SIEMENS

Siemens response to National Infrastructure Commission call for evidence - Large-scale transport infrastructure improvements in London

Introduction

This document forms part of Siemens' response to the consultation published by the National Infrastructure Commission. The response relates to the third part of the call for evidence: **London's transport infrastructure**.

Siemens in the UK employs almost 14,000 people across the UK with 13 manufacturing sites and multiple other facilities.

London and the wider South East are an important market for our various businesses, where we employ around 2000 people. Siemens manufactures and maintains the highly reliable mainline trains operated by South West Trains, Heathrow Express, Greater Anglia and London Midland among others, transporting passenger in safety and comfort in and around the capital. From 2016 Siemens will introduce the state-of-the-art Class 700 fleet to the UK. These new trains will provide a much improved passenger experience on the Thameslink route and help to create 2,000 jobs across the UK supply chain.

Siemens has been involved in the signalling of London Stations for over 150 years. We resignalled the Victoria line in time for the 2012 Olympic and Paralympic Games and are working with London Underground on continuous improvements. We are now resignalling the Thameslink route, and supplying Crossrail with signalling, train supervision, station and line management and train control.

Elsewhere, using the latest electric traction drive technology from Siemens, London's new Routemaster buses are up to 40% more fuel efficient than diesel buses with a 47% reduction in C02 and a 78% in NOx (nitrogen dioxide). Siemens' detection and enforcement system architecture is helping London to reduce traffic levels, congestion and pollution as part of the London-wide Congestion Charge and Low Emission Zone.

Siemens also supports London's energy and safety needs. Siemens fire safety technology protects 84% of buildings and safeguards 90,000 people at Canary Wharf. In Bexley, Siemens provides 24/7 CCTV services, helping transform the area into London's safest borough.

Finally, Siemens invested £30 million in The Crystal at Royal Victoria Dock. As one of the World's most sustainable buildings and home to the World's largest exhibition on urban sustainability, the facility also houses our city experts who are working on making city infrastructure around the world cleaner and more efficient.

We are therefore responding to this call for evidence as both a business user and major supplier of infrastructure technology and services in London and, indeed, elsewhere. We have responded in broad terms to specific questions on strategic priorities for London's transport infrastructure. We have also contributed to the CBI's industry wide response to this call for evidence. However, technical innovation often plays a major role in determining the right transport solution to a particular project or problem, whether that is over-capacity on the railways or congestion on the roads. As such, our evidence sets out what we see as the major challenges facing London's transport infrastructure and some of the technologies, which we as suppliers believe could address these. We also outline potential delivery challenges.

Response to Questions:

1. What are the major economic and social challenges facing London and its commuter hinterland over the next two to three decades?

The economic and social challenges facing London are well known. It is a city on the move, which is predicted to grow from 8.6 million in 2015 to over 11 million by 2050. Such development is a testament to London's ongoing success, but it creates pressure on public services, increases demand for housing and exacerbates environmental challenges faced by the city, such as poor air quality. Investments in transport connectivity and technology can play a significant role in addressing these challenges by making existing areas more attractive to live in, opening up new areas to development and helping to reduce energy consumption and air pollution.

As London continues to grow the primary and overarching challenge for London's transport system is one of capacity. The strain on the capital's transport arteries is considerable and will only increase. Whilst there are a range of short term options that can be considered, such as better access to platforms through increased provision of lifts or escalators, these measures will only help with the existing volume of passengers and are not sufficient to cope with continued growth.

In addition when it comes to rail/metro provision, there are some notable black spots within the capital. For example, when travelling between areas south of the river - by tube or train - passengers often have to go into central London and then back out again.

Large scale projects such as Crossrail 1 and the Thameslink upgrade will help reduce capacity issues but we need more of these types of projects. Moreover when it comes to the Tube network, we are coming to the point where changes to the existing infrastructure are not having the impact needed and whole scale re-developments will be needed to provide for continued growth in passenger numbers. There has also been a marked increase in the risks related to operating a world-class transport system both in terms of cyber and the physical threat from terrorists. These are threats that will need to be considered as we continue to upgrade and develop the network.

2. What are the strategic options for future investment in large-scale transport infrastructure improvements in London – on road, rail and underground – including, but not limited to Crossrail 2?

