THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

DINNER/DISCUSSION SUMMARY

A national infrastructure for the 21st Century

Held at The Royal Society on 11th November, 2009

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the Council for Science and Technology,
The Engineering and Physical Sciences Research Council, Halcrow Group
and the Science and Technology Facilities Council

Chair: **The Earl of Selborne KBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Sir Mark Walport FMedSci**
Director, The Wellcome Trust and member of the Prime Minister's Council for Science and Technology
Professor Brian Collins FREng FIET
Chief Scientific Adviser, Department for Business, Innovation and Skills and Department for Transport
Professor Tim Broyd FREng
Group Technology Director, Halcrow and Chair, Policy Panel, Institution of Civil Engineers

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SIR MARK WALPORT outlined the conclusions of the Report of the Council for Science and Technology (CST) on a National Infrastructure for the 21st Century. A working and effective infrastructure was crucial for any society, without it a country could not be called developed. We took it for granted and remembered it only when it stopped functioning. Energy, water, transport and ICT were the essential features. Creating a growing economy, responding to changes in global factors, promoting social cohesion, and, ultimately defining the sort of life we wanted for the future, were the key problems. But, we had now ageing components requiring reconstruction (e.g. the London water mains), which were at the limit of their capacity, and untested against socio-demographic changes and issues such as climate change, extreme weather events, terrorism and failure. Resilience must be built into the networks to cope with evolving technology, progressive changes and unpredictable events. Systems and networks were interdependent and must be considered holistically. To overcome the fragmentation of ownership and operation of the networks, there needed to be a lead department for each network; an independent stakeholder to advice government; and a consistent and long term vision to encourage investment. Government itself needed to get departments to work together, to prioritise resilience and interconnectivity for networks, improve knowledge sharing and transfer, and implement the new Planning Act. The regulatory bodies should be reformulated so that they did not concentrate only on economic factors; working together and promoting innovation and R&D. We needed to improve procurement, remove barriers to deployment, and establish priorities. But above all, we needed to understand social and political issues and engage the public in dialogue in order to gain support for the investment needed for the infrastructure. Industry should specify and support the skills needed for the work and we needed to be able to draw on international expertise and experience.

PROFESSOR COLLINS outlined briefly developments in the infrastructure since the 19th century - motorways and North Sea gas; privatisation and market led decisions under regulatory control; and new structures such as PFI and PPP (Public Private Partnership). He agreed with Sir Mark about the challenges of ageing networks at the limit of their capacity and unsuited to meeting new challenges. He was concerned about the lack of data on expenditure on the infrastructure and how it was funded. Fundamental scientific questions were whether we could understand the national scale of infrastructure issues, and, if so, how to go about it, and how to relate it to the socio-economic-technical context in which we lived, one in which elections took place every five years, the public were not interested and technical change was happening very rapidly. We needed to find a language to describe and analyse the interdependence of networks, how to use new technologies (such as plastic electronics), and avoid being locked into technologies which might be outdated before investment had been completed. We needed to know how to deliver resilience into systems, gain social acceptance for investment, stress the low carbon priority and understand the economic benefits. We needed to shake people out of silo and habitual thinking in order to gain public acceptance and encourage behavioural change - good design was vital. There was no adequate systems analysis of the interconnectivity of networks as linkages between systems were unregulated. Cascade failure could result. New Orleans was an example of failure to appreciate these linkages. The challenge for modellers was to decide how to optimise investment, which meant choosing priorities. Key problems were developing and maintaining a culture that valued the infrastructure, getting the skilled workforce, deciding the right balance between security, economic policy and social acceptability, and making clear the dangers of the do-nothing option.

PROFESSOR BROYD said that some of the major projects in which Halcrow had been involved, such as High Speed 1, and the St. Petersburg Flood barrier, showed how large scale investment could be done in time and on budget. He outlined the findings of the Institution of Civil Engineers State of the Nation Report on Defending the Critical Infrastructure. It defined critical infrastructure as assets which, if destroyed, would cause major disruption. Such disruption could have catastrophic effects - huge loss to the economy, loss of life and major damage to the environment. He agreed with Sir Mark and Professor Collins that ageing infrastructure and capacity limits meant that there was dangerously little resilience and flexibility in the systems. The dangers from terrorism and systemic failure were great, and the need to meet climate change targets vital. We needed a long term policy to address the vulnerability of the networks and build reserve capacity. While there had been improvements in looking at separate networks, there was still no overarching body who looked at risks holistically. There should be a single point of authority, a body which would be independent and consider gaps and interconnectivity and redress the politicians' short term horizons. We also need to obtain much greater knowledge of the systems and the impact of failures. There should be a Natural Hazards Team which would work to ensure that additional spending was appropriate and proportional. Funding for maintenance should rise, but competitive markets may not be able to fund this. A National Infrastructure Investment Bank

might be desirable. The report's conclusions that planning and regulation needed to be radically restructured endorsed the views of Sir Mark and Professor Collins .

A leading theme in the following discussion was the relationship between the essential need, which experts saw, to invest in infrastructure in order to minimize the risk of failure with catastrophic consequences and the lack of understanding in the public of the importance of the infrastructure and the consequences of failure. This meant that politicians, who were inevitably focussed on the short term of five year electoral cycles, were not themselves pressured by voters to take action and develop long term policies. Such policies were essential to create sufficient certainty for an investment climate which would favour private sector investment to mature.

The Government had shown signs of recognizing some of the problems the speakers had identified, notably the new Planning Acts and the recent planning documents on nuclear power and energy. But we had to see how effectively these initiatives could be implemented. Certain events - such as the 2007 flooding and the recent snow storms - had alerted the public to specific problems and encouraged Ministers to react positively, but there was still no understanding of interconnectivity or the scale of the investment needed to minimize risk. The media had a large role to play, but it was not interested, unless there was a significant individual failure, in which case they only sought someone to blame. Significantly, there was no significant media coverage of the CST report - not even in Nature. Part of the problem was the emphasis on very large scale projects, individuals in any particular place found it difficult to see the benefit to them, because they could not see the local implications. It would help if smaller schemes were designed which could be seen to be important locally. We need to develop pressure groups for infrastructure investment in the same way that environmentalists built pressure groups for the environment. Social science and technology need to be much more closely linked, with joint programmes. There was a danger that we overdesigned and engineered, for narrow economic reasons, without taking sufficiently into account what people actually wanted and how they reacted to changes. Design was crucial. Good design was not just technical and aesthetic; it should be embedded in research coming from close observation of how people behaved, and what might influence their behaviour. Big engineering should only happen when it is absolutely essential.

The public might react more positively if it understood that we were seeking to enable individuals to maintain an acceptable standard of life for the future. If the aim was to stimulate public interest, minimization of disruption with catastrophic consequences was, perhaps, too negative. So, would it be fair to describe continuing to live at an acceptable standard the optimisation government is seeking? But such a formulation means further defining of "acceptable". Is it compatible with behavioural changes needed for climate change? How does it fit in with other social policies and the driving force of consumerism? It must be capable of redefinition as either economic or environmental conditions change. What is clear is that experts alone cannot bring about a change of culture where data on the state of the infrastructure and the need and scale of new investment is of interest and public debate - as it is in Singapore. We need forceful political leadership which will drive forward the agenda and be clear what the priorities are.

A further theme was whether it would be feasible to set up structures which would deliver the necessary improvements: whether funding would be possible; and the necessary skills available. Not all funding - or indeed most - needed to come from the taxpayer. Investment in infrastructure should be profitable for the private sector, and with the development of PPPs, it was becoming clear that acceptable arrangements could be introduced which both safeguarded the public interest and allowed investors to make a return. Given the present economic climate, one might start from the position that the government needs to define the public good from infrastructure investment; and then determine how much funding should come from the Treasury, no matter what came from other sources. But others said that the problem was so serious that one should start from what funding was necessary to improve the infrastructure and the Treasury must meet any shortfall after accessing private investment.

There were different views on skills. Some thought the skills were available, as many young people were anxious to work in relevant areas, and there was a significant increase in STEM graduates. We could always access international skills and the problem lay in middle management, who still thought habitually and in silos. But others were more sceptical: for example, was the programme for new nuclear stations compatible with the timescale needed to produce trained nuclear engineers? But there was no doubt that all engaged in improving the infrastructure needed to step up their activities. In procurement, we need to be more sophisticated in considering value and generally improve expertise in purchasing (there were far more courses in selling and marketing than there were in purchasing); in design we need to do more derisking before spending money; research should be more specifically directed to practical issues specified by industry and focussed on their needs, and the concept of partnership more widely understood - both inside government and in the utilities sector. Perhaps, in government, there needed to be a Chief Engineer who could supervise many of these activities.

Finally the presenters were challenged to present their priorities. Their responses were: getting better public understanding of why the infrastructure is so important and needed investment; getting better data to understand what we have and what we need; understanding interconnectivity; leadership; and establishing a central focus for government decision on the basis of objective advice.

Sir Geoffrey Chipperfield KCB

The speaker presentations can be found on the Foundation website at www.foundation.org.uk .

Useful web links:

Council for Science and Technology
www.cst.gov.uk/reports/files/national-infrastructure-exec-summary.pdf

Centre for the Protection of National Infrastructure
www.cpni.gov.uk

Engineering and Physical Sciences Research Council
www.epsrc.ac.uk

The Foundation for Science and Technology
www.foundation.org.uk

Halcrow Group
www.halcrow.com

Home Office
www.homeoffice.gov.uk

State of the Nation Report: Defending Critical Infrastructure, Institution of Civil Engineers
www.ice.org.uk/state_of_the_nation/index.asp

Natural Environment Research Council
www.nerc.ac.uk

Research Councils UK
www.rcuk.ac.uk

Science and Technology Facilities Council
www.stfc.ac.uk

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