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PAUL JOWITT

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This is the inaugural address of **Paul Jowitt,** who became the 145th president of the Institution of Civil Engineers on 3 November 2009.

To stand in the shadows of Thomas Telford's Dean Bridge, beneath the vaulting roof of William Barlow's St Pancras station (Figure 1) or inside Joseph Bazalgette's pumping station at Crossness is both an inspiring and a humbling experience. The Institution of Civil Engineers (ICE) building at Great George Street in London evokes a similar sense of place, a cathedral of civil engineering echoing with the voices of the great engineers of the past whose names are carved in its Portland stone, whose portraits adorn its walls and whose spirits inspire us today.

It is easy to think of the nineteenth century as the halcyon days of civil engineering, but I wish to state at the outset that now is the time for an engineering renaissance – to build and rebuild our infrastructure in a burgeoning world in the face of the complexities of climate change, in the face of a globalised economy and the fallout from a collapse of the financial systems upon which it was built, in the face of international competition for natural resources, and the fact that much of the world's population has no access to the infrastructure platform upon which civilisation and its survival depends (UN, 2003, 2009a; Burns, 2009).

The great nineteenth century heyday of engineering – that era of massive mechanisation and urbanisation – took the early industrial revolution from the eighteenth century right through into the twentieth century. It simultaneously improved the health of a nation and the wellbeing of the common man, with improvements in water supply and sanitation, economic growth and greater equality of opportunity and social mobility.

From the crucible of that nineteenth century technological and economic powerhouse came much of the world as we see it today, with successive waves of technical innovation and periods of rapid social change. From it sprang the transportation systems of canals, highways, railways and ports; the power systems; the water supply, sewerage and irrigation systems; the production and consumption of consumer goods on a massive scale in an increasingly urbanised society; and the development of large-scale construction and the changing form of cities and towns. But from it also sprang the problems of congestion, air pollution, damage to the environment, profligate resource use, global warming, over-abstraction of watercourses, water pollution, urban blight and social injustice.

It was never anticipated that man's activities would lead to impacts on a global scale, which now threaten the environment and humanity's place in it. Despite our scientific understanding, we did not anticipate the wider physical and non-physical consequences at the systems level. The emergent properties and behaviours of large and complex systems were neither fully appreciated nor fully understood.

There is still a long way to go in changing individual, corporate and national behaviours, but there is no doubt that we are now entering the systems phase, and with it the need to develop systems-level solutions. That nineteenth century era of great engineering in the UK and the west – and with it massive growth in effective infrastructure which saved the health of nations and powered their economies – enjoyed two advantages: seemingly unlimited sources of energy – coal, oil and gas – and a world environment of apparently boundless capacity in terms of water supply, food, materials and other natural resources relative to human need.

It was largely unfettered by the demands of democracy and planning restrictions and had little regard for health and safety. It was funded by ambitious men of massive private wealth, had easy access to raw materials from the empire and scant regard for the rights of other nations. Not so today; now we know differently.

The challenge

This time the scale of the problem is orders of magnitude greater; environmental constraints are dangerously close to being breached; there are growing international tensions for access to water, minerals and other scarce resources. We no longer have the moral

Figure 1. The vaulted roof of William Barlow's 1868 train shed at St Pancras station in London is both inspiring and humbling – now is the time for an engineering

>PRESIDENTIAL ADDRESS

>PAUL JOWITT

freedom to power our way into the future by burning fossil fuels.

Around 1 billion people do not have access to safe water, 1·6 billion people are without electricity, 2·5 billion live without adequate sanitation, over 1 billion are without access to telephone services and roughly 1 billion of the world's rural poor do not have adequate access to all-weather roads (World Bank, 2008).

Resolving all this will require tremendous innovation and ingenuity by engineers, working alongside other technical and non-technical disciplines. It requires the civil engineer's ability to synthesise solutions, not simply an ability to analyse problems. It needs the civil engineer's ability to take a systems view at a variety of scales ranging from devices and products through to the large-scale delivery of infrastructure services.

