estonia. The modelling results and actual use deviated less than 10%, where conventional transport planning produced a deviation of 20-50%.

Accurate data enable precise prioritisation and ultimately the most cost-efficient and enduring decisions in terms of benefiting society at large.

Raul Vibo is the Design Manager at Ramboll Roads and Infrastructure Department in Abu Dhabi. Prior to joining Ramboll Middle East in 2013, Raul worked as a senior design engineer, project manager and head of department at Ramboll Estonia. He previously headed the Planning Department at the Estonian Roads Administration. Raul Vibo received his Master’s degree in Transport Engineering from Tallinn Technical University in 2001.
In a resource-scarce world, getting more out of less is a must for engineering projects to succeed from a lifecycle perspective. It is essential to optimise each and every detail in the large-scale instructural projects to make the most of the innovative investments in the short and evenly important - the very long run. Value engineering is key in long-standing mobility projects.

By Morten Lund

In 2019 when Copenhagen’s upcoming M4 metro line starts servicing the neighbourhood of Nordhavn - a new harbour district with 40,000 inhabitants - the tracks will not run underground. Instead the metro system will be elevated, leaving room for a bicycle section beneath the railway construction.

Designed by Ramboll and architectural firm COBE, this solution provides liveability and is considerably cheaper than an underground one. As such, it perfectly sums up Ramboll’s vision for value-adding engineering, says Ib Enevoldsen, Executive Director of Transport at Ramboll.

“Value engineering encompasses everything from ensuring the mobility and continued development of our society to making sure you choose the right bolt for a structure, so the entire structure won’t have to be replaced in 20 years but rather in 50. Value engineering
Northern Europe’s largest bridge project involves several prime examples of value engineering. Not only is the Queensferry Crossing (formerly entitled as the Forth Replacement Crossing) the largest bridge project in Northern Europe and the largest civil engineering project in Scotland for a generation – it is also a prime example of how smart engineering can add extra value to a publicly funded project.

When completed in 2016, this new road bridge, linking Edinburgh with the county of Fife north of the Firth of Forth, will partially replace the existing Forth Road Bridge, which will then become a route for buses and public transport.

The foundations (left image) constitute the most important value-engineering contribution. For these, Ramboll and FCBC contractors took a completely different approach from that envisaged in the specimen design, opting for a spread-footing foundation over precast shells around bored piles. This meant substantial savings on foundation costs.

The deck provides another example. Ramboll worked closely with FCBC to come up with an optimised composite deck cross-section. This design proved the most economical, but it also provided another key benefit in the form of a much simpler transition section from the approach viaduct to the cable-stayed bridge.

A third example is the use of embankment fills to shorten an original multi-span viaduct to a two-span construction. Reconfiguring the slip roads at the Ferrytoll Junction was an intrinsic part of this solution, enabling a much more efficient design overall.

“The lesson learned is to think about the project holistically and not just as individual components. That is the whole concept of value engineering – merging the skills of the project partners in order to create innovative solutions that add value,” says Ramboll director Peter Curran.

An essential feature in a resource-scarce world
In a world increasingly impacted by resource scarcity, getting the most out of those precious resources is key. Creating smart, innovative engineering designs is one means to this end. They add extra value without inflating costs – and without compromising performance or quality. For instance, the solution could be as simple as designing slimmer structures, thus reducing the amount of materials used and in turn the fuel consumed by trucks to transport those materials.

With today’s resource agenda, value engineering should never be viewed as an extra service, emphasises Lars Riemann, Group Director of Buildings at Ramboll: “Value engineering is not a science or a service. It’s an essential feature of all engineering projects today,” he says, adding that one must always consider the costs over an entire lifecycle.

“If you save too much money in the construction phase, it might increase running costs later on. So, we as consulting engineers should always engage in a dialogue about lifecycle costs to ensure maximum value for the client,” says Lars Riemann and adds: “Everything today is about getting more out of less. There is nowhere in society that is not trying to add value without adding more costs. That’s what we’re doing in our engineering designs as well.”

According to William Howard, Executive Vice
“Value engineering is not a science or a service. It’s an essential feature of all engineering projects today.”

Lars Riemann, Group Director, Buildings, Ramboll.

Lars Riemann, Group Director, Buildings, Ramboll.

“Some excellent engineering”

According to Ib Enevoldsen, value engineering - in all its guises - is an important part of creating liveable cities. In general, a poorly laid-out connecting road or bridge can easily wind up decreasing a community’s mobility if poorly designed renovations have to be done before the life cycle of the structure is projected to end.

“It’s our obligation to use our expertise to provide value engineering and thus help develop society. As consulting engineers, we must constantly think in new solutions and new technologies. No doubt about it. When traffic planners or maintenance personnel inspect structures 30 years from now, I would like to hear them say ‘that is some excellent engineering’.”

President, CDM Smith, and member of FIDIC’s executive committee, value engineering often results in identifying modifications that reduce cost, save time and improve quality - sometimes all three or two of the three. Another benefit of value engineering is the development of an improved understanding of the project by the entire project team before the expensive construction process begins.