2.1. Making the right choice at the outset: Technological Innovation and Financing

As a business user, and to address the capacity crunch outlined above, we are supportive of projects such as Crossrail 2 that will help to alleviate congestion on busy routes into central London. We also

believe that river crossings, particularly in the east of London, are key to unlocking London's future development potential and meeting the target of 50,000+ new homes per annum.

However as a supplier and finance provider towards infrastructure projects we would also make a broader point about the importance of making the right choice about technology and finance solutions to infrastructure problems at an early stage.

Technical innovation can play a major role in determining the right transport solution for a particular project or problem. Whether it be in the latest technologies for rail signaling and train control to improve capacity and performance, or smart technologies which can optimise road space, prevent congestion before it occurs, and manage parking systems in cities and towns to maximise parking availability, it is increasingly the case that technology can play a major role in determining which transport solution might be the most appropriate for a given set of circumstances or objectives.

Having overall control of the London Transport network, TfL has the unique opportunity to introduce a smart ticketing system to encompass an integrated travel information system which would encourage travellers to move between various modes of transport dependent upon demand, capacity, weather conditions etc.

More efficient use of road and rail capacity through the use of smart technology can itself be a transport solution, perhaps in certain circumstances even avoiding the need to build brand new capacity altogether. Technology can therefore also drive down costs and drive up efficiency not just for individual capital projects, but for the wider management of transport systems.

It is therefore increasingly important that technical considerations are taken into account at the earliest stages of a project development to ensure that the right solution to a particular problem or wider transport objective is developed from the outset. Technology should not be an issue that is left to be addressed once a particular transport solution has been decided upon.

Similarly when considering financing of large and complex projects a full analysis should be undertaken of all the options at the outset. While Public Private Partnerships (PPPs) often come in for criticism we consider such structures to be highly beneficial under the right circumstances in the transferring of risk from the public sector to those best able to manage and control them.

It was noted that on the Crossrail Rolling Stock Project the funding route changed from a PPP to public funding towards the end of the bidding phase. Such changes at the end of procurement and once a full submission by all the bidders required further rounds of bidding. This is inefficient and adds cost and time for both the procurement authority and the bidders.

That said, International Finance Institutions such as the European Investment Bank (EIB) provide funds to both the Public and Private Sector and we encourage full use of their facilities. EIB provides long term debt on advantageous terms and Siemens uses EIB worldwide. We are aware of TfL's use of EIB in financing its projects.

2.2. Technological solutions

Rolling stock and Refurbishment

New rolling stock can dramatically improve the experience of commuters while also helping to alleviate capacity issues across the network. Siemens' new fleet of Class 700 trains, which will run on the Thameslink line from spring 2016, will provide 80% more peak seats across central London from

2018. The New Tube for London would also provide a similar step change in terms of capacity right across the Piccadilly, Central, Waterloo & City and Bakerloo lines.

Refurbishment programmes, such as that for the 1995 (Northern) and 1996 (Jubilee) stock, can only go so far in solving the capacity problem. As a world city, passengers expect high standards from London's transport system. Refurbishment does not always provide the step-change that most people expect but can go some way to helping to bridge the gap whilst the larger scale projects are in development. However, even after further upgrade to the Tube there is still likely to be a saturation point when we reach a maximum potential capacity. As a result, rolling stock is only part of the solution. There needs to be a fully joined up approach with signalling in the capital to push the performance of trains

Signalling
Delivering increases in the number of trains per hour should also be a priority. State of the art signalling and modern trains are key to achieving this. While the Victoria line is currently operating at up to 34 trains per hour the goal is to further increase the frequency for this line together with other tube lines by both optimising the current technology and introducing new state of the art signalling technology.

Traffic
Without further measures to reduce or redistribute demand (e.g. extend the Congestion Charging area), road traffic is forecast to increase over the next decade and beyond. To help mitigate the effects of this increase, TfL is already extending the use of SCOOT throughout London. SCOOT (Split Cycle Offset Optimsed Technique) is an algorithm, originally developed by the Transport Research Laboratory, and adopted by TfL which adapts traffic signal timings automatically according to current traffic conditions.

All of the traffic signal junctions in London are connected to a central Urban Traffic Control (UTC) computer system which runs SCOOT on those junctions equipped for it. For those junctions not equipped with SCOOT, the traffic control plans are mainly fixed and are not automatically adaptable. It therefore makes sense to extend SCOOT control to most, if not all of London's signalised junctions.