We also need to take a long-term view – not one where the future is discounted and where major decisions on engineering infrastructure are thwarted by blind obedience to the Treasury discount rate, or where regulatory cycles of 4–5 years do not account for asset lifetimes of 25–50 years. This means not just a shift to whole-life costs but a shift to whole-life values.

We face two issues of truly global proportions: climate change and poverty reduction. The tasks confronting engineers of the twenty-first century are

- engineering the world away from an environmental crisis caused in part by previous generations in terms of energy use, greenhouse gas emissions and their contribution to climate change
- providing the infrastructure platform for an increasingly urbanised world and lifting a large proportion of the world's growing population out of poverty and the associated problems encapsulated by the UN millennium development goals (UN, 2009c).

This will require a combination of re-engineering existing infrastructure and provision of first-time infrastructure at a global scale, and simultaneously reducing carbon emissions by up to 80%.

So now is the time for an engineering renaissance, for a golden era of engineering to take us safely through the rest of this century and beyond. My great friend and mentor, Colin Brown, recently put it to me as follows: 'This is about asking engineers to engage in a process – it's a test of reality not a test of laboratory. It's about how we decide to do this or do that – and to avoid surprise.' This means that the great age of engineering is now.

Climate change

For all practical purposes, the climate change debate is over. The relationship between the greenhouse effect and carbon dioxide emissions from the burning of coal was postulated long ago by Fourier (1824). The effects were predicted in 1896 by the Swedish chemist and Nobel laureate Arrhenius (1896). The debate effectively ended with the work of the Intergovernmental Panel on Climate Change (IPCC, 2007). We now know that the continued use of fossil fuels is certain to accelerate the earth's climate to a point of no return. What is left for the climatologists is now a matter of monitoring and calibration.

For the politicians, now is the time to agree to massively reduced carbon dioxide emissions and global convergence to a low-carbon economy. For engineers, now is the time to provide the solutions that will give the politicians the confidence to make the right decisions, the time to design and deliver the infrastructure adaptation and mitigation measures necessary to secure a sustainable future.

The measures are not about saving the planet as such – it will save itself by finding another set of stable ecosystems and sets of biodiversity – but about saving humanity's place in it and those other species we will take with us should we fail. Noah saved biodiversity by building an ark to save it from a flood; he did not destroy it by causing one.

At their triennial conference in London in 2006, ICE, the American Society of Civil Engineers and the Canadian Society for Civil Engineering signed a protocol for engineering a sustainable future for the planet. In 2009, at the next triennial conference in St Johns, Canada, the three bodies agreed to a follow-up action plan on climate change. I was proud to be involved in drafting both of these.

A 2009 protocol on civil engineering and climate change acknowledged the need to adapt infrastructure to the anticipated effects of climate change and the worldwide impacts of increased exposure to flooding, reduced access to drinking water supplies, and the threat to food security in large parts of Africa, Asia and Latin America – with implications for us all.

The plan determined that civil engineers must lead the way in developing new mitigation technologies and materials to reduce emissions over the whole life cycle of infrastructure systems. It committed the institutions to develop guidance to assess the vulnerability of civil infrastructure and best engineering practice for adaptation measures to address those vulnerabilities.

In November 2009, ICE produced a State of the Nation report on low-carbon infrastructure (ICE, 2009b).

The economy

The world's economy over the past 50 years or so has been built on the production, acquisition and disposal of consumer goods in an increasingly material world. But the material world has failed to have due regard for the underpinning infrastructure that provides the foundation upon which civilisation depends. Existing infrastructure has been left to rot, under-funded. Investment in new infrastructure has not been forthcoming anywhere quickly enough.

The world's financial systems of the past 20 years or so have seen money and risk shuffled around the world in ever more complex and arcane ways. Short-sellers have short-changed the public and shattered the economic foundations of the financial casinos in the process.

Now is the time for a more solid foundation and an infrastructure platform for the world. In a searing critique of the financial sector, Lord Adair Turner, chairman of the UK Financial Services Authority recently described much of the City's activities as, 'socially useless,' and questioned whether it had grown too large.