“Traditionally, the most used value engineering efforts are the 2nd opinions on design with regards to material use e.g. ccm of concrete, tons of reinforcement steel or structural steel. But more recently value engineering has more turned into other areas such as choosing a design, and thus an implementation method minimizing the carbon footprint for the project or a method which is more suitable for the use of local suppliers and materials than being shipped from far,” says William Howard.

One way that Ramboll is approaching value engineering in the construction sector is to use more cross-laminated timber (CLT) - engineered, multi-layered wood that can be used in place of traditional concrete structures in new buildings. Although CLT costs about the same as concrete, it is three times lighter – a fact that saves a great deal on foundation costs, as the foundation only has to support a third of the weight. To this can be added that CLT is quicker to mount than concrete, thus shaving installation costs. (Top image: Earlham Academy atrium bridge during construction)

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Having sea access independent of the Strait of Hormuz makes Fujairah, a central hub for trade passing through the oil-rich Arabian Peninsula. Connectivity is a prime asset for the tiny sliver of coastal Territory that have a masterplan to secure the Emirate’s future development.

By Sarah Katz
Connecting Middle Eastern Energy Markets

An interconnected regional energy market offers many advantages: Shared infrastructure means better prices for consumers; cross-border regulation and trade become possible, thus helping to regulate fair trade on the wholesale markets; and, finally, price manipulation is curbed.

In the Middle East, 20 countries are working together to determine the best options for interconnecting gas and power in a single energy market.

Ramboll proposed feasible infrastructure options to ensure energy availability, identify implementation methods and outline an energy trade strategy among Arab countries. The options were supplemented by techno-economic feasibility analyses examining several scenarios involving almost 60 stakeholders.

Having sea access independent of the Strait of Hormuz makes this tiny sliver of coastal territory a secure portal to the Gulf and thus a centre for trade passing through the oil-rich Arabian Peninsula. The emirate has wisely chosen to leverage this unique position to promote the global sustainability agenda.

Fujairah, like most regions of the world, has to plan for growth against a backdrop of such existing and emerging issues as regional security, geopolitical pressures and opportunities, high growth rates, climate change, environmental considerations and employment generation.

Planning for growth
Fujairah is basing its development on the existing demographic, cultural and business environment, mapping future opportunities and a sustainability framework to structure its future development options.

More than just a plan
Søren Hansen, Project Director, has more than 20 years’ global experience working with urban development and planning. He explains:

“The sustainability framework was developed in close collaboration with the emirate’s leadership. It includes the following wording: ‘Rooted in its rich natural and cultural heritage, Fujairah will develop into a highly liveable, sustainable community of skilled and engaged citizens working hand in hand to build a responsible and thriving economy in a changing climate.’ This focus was key for the small emirate to go beyond making what needed to be more than just a plan.”

Urban growth drivers
Ramboll’s role has been to develop an innovative and implementable strategic framework plan with a 25-year horizon. The Fujairah framework plan focuses on key urban growth drivers including demographics, economy, strategic transport links and residential growth. Rupak Chatterjee, Principal Urban Planner, tells us why the emirate is focusing on urban quality of life:

“The key planning approach adopted for Fujairah is ‘Compact Urban Growth’ - in view of the emirate’s limited flat land availability and to improve urban quality of life.”

Sustainability a guiding star
Jointly prepared by several ministries, including the Ministry of Urban Planning, the plan not only outlines focus areas but goes a step further, presenting a comprehensive planning framework for Fujairah’s development. For example, a suite of planning-based tools sets the parameters for growth and development...
At the moment, Qatar has no rail-based infrastructure. This is changing rapidly as the current plan for Doha’s first metro system and a nationwide railway moves ever closer to connecting Qatar to the larger Gulf Rail. Known as “the green line”, the metro forms part of Doha’s new underground transport system and is a key deliverable for the 2022 FIFA World Cup. Ramboll is serving as the design verification engineer for the project and providing multidisciplinary, cross-company expertise.

Richard Beard, Director of Ramboll Middle East, explains the project’s regional significance:

“The green line is part of the Doha Metro development, which in turn is part of the plan to introduce railway as an important element of the public transport system in Qatar. The railway development is part of Qatar’s national vision, which focuses on economic, social, human and environmental development. We are excited to be contributing to connecting Qatar to the wider railway network planned by the Gulf Cooperation Council (GCC).”

The vision is to generate the region’s most comfortable, reliable and safe railway system, and to promote public transport in a country that has traditionally made cars its preferred mode of transport (image below left).

Stakeholder engagement and local ownership have been key elements from start to finish. “We conducted four major public workshops and more than 20 stakeholder meetings to involve the local community and get them committed to the plan in the final phase of our engagement in Fujairah. Local stakeholder ownership and commitment have been alpha and omega in ensuring that Fujairah maximises its position as the needed emirate,” Søren Hansen concludes.
THINK SUSTAINABLE
(TO MAKE IT LIVEABLE)

Growing while leaving an even smaller footprint. www.ramboll.com