SCOOT also gives TfL the capability to change priority for certain road users; for example SCOOT can run a plan optimised for cyclists, or for pedestrians or for road traffic travelling on certain arteries such as the North Circular.

The second option to alleviate future road traffic congestion is SITS: SITS stands for Surface Intelligent Transport System. SITS will bring in advanced methods for collecting data on the state of London's road traffic, including cyclist. These methods currently include sensors in the road for road based traffic, above ground sensors for people and road traffic and use of Automatic Number Plate Recognition (ANPR) cameras for collection journey time information. Extensions to these sources will include Bluetooth data, GPS data, Mobile Phone data and many other data sources yet to be developed. These extra data sources will improve the "eyes and ears" of SITS to make more intelligent decisions based on current conditions. TfL will also deploy predictive modelling techniques using and combination of a "model of London" and simulation to predict the future state of congestion given a set of initial conditions. This will help TfL to get more capacity out of the existing road network and will also assist with a more rapid response to planned or unplanned

events. TfL will also be able to forecast the effect of roadworks on the immediate and surrounding areas and to simulate the effects of remedial actions.

Hybrid, Electric and Hydrogen vehicles
In addition to taking steps to tackle traffic, more can be done to accelerate the roll-out of hybrid, electric and hydrogen vehicles, including buses. These can play a major role in ensuring that London keeps moving and air quality is improved.

Modern urban transport networks have been developed over several decades based upon the availability and operational characteristics of diesel fuelled transit buses. Currently there are more than 8,000 diesel buses operating in London and while many of these vehicles use reduced emission hybrid technology, significant levels of harmful pollutants are still emitted as diesel remains the primary fuel source. However advances in battery and propulsion technology over the past five years have made zero emission transit buses a reality in many global cities, including London. Nonetheless many obstacles remain, preventing this new technology to evolve and mature from pilot phase into scalable real world applications. To overcome some of these challenges and support sustainable deployment of zero emission buses, Siemens has developed a number of electric fuelling solutions. Already deployed in Europe and North America, automated opportunity charging systems, intelligently networked to the distribution grid, permit wide scale roll out of electric buses within existing transit operations.

London already has some small fleets of fully electric vehicles in service and has been operating Hydrogen Fuel Cell vehicles zero emission buses on route RV1 between Covent Garden and Tower Gateway since 2011. There are eight buses in operation which means it is the first time a whole route has been fully operated by hydrogen powered buses in the UK.

2.3. Deliverability

The terms of reference accompanying this call for evidence also seek views on the deliverability of strategic transport priorities. As major suppliers, we would highlight the following general issues which need to be considered in relation to potential rail upgrades:

Challenges for TfL
Transport for London (TfL) has performed well in a number of recent passenger surveys, with satisfaction across the Underground at an all-time high between December 2014 and March 2015. However they face the challenge of having to continue to build on these numbers whilst facing budget cuts. This is clearly not an issue within the remit of the NIC, but it is important consideration nonetheless.

Project Delivery
With a significant amount of investment planned for London's transport network the coming years we will see a number of large scale projects being carried out at once. Whilst there is likely to be some disruption, we need to ensure that every measure necessary is taken to minimise the impact on the day to day lives of Londoners and commuters. This can only be done with excellent planning and co-ordination between all parties involved in the upgrade. We can, where possible, also try to keep existing systems going until the new ones are in place and ready to use. For example, when re-signalling the Victoria Line, Siemens kept the existing system running while they were implementing the changes, ensuring the transition ran as smoothly as possible

Skills
Over the next 10 years, 3,300 new workers are needed for to help meet the UK's Traction & Rolling Stock (T&RS) needs alone. This represents a serious challenge for the future of London's rail network.

This skills shortage is why Siemens has established the National Training Academy for Rail (NTAR) in Northampton, which will provide 20,000 man days of training per year. NTAR has enabled SMEs to access best in class training for rolling stock maintenance. By taking leadership in important areas such as these, larger players can open the door to market access for those companies that sit within their supply chain. One of the great benefits of NTAR is its links to other academies across the country, which all seek to complement each other. For example, National College for High Speed in Birmingham and Doncaster will have a different remit from that of the site in Northampton.

It is important that industry continues to invest in skills, but we need to do so in partnership with government at all levels and with the knowledge that there is a pipeline of work in order to sustain the rail sector and retain skilled employees.