During a recent visit to the London School of Economics, the Queen asked why nobody had noticed that the credit crunch was on its way. A response came quickly from leading economists from the British Academy (Besley and Hennessy, 2009): 'Many people did foresee the crisis… (but) the timing of its onset and ferocity were foreseen by nobody… Risk managers frequently lost sight of the bigger picture…So in summary, your Majesty, it was a failure to understand the risks to the system as a whole.'

Readers might be thinking that I am not saying enough about civil engineering, that I am focusing too much on economics. But unless we understand the system in which we operate, unless we engage with those who determine policy and command the economy, and unless we start to speak in the language of their discourse, then we will fail. Remember this – when the politicking is over, it will be to civil engineers and other professions that they will turn. Remember too, civil engineering was also founded on a moral imperative: 'civil engineering is the art of working with the great sources of power in nature for the use and benefit of society'. (Thomas Tredgold's original definition was 'Civil Engineering is the art of directing the great sources of Power in Nature for the use and convenience of man'.)

Now it the time to recapture that – not for ourselves, but to benefit the societies we serve and to influence those who set the policies that

>PRESIDENTIAL ADDRESS

>PAUL JOWITT

will enable us to do it. Now is the time to ready ourselves, to make the case for infrastructure, to develop the technologies and to inspire and prepare our young engineers to deliver it. Yes, we have the imagination, and yes, we have the innovative solutions.

However, there is no point in talking to ourselves in a language that others do not understand. This is why ICE has developed a much more intensive and focussed public-affairs policy. Its State of the Nation briefings on key issues to key policymakers have been very effective. ICE advocated the establishment of the UK's Infrastructure Planning Commission, launched in October 2009, to ease the planning process for large-scale infrastructure. ICE pressed for the appointment of a government chief construction adviser, to oversee UK construction strategy, and play a leading role in the development the government's advisory body, Infrastructure UK, and provide a focal point for the construction sector in delivering a sustainable, competitive and low-carbon economy.

Time to reboot

In December 2008, the US columnist and triple Pulitzer prize winner Thomas Friedman wrote the following in the New York Times.

> 'The day started well. I took off from Hong Kong's ultramodern airport after riding out there from downtown on a sleek high-speed train. Landing at Kennedy airport from Hong Kong was like going from the Jetsons to the Flintstones. As I looked around at this dingy room, it reminded of somewhere I had been before. Then I remembered: it was the luggage hall in the old Hong Kong Kai Tak Airport. It closed in 1998. All I could think to myself was: if we're so smart, why are other people living so much better than us? What has become of our infrastructure, which is so crucial to productivity? To top it off, we've fallen into a trend of diverting and rewarding the best of our collective IQ to people doing financial engineering rather than real engineering. John Kennedy led us on a journey to the moon. Obama needs to lead us on a journey to rediscover, rebuild and reinvent our own backyard. That's why we don't just need a bailout. We need a reboot. We need a build out. We need a build up. We need a national makeover.' (Friedman, 2008)

Friedman was writing about infrastructure. However, it is not about infrastructure for its own sake, but about infrastructure which leads to a sustainable future, about infrastructure that provides sustainable urban environments, and about infrastructure that inspires (Figure 2).

Now is the time for practitioners – planners, architects and engineers – and the engineering research community to work together with end users and stakeholders to build sustainable and fulfilling environments, or, to put it more bluntly, 'to make places where stuff works and people are happy'.

For the past 6 years, UK Engineering and Physical Science Research Council (EPSRC) has been funding the 'Sustainable urban environments' (Sue) research programme, a £38 million programme involving 18 research consortia, 60 universities, 213 project partners and stakeholders and covering urban and built environments; waste, water and land management; transport and knowledge management; and decision-making. What is required now is to put the fruits of this research into practice through implementation strategies for sustainable urban environments (e.g. the Issues project) (EPSRC, 2009).

Sustainable urban environments are not just places to live and work, but places where we feel fulfilled and inspired. It was Winston Churchill who said, 'We shape our buildings, and afterwards our buildings shape us' (Hansard, 1943). Now is the time to shape our cities for future fulfilment and, despite the economic situation, now is the time to invest in the critical infrastructure that inspires.

