

**Royal Academy of Engineering:
Visiting Professors' Workshop at Churchill College,
Cambridge**

12 & 13 September 2006

Day One

Tuesday, 12 September 2006

SESSION 1

Hugh Norie FREng

Welcome to this the latest workshop in a series which has been held from time to time to review the Academy's Visiting Professors Scheme. And I would particularly like to welcome delegates from the Institutions, the Design Council, the ETB and EC(UK), the Design Leadership Forum and SEMTA.

The last workshop was held in 2002, and examined Best Practice in the teaching of Engineering Design. The book edited by Ken Wallace, called Educating Engineers in Design, was an outcome of that workshop. For this workshop, we want to make a change and look not just at what the VP Schemes are doing, but what is the likely future trend of the whole engineering industry and of the teaching of engineering, and how this could and should affect the work of the VP's within the undergraduate teaching framework.

We are seeing the start of what could become a tectonic rearrangement of the foundations of our industry, driven by the spectacular rise in the technical, pedagogical and research capabilities of non-European countries, and particularly the BRIC Group (Brazil, Russia, India and China). As part of this, we are seeing changes in trade, manufacture and the provision of services which are in turn leading to significant relocation of industry, and of technical development, away from traditional European centres. The strong economic performance of these rising countries and their younger, energetic populations are in turn powering increasing national standards of living and expectations, and higher national standards of excellence. The RDE 100 (the most Rapidly Developing 100 Economies— led by the BRIC countries and Mexico) are increasingly cash-rich, ambitious, and politically influential, and could come to dominate many traditional industries. Some of our assumptions about the UK being able to rely on a high-tech post-industrial economy, based on innovative, top-end science, may be undermined by the developing intellectual power and wealth of these new economies (the US Engineer of 2020 project forecasts that 90% of all engineers will be educated in and practice in Asia by 2020). At the same time the forfeiture of ownership of many of our top companies to overseas stakeholders will affect our ability to retain control of policy on the future direction of these companies, and of their research. Sir George Cox and Professor John Roulston will take up this theme later this afternoon.

We are facing other challenges, many of which will require a supply of well-qualified engineers for their resolution. These include sustainability, climate change, globalisation, and societal changes, including demands for better living standards at both basic and more sophisticated levels. And also - for better and worse – the issues of knowledge transfer. There are other challenges at the national level: falling standards of education, students' loss of interest in the harder subjects, and loss of skills. We are also facing an increasing dependence on IT, which will have to be serviced – but not necessarily by means which will remain within our control.

Given these uncertainties, the means of providing a sufficient force of engineering talent to meet our future needs is unclear, but there are some indicators. It must also be recognised that this is not a unique concern of the United Kingdom, and the United States in particular has been at the forefront of debating the problem. Our concern today is particularly to consider how teaching may need to change to meet the requirements of this different world, and therefore the changes we need to take into account in charting the way forward for, for instance, the Visiting Professors schemes.

In the Synopsis circulated to you with the papers for this event, we have put forward various questions for consideration, and there are undoubtedly many more. Some of the critical issues are:

1. What should be the primary focus of education at university level: is it to train and widen the mind, or to increase the knowledge that is of direct use to future employers? Should it be to excite and energise the student? What competences will be needed in the future?
2. In each case, how should industry contribute to the curriculum and its teaching?
3. What would be the best linkage, and balance, between teaching and research? Should teaching be managed independently of research? How should good teaching be encouraged, and how should teaching excellence be measured? How should the RAE be revised? What should be the balance between Government and private funding?
4. UK skills are reported as lagging behind world-class standards (this has been emphasised recently by Sir Richard Lambert at the CBI). Is this issue being tackled adequately? What further action would be feasible? Can we succeed anyway into the future given the UK's shrinking industrial base and lack of a national policy on

maintaining a core of industry within the UK (compare this, for instance, with the strong US focus on its defence industries)? Can we rely solely on innovation to maintain our economic momentum? In the book, *Managing Innovation*, by John Bessant, Joe Tidd and Keith Pavitt, the point is made that many innovations fail, and that the cost of bringing new technology successfully to market can be extremely high (they instance Motorola's Iridium project); so is this really a model for a whole economy? And if so, the number of graduates needed must also be very high – given the need for excellence and critical mass.

5. And how should we monitor, and forecast, the changing industrial and technological landscape?

From the Academy's perspective, a major initiative has been launched with the Henley Study - *Educating Engineers in the 21st Century: The Industry View*, and this is already generating valuable information. Professor Julia King will be talking about this tomorrow. The Academy is also heavily involved in bringing a greater awareness of engineering into schools through the BEST and TESS programmes. Through these and other initiatives we may be able to define outcomes more accurately, for instance the required competences in a world of change. But I believe we also need to consider how we can remain effective in influencing outcomes: strategically, should this be through affecting Government policy, or even breaking away from it; and then at the level of the VP schemes, this might be through a significant change in direction. The issues are many and varied, and need to be prioritised and focussed in our discussions.

The framework for the questions we would like to have answered, or have got close to answering, by the end of this workshop is, we think:

- A. Who – what sort of people – need to be brought on through the educational system if change is to be addressed effectively?
- B. What is the role of education at both school and university level to teach these people? And what should they be taught?
- C. What should industry do to assist in this process?
- D. What is currently holding us back – why are we not dealing adequately with change now? What are the barriers to success?

E. What can the Academy do to facilitate this, eg through the VP schemes? What are the plans for action?

We must certainly look at how we can build on the VPs – universities are now accustomed to employing them to good effect, giving us a sound base for further action. And, critically, universities must be fully involved with all such plans of action as they evolve.

The programme for our workshop will start with a mind-flexing exercise, entitled Issues Driving Change, run by Chris Lubkeman. This exercise has been used effectively with industrial and political leaders around the world, and you will certainly find it interesting. We then have George Cox and John Roulston's perspectives on the changing environment of industry and engineering. Tomorrow morning we start with three presentations on Engineering Higher Education, followed by a panel and floor discussion. We then break into syndicate groups, asked to define an action list for the Academy, including proposals for the VP Scheme into the future. Then tomorrow afternoon we will have a plenary working session to bring the workshop together and set the direction for the action plan. And finally, we will need to agree how this is to be monitored and refreshed to maintain the plan's effectiveness and relevance into the future.

This is a demanding schedule, and we need your best advice and assistance if we are to succeed.

We will now move straight on to the next phase which is Chris Luebke's work. You will have seen Chris's biography in the papers that have been handed out but I will just confirm that he is the Director for Global Foresight with the Arup Group and has the particular role of looking at drivers for change and how these can be brought into a logical business strategy. He has built his career from the disciplines of architecture and structural engineering, involving some highly innovative concepts. He has been named as one of the 10 futurist shapers who will change the way we live – and you will certainly do so this afternoon.

Chris has run many workshops on the issues and processes of change and has used these techniques extensively.

Mini-Workshop:

“ISSUES DRIