# OPINION: MODERNISING NATIONAL INFRASTRUCTURE

## – A CALL FOR ANALYSIS AND ACTION

Professor Brian Collins FREng

**The national systems that provide us with vital services – water, electricity, gas and the rest – are in need of urgent modernisation, says Professor Brian Collins, Chief Scientific Adviser to the Department for Transport and the Department for Business, Innovation and Skills, if the UK is to make best use of the latest technological innovations and remain economically competitive.**

In the UK, we expect our infrastructure – the systems that provide such essential services as water, electricity, gas, oil, waste management, transport and telecommunications – to be commercially, socially and environmentally acceptable. We urgently need to modernise our infrastructure to ensure that demands on its capacity and capability are able to be met. This will enable the UK to remain competitive and provide appropriate levels of service for its citizens.

Such systems may be operated by public or private sector organisations; most are currently operated by private sector organisations, not necessarily UK-owned, but a few are still in public sector control, usually agencies of central government departments, such as the Highways Agency and the Environment Agency.

Since the start of privatisation in the early 1980s, there has been little coordination of how we as a nation develop and manage infrastructure. As a result, each 'component' is optimised within its own market, driven largely by short-term commercial factors. This approach has resulted in little modernisation or consideration for changed priorities. Without significant changes we run the risk that short-term thinking will prevail to the detriment of the future agility, resilience and exploitability of our infrastructure.

We regulate service providers – in the public and private sectors – through primary legislation, pricing regimes, health and safety requirements and competition law. If we are to develop infrastructure that meets our changed needs, we have to ask ourselves whether the existing regimes for governance and regulation can deliver the coherence that is essential for successful modernisation.

Modernisation of the UK's infrastructure is also essential if we are to exploit innovations in technology, such as new materials, better diagnostic sensors and industrial biotechnology. Over the past 30 years a revolution in information and communications technologies (ICT) has had a considerable impact on all aspects of modern life and on the provision of national infrastructure in particular.

However, the fragmented nature of our infrastructure – its governance, the physical and logical assets of networks and data management processes – means that we do not fully exploit the data and information that we collect. This makes for an inefficient operation of the systems and an inability to be proactive in avoiding breakdowns or to recover quickly from them. We need to use ICT to the fullest extent, to create an 'intelligent infrastructure', one that ensures resilience, agility and efficiency through good diagnostics and effective data sharing.

To bring our infrastructure into the 21st century, we have to do so against goals and criteria that are very different from those of 30 years ago. For example, our infrastructure is not optimised for the environmental issues that we now face, including the need to mitigate or adapt to the effects of climate change.

The Living with Environmental Change (LWEC) programme is a major Government response to climate and environment change. Part of the remit of the LWEC research programme includes the modernisation of national infrastructure. However, the work needed to modernise our infrastructure goes far beyond the LWEC's planned activity. Clearly duplication is to be avoided, so we need to ask ourselves, if the LWEC programme could act as custodian of all the environmental factors affecting the modernisation of national infrastructure could the LWEC programme take up any new environmental activities as they come to light? Could the LWEC model be replicated for other non-environmental topics?

If we are to modernise infrastructure, we will need people of the highest quality, with multidisciplinary education and experience. The required skills are already in short supply. This raises the important question of how the Government should promote the development and maintenance of the skills that we will need, and how to integrate that activity into skills development across the UK.

The current financial situation makes it harder to take an integrated approach to modernising our infrastructure. However, investing public money to kick-start the economy could fund large initiatives to modernise national infrastructure. Without proper planning and consideration of the need for coherent modernisation, such programmes could be no more than a series of piecemeal projects. This then raises questions about the risks and benefits of the Government taking time to consider how to maximise the medium and long-term impacts of these initiatives on the public good and national infrastructure.

An underestimated and poorly understood element of infrastructure is the cost of failure and recovery in comparison with the cost of the measures possibly taken to reduce such failures. When a large number of users share infrastructure, such as in the UK, analysis is complicated but not impossible.

Our infrastructure consists of many interdependent components. Failure in one element affects others, sometimes in unpredictable and disproportionate ways. For example, if a water pump with no early warning diagnostics fails, this could cause an automatic shutdown of an electricity substation. This, in turn, stops an electrically powered railway system, which delays workers in getting to work, losing firms many millions of pounds.

We need to ask ourselves if the only way to update our infrastructure, and to provide resilience, is to take a coherent approach and consider our infrastructure as a 'system of systems.'

Without modernisation, the country's global competitiveness will be at risk. The UK will also become a less attractive place to live. Even with modernisation, if it is not coherently defined and directed, our infrastructure may deliver insufficient value to suppliers and users, socially and economically.

If the UK is to make its infrastructure fit for the new millennium, the Government should act as owner of the 'big picture'. In partnership with commerce, it should define a vision for our infrastructure over the next three or four decades.

Government should review the regulatory structures to change the balance between short, medium and long-term incentives for investment in infrastructure. It should oversee a portfolio of research and development programmes to modernise national infrastructure, with local public bodies and private industry managing detailed implementation projects and with finance coming from both sources.

**BIOGRAPHY – Professor Brian Collins FREng**

Professor Brian Collins became the Department for Transport's Chief Scientific Adviser (CSA) in October 2006 and the CSA for the Department of Business, Enterprise and Regulatory Reform in May 2008 and CSA for the Department for Business, Innovation and Skills in June 2009. He is also Professor of Information Systems at Cranfield University. He was elected a Fellow of The Royal Academy of Engineering in 2009.

*[Editor's note: the topic of adapting infrastructure to a changing climate is also addressed by Jim Hall and Lord Krebs on page 20 of this issue.]*