In the 1930s, the response to the economic depression in the USA was Roosevelt's 'new deal': investment in critical infrastructure, such as the Grand Coulee and other hydropower dams on the Columbia River. The folk singer Woody Guthrie was hired by the US Department of the Interior to write songs about the Columbia River scheme (YouTube, 2009; MySpace, 2009). He was inspired to write 26 songs in 28 days, including three of his most famous: Roll on Columbia, Pastures of Plenty, and Grand Coulee Dam. Of the Columbia River and the Grand Coulee dam, Guthrie sang, 'Roll along Columbia, you can ramble to the sea, But river, while you're rambling, you can do some work for me'. There are massive opportunities today to power the future using renewable technologies, not least those that can exploit wave and tidal energy, harnessing the great sources of power in nature (Scottish Government, 2009).

Woody Guthrie also wrote This Land is Your Land – and so it is. Now is the time to re-invest in our infrastructure – and future-proof it against

Figure 2. Michel Virlogeux's 2004 Millau Bridge across the Tarn Valley is a recent example of infrastructure that inspires

climate change and catastrophic systemic failures from natural and other sources. It is bad enough when infrastructure fails through natural causes. It is unacceptable that it should fail by neglect.

ICE's recent State of the Nation report on critical infrastructure (ICE, 2009a) called for the establishment of a new single point of authority for infrastructure resilience. It is vital that we understand the potential impacts of the failure cycle and its societal context. We need to manage infrastructure lifelines in all phases of their lifetimes.

Let us remember that civilisation – a functioning society and business – depends on a series of complex infrastructure networks, providing our cities and towns with clean water, transport, energy and the capacity to trade efficiently. However, this complexity also makes these networks vulnerable. When infrastructure fails, things go wrong. The risks of infrastructure breakdown, and the scale of its consequences, are increasing from a range of random and non-random sources including climate change, potential over-dependence on high-technology infrastructure and increasing urbanisation (in both the developed and developing worlds).

The waters might be muddied but issues are crystal clear: nature is a great leveller. We saw it when hurricane Katrina hit New Orleans in 2005. A few simple civil structures failed – some flood levees. Eight hours later, the social cohesion of a city in the world's richest and most advanced country was reduced to chaos. No electricity, no ATMs, no cash, and therefore an inability to buy food or water.

We have seen it recently with the floods in Cumbria and Dumfries in November 2009. We saw it in Yorkshire and Scotland in 2007: loss of homes, people camping out in their driveways to protect their shattered properties and remaining possessions. Some would not return to their homes for over 12 months, some still haven't.

We saw it with the earthquakes in China,

 ISSN 0965 089 X

>PRESIDENTIAL ADDRESS

>PAUL JOWITT

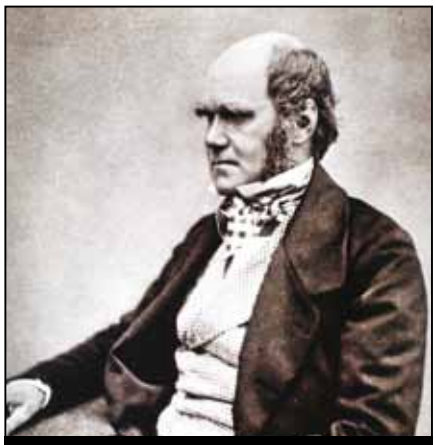

Figure 3. Charles Darwin (1800–1882) was one of the world's first systems thinkers – civil engineers need to develop systems-

Pakistan, Italy and just recently in Indonesia. We saw it with the tsunami in 2004 in Indonesia, Sri Lanka and India, and again just recently in Samoa: thousands dead, thousands displaced – loss of homes and livelihoods.

We have seen it as a result of terrorist events – the World Trade Center, the London Tube bombings, Madrid, Glasgow and in India, Pakistan, Iraq and Afghanistan: severe loss of life, economic damage, massive disruption to transport and communications systems, mobile-phone networks swamped.

The incidents show that we are only hours away from social collapse if critical infrastructure fails. Now is the time to look at the bigger picture – in terms of timescales, in terms of connecting disciplines, in terms of whole-world thinking, in terms of systems.

Systems

The prevailing western and north-American view of science and technology has been essentially reductionist, which does not encourage a systems or holistic view of the world. As we enter what has also been called the 'ecological age', civil engineers need to adapt and learn from other disciplines and from other cultures that have a much closer relationship with the world in which we live – the American Indian, the Celt, the Inuit, the Aboriginal, the people of the Masai Mara, the Maori.

In recent years we have justly and proudly celebrated the anniversaries of great engineers – Thomas Telford's 250th, Isambard Kingdom Brunel's 200th, Thomas Hawksley's 200th. Last year was the bicentenary of Charles Darwin – one of the first systems thinkers, at least in 'western' philosophy (Figure 3). As civil engineers, we need to develop systems-level solutions to enable us to give better advice and to arrive at better decisions.

We need to distinguish between complexity and complicatedness; to distinguish between those things that are rich in structure compared to those which are just rich in detail.

We need to tackle issues of land-use planning, urban regeneration and transport as parts of the same system. In terms of transport, we need to see different travel modes as complementary, not just as competing alternatives leading to all manner of undesirable and unintended consequences at the systems level. In terms of water and water resources, now is the time to stop thinking of water as just another commodity.

In a recent presentation to ICE's council, the government's chief scientific advisor, John Beddington, outlined ten twenty-first century challenges as the 'perfect storm'

- urbanisation
- population
- food security
- poverty alleviation
- energy demand
- climate change
- water demand
- counter-terrorism
- infectious diseases
- biodiversity.

These challenges are not independent – they are interconnected. They are the emergent properties of large-scale, complex systems. One way or another, civil engineers have a positive role to play in addressing all of these – by dealing with the underlying systems. More to the point, Beddington and others in government increasingly recognise that too: they realise the role of the civil engineer and are ready to listen.

Later in 2009, Beddington encouraged the Royal Academy of Engineering, ICE and the Chartered Institution of Water and Environmental Management to hold a workshop to examine the key issues of water security. The workshop covered water resources and urbanisation in Asia, agriculture in sub-Saharan Africa and sustainable water resources development in Europe. The recurrent message that emerged was the need to adopt a systems approach to water security, to develop a systems-level understanding to enable better decision-making.

Water security is not confined to the UK, it spans the world. Rivers and aquifers do not respect national borders and this has the potential for international conflicts – not least in the Middle East, in Africa and in the Indian sub-continent. As Mark Twain once observed, 'whiskey is for drinking, but water is for fighting over'.

International development

The criticality of infrastructure is not confined to the developed economies of the world. ICE has worked with other built-environment professions and the Max Lock Centre to produce a guidebook for disaster risk reduction and response. The effects of climate change and the fallout from political strife add to the catalogue of disaster-relief work.

ICE has long been a supporter of RedR – the Register of Engineers for Disaster Relief. There is hardly a place in the world where engineers from RedR have not been deployed in the wake of some disaster or another to bring humanitarian relief – re-establishing or establishing from scratch the fundamental human requirements of water supply, sanitation, power, shelter, food and medical supplies and other essential services.

However, civil engineers also need to be proactively involved in international development, not just responding to disasters after they have happened. Effective economic recovery and sustainable development will also depend on extending infrastructure to those in the world who have been left behind in the past 50 years and who will be exposed to even greater threats in the next 50 years.

The world's population is now over 6 billion and set to rise to 9 billion by 2050. Urbanisation is increasing apace. There is a tide of humanity heading from the countryside to the city: tens of millions per year. The demand for effective infrastructure services is immense.

Progress towards the UN millennium development goals (UN, 2009c) is behind schedule, and the global economic crisis has had grim repercussions (UN, 2009b). The consequences of climate change – sea level rise, changes in rainfall patterns, drought and flooding – will impact most on the most impoverished people of the world. The first six of the eight UN goals are directly concerned with the human condition: their physical health, their economic and social well-being and their capacity to play a full and useful role in the world. This all depends on access to infrastructure, on civil engineering.