3. What opportunities are there to increase the benefits and reduce the costs of the proposed Crossrail 2 scheme?

Maximising industrial opportunities
As outlined above industry need certainty and a long-term investment and planning horizon if it is to invest in skills and innovation to drive down costs. The creation of the NIC is a welcome move in this regard if it leads to longer-term certainty in the UK's infrastructure investment. As widely recognised the rail sector in particular has suffered from the on/off approach to public spending which has often been adopted in the UK. Developing Crossrail 2 and other similar major transport projects not just in London, but elsewhere in the country, will help the UK to maximise opportunities in the associated supply chain and services sector.

Stakeholder engagement
The high level of stakeholder engagement already witnessed on the Crossrail 2 scheme is to be welcomed. Consultation with stakeholders and the public is also absolutely crucial when planning and delivering large scale rolling stock improvements in the capital. The Class 700 benefitted from feedback from UK train operators, train crew, cleaners and maintenance staff, as well as dedicated passenger research. Any future rolling stock project from Crossrail 2 would benefit from a similar programme.

Predictive maintenance
Siemens has led the rolling stock industry in terms of predictive maintenance. Our new depot at Three Bridges – part of a €400million investment – is leading the way in this area. By catching a fault early, a more considerable cost associated with a full replacement can be avoided. It also reduces the likelihood that passengers' journeys will be affected. Siemens' new facility at Three Bridges has an automatic inspection facility which uses laser measurement to accurately predict when key train components need to be maintained or replaced.

Aligned incentives
Crossrail 2 would benefit from the introduction of performance based contracts, whereby suppliers and manufacturers are incentivised for their performance. This works to encourage and drive

excellence while ensuring the Government receives good value for money after the main procurement process has been completed.

4. What are the options for the funding, financing and delivery of large-scale transport infrastructure improvements in London, including Crossrail 2?

Raising finance

Raising finance is a crucial part of some procurement processes, however we realise that it is not always possible to do this quickly. The contracts for the Intercity Express Programme and Thameslink were awarded more than two and a half years later than intended, partly due to issues with securing funds during the financial crisis.

As the UK's economy recovers the challenge is to continue to attract investors seeking a stable return, such as pension funds. They will be won over more easily if the right contractual structures are in place, these need to be transparent with an emphasis on the benefits of entering into the agreement.

In terms of alternative financing models we note and support the success of the Crossrail Business Rate Supplement which financed £4.1 billion of the costs of the £14.5 billion Crossrail project. Worth 2p for business properties with a rateable value of more than £50,000. Smaller firms around the new line's stations were required to pay as they will benefit most. We are supportive of a more general use of the Business Rate Supplement provided it is, as now, capped and subject to approval by local stakeholders.

Green Bonds

The Climate Bond Initiative estimates the Climate-Aligned Bonds market, which includes labelled green bonds and unlabeled climate-aligned bonds, to be $598 Billion in 2015. The majority fund transport solutions (around 72 percent) and energy (15 percent). Unlabeled green bonds are an important source of finance for projects that have an impact on reducing GHG emissions, for example a new railway.

In June 2014, Johannesburg successfully issued a green bond, becoming the first C40 city to do so. The bond, with a value of US$143m, was 1.5 times oversubscribed and will finance a wide range of green infrastructure projects across the energy, water, waste and transport sectors. In Washington DC, the District of Columbia Water and Sewer Authority (DC Water) has issued a $350 million 100 year green bond. The bond is helping to finance a portion of the DC Clean Rivers Project, a $2.6 billion project to construct tunnels that will transport combined sewer overflows, to DC Water's Blue Plains Advanced Wastewater Treatment Facility. The project serves several "green" purposes including improving water quality for the District, flood mitigation and waterfront restoration

5. How have major metropolitan areas in other countries responded to similar challenges and priorities? Are there any lessons to be learned and applied in London?

Decision-makers in London should be able to draw on ideas and experiences in other cities and countries to ensure that we develop the best transport system possible. Drawing on Siemens' extensive experience in other contexts, some solutions adopted in other countries are outlined below.

Protecting the environment
One of the central challenges for London is ensuring growth is sustainable, mitigating as much as possible potential impacts on the environment. This can be done by ensuring that all new rolling stock are designed for the future, meaning that they are based on the latest technology that allows them to be energy efficient for the duration of their life span.