The other two UN goals relate to the environmental limits within which we have to operate, and the partnerships we need to build, to deliver the infrastructure upon which civilisation depends – infrastructure that achieves real, pro-

 ISSN 0965 089 X

>PRESIDENTIAL ADDRESS

>PAUL JOWITT

poor outcomes in the process of its planning, construction and operation.

Lack of access to basic infrastructure is at the root of world poverty and the human tragedies associated with it. Many communities are marginalised with little access to even the most basic of infrastructure, education and healthcare, and tenuous legal tenure to land or property. In the massive Kibera township in Nairobi, the people are exploited, with most of the dwellings owned by private landlords and where the payback period is 9 months (BBC, 2009). Yet even in Kibera, community groups are bettering their community, by constructing toilet blocks and running a maternity unit, assisted by aid funds and personal subscriptions of a few Kenyan shillings per month. In their overcrowded classes, schoolchildren are attentive and smartly turned out. In her schoolbook an 8-year-old girl writes in neat handwriting that cutting down trees is bad for the environment because it leads to soil erosion – and yet much of Kibera relies on fuel wood for cooking. That 8-year old girl is taking a systems view.

Even in the emerging economies of such as India and Brazil, there is scant evidence that the underclasses are benefiting significantly from their countries' transformation into technologically driven powerhouses. Most are still living in what are euphemistically called 'unplanned settlements': slums. From Mumbai to Nairobi, from Cape Town to Rio, the urban landscape is scarred by amorphous, slum-grey shanty towns, built from whatever materials come to hand, with water courses polluted by sewage and solid waste.

The solutions today are deceptively straightforward – the provision of basic urban infrastructure and effective infrastructure services. Now is the time for an engineering vision for delivering the UN millennium development goals.

There are certain prerequisites for development, without which attempts to improve livelihoods in the developing world will be unlikely to succeed. These include reasonable governance structures; a functioning civil society; an effective local economy; and freedom from persecution, conflict and corruption.

ICE and the charity Engineers Against Poverty are partners in the 'Construction sector transparency' (CoST, 2009) initiative funded by the UK Department for International Development (DFID, 2009). The project is being piloted in Tanzania, Zambia, Vietnam and the Philippines. It is tackling problems of corruption and shoddy workmanship in construction to ensure that government-funded construction projects are delivered on time, at high quality and at a reasonable price – exactly the same values and expectations that we would expect in the developed world.

A functioning local business sector can also reduce poverty through direct involvement in the development of effective and sustainable infrastructure, providing an internal demand for local skills and employment. This is exemplified by the work of Ron Watermeyer, former president of the South African Institution of Civil Engineering. Watermeyer was seconded to the South African government in 1995 and led Soweto's contractor development programme. He was closely involved in community-based job-creation programmes and the development of local engineering businesses and enterprises.

Now is the time to work with our engineering colleagues across the globe to build the engineering capacity to create the infrastructure services to deliver the UN millennium development goals. If we are successful, the lessons learned by that 8-year-old girl in Kibera will have been worth it and put into practice. She might still be at school in her teens, her family part of a recovering local economy, her community less at risk from disease from poor wastewater disposal and fetid solid waste. Perhaps she will go on to college and become part of the infrastructure delivery process.

It is not limited to Kenya (Parikh and McRobie, 2009): elsewhere slum dwellers are organising themselves through organisations such as Slum Dwellers International (SDI, 2009a, b). Rose Molokoane, president of the South African Federation of the Urban Poor, puts it like this: 'Poor people are really fed-up of being objects and subjects. Instead, they want to be partners in the creation of cities without slums'.

Infrastructure delivery also requires investment. Those mired in poverty do not have and cannot afford all the resources necessary to resolve their plight. They will need external investment from business and international agencies, and assistance from the worldwide engineering community. There will be no spectators as the future unfolds, but there are particular roles for civil engineers.

ICE is doing all it can to build engineering capacity at the international scale. We are working with the Royal Academy of Engineering, the South African Institution of Civil Engineering and the African Engineers Forum to build engineering capacity in Africa (Figure 4). We are working with Unesco and Engineers Against Poverty on university curricula for engineering for international development. We are in contact with senior officials at DFID, UK Aid and politicians from all parties to pursue all these initiatives.

Figure 4. ICE is a partner of the Africa–UK Engineering for Development Partnership, one of many initiatives to build engineering capacity in

Supporting young engineers

The current state of the economy is having profound effects on civil engineering – and civil engineers. We know that many civil engineers have lost their jobs and the recruitment of graduate engineers has slowed. Now is not the time to lose a generation of young engineers.

Now is the time to inspire them and allow them in turn to inspire the rest of us through their passion, their values and their energy. Now is the time to encourage, nurture and support the engineers of the future. We must do this throughout the engineering professions – individually as role models, corporately through the engineering industry and professionally through the ICE.

The graduates and student members of ICE are our lifeblood. Many of our graduates are members of Engineers for Overseas Development, an initiative started by Ian Flower of ICE Wales to, 'assist in the development and training of graduates by challenging them to undertake projects that improve public health in developing countries'. Many of our younger members are also members of Engineers without Borders, a student-led charity established to, 'facilitate human development through engineering'.

At the international scale, many engineering students from the developed and developing worlds are taking part in the Mondialogo engineering awards (Mondialogo, 2009), developing engineering projects to address the UN millennium development goals. As a member of the Mondialogo Jury I have witnessed first hand the way in which young engineering students work together – crossing boundaries,

 ISSN 0965 089 X

disciplines, nationalities and cultures (Figure 5).

One of ICE's distinguished past presidents, Thomas Hawksley, made some very pertinent observations about supporting young engineers in his presidential address. They are worth repeating.

Hawksley said, 'On the subject of professional education, I would say to the students – of all things, don't attempt too much'. He advised them to maintain their skills in mathematics and engineering science, to develop their language skills and to keep up to date with cognate subjects. He advised them to practise as much as possible the art of mental computation, for this would give them the means of almost intuitively arriving at the best of several alternative plans or methods; to develop a knowledge of form and function; and to develop an understanding of practice, adding that this knowledge is not to be obtained in a school, a college, or an office.

He said, 'Don't be afraid of soiling your hands or dirtying your boots, but be in every other respect – in thought, feeling, and conduct – a gentleman'. This was before we had a female president! What he meant was to be well-mannered and considerate with high standards of proper behaviour – that is, to adopt a professional ethic.

A few years ago I led a task group to define ICE's sustainable development requirements in civil engineering degree programmes. I wish I had read Hawksley's address beforehand as it would have saved some time. Fortunately, we did not get it wrong. Our conclusions were in line with Hawksley's advice: to balance engineering knowledge – both theoretical and practical – with a disciplined body of general knowledge, and the need to develop skills of discrimination and judgement through close observation of sound engineering practice.

Hawskley concluded his address as follows: 'I shall be happy to afford to the students of the Institution all the opportunities in my power... If they will do me the pleasure to accept an invitation to visit the Leicester Waterworks, which combines in itself the storing, the gravitation, and the pumping systems, I shall be only too glad to make all the necessary arrangements.'

Figure 5. The Mondialogo engineering awards encourage engineering students to work together – crossing boundaries, disciplines, nationalities and cultures

Hawksley was an engineer committed to the provision of public services, the underpinning infrastructure upon which civilisation depends, and committed to developing the next generation of engineers to deliver these goals. Like Joseph Bazalgette, he was an engineering hero then, and he would be a hero now.

Conclusion

Now is the time to support our young engineers, the time to unleash their skills and enthusiasm. Now is the time to build engineering capacity worldwide for international development and to deliver the UN millennium development goals.

Now is the time for an engineering renaissance, the time to build and maintain the critical infrastructure upon which civilisation depends – both at home and abroad. Now is the time to take a systems view of the world and deliver systems-level solutions.

Providing the platform for a sustainable future for succeeding generations has never had a more important moral, economic, social and environmental imperative. Now is the time to deliver. As civil engineers, this is our job.

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Institution of Civil Engineers
One Great George Street
Westminster
London SW1P 3AA

t +44 (0)20 7222 7722
f +44 (0)20 7222 7500
ice.org.uk

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