The **C2 metro train for Munich Underground**, unveiled by Siemens towards the beginning of 2014, sets new standards in energy efficiency. Forming part of an eventual fleet consisting of 126 new metro cars, the train is:

- Up to 97 percent recyclable
- Energy-efficient, thanks to the recovery of up to 50 percent of the braking energy
- Has LED lighting throughout

Hybrid buses powered by Siemens in Swedish cities

Volvo's new electric ZeEUS12m plug-in hybrid bus with Siemens fast-charging technology have started running in Stockholm after having been tested in Gothenburg over a period of three years. The tests have shown that plug-in hybrid buses reduce fuel consumption by more than eighty per cent and the total energy demand by more than sixty per cent.

Siemens' Velaro family of high speed trains operate worldwide including on HS1 in the UK and routes in Germany, Russia, China and Turkey. The train has been modified for a number of different conditions but has energy efficiency right at its heart, this includes features such as:

- Aerodynamic optimization on the roof section reduces sonic boom in tunnels. This includes fully encased roof-mounted equipment and an aerodynamically refined spoiler, nose, and front section
- Surplus braking energy which is fed back into the power grid
- Both of these features reduce energy consumption and CO2 emissions. The overall result is equivalent to a gasoline consumption of 0.33 litres per seat and 100 kilometres

eHighway to reduce CO2 and nitrogen oxides
Siemens is currently trialling our eHighway system in Los Angeles and Gothenburg. This allows road freight transport to be powered by electricity, combining the efficiency of the railroad with the flexibility of trucks into an innovative freight traffic solution that is efficient, economical, and environmentally friendly. The system makes it possible to reduce the use of fossil fuels and truck operating costs, at the same time eliminating local emissions such as CO2 and nitrogen oxides. Almost 90% of freight in the London area is carried on the roads and thus a significant contributor to congestion and pollution and the amount of freight is increasing due to the "Amazon effect". The use of electric vehicles for freight including last-mile (*or "last two-kilometres"*) logistics would help to alleviate the pollution caused.

Reliability
The levels of reliability required by TfL are significant. Suppliers of a range of products need constantly to innovate and develop new technologies.

As with any Siemens train, the C2 Metro train for Munich Underground is manufactured and maintained to exacting standards. Cutting edge, highly reliable technology means increased time between maintenance, increasing availability to the operator.

In Spain the Velaro train operates the busy Barcelona to Madrid high speed route where it travels well over 500,000 kilometres a year with punctuality exceeding 99%.

Integrated transport
As London's rail network continues to grow the challenge is to ensure integration between various modes of transport. Siemens is undertaking work with the German Federal Ministry of Economics and Technology to integrate further different transportation providers. A key part of this is a B2B IT platform which provides access to information (e.g. for route planning) and transactions (for bookings and reservations). Integrating 'mobility partners' such as bus, taxi, (e-)car sharing, bike-sharing, parking has a number of benefits including:

- Environmental – e.g. by reducing traffic congestion or time spent searching for car parking spaces
- Financial – studies show that such a service can generate additional revenue for transport providers

Procurement should include state of the art multi-point solutions for city infrastructure and promote innovation which is critical for UK infrastructure. Such improvements can also be justified in terms of productivity.

Further information and follow-up:

We would welcome the opportunity to meet the NIC team to further explore the topics listed above. For this or any questions arising from this response contact:

[contact redacted]

Siemens plc, 8 January 2016

About Siemens
Siemens AG (Berlin and Munich) is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. The company is active in more than 200 countries, focusing on the areas of electrification, automation and digitalization. One of the world's largest producers of energy-efficient, resource-saving technologies, Siemens is No. 1 in offshore wind turbine construction, a leading supplier of combined cycle turbines for power generation, a major provider of power transmission solutions and a pioneer in infrastructure solutions as well as automation, drive and software solutions for industry. The company is also a leading provider of medical imaging equipment – such as computed tomography and magnetic resonance imaging systems – and a leader in laboratory diagnostics as well as clinical IT.
In fiscal 2014, which ended on September 30, 2014, Siemens generated revenue from continuing operations of €71.9 billion and net income of €5.5 billion. At the end of September 2014, the company had around 357,000 employees worldwide. Further information is available on the Internet at www.siemens.com. October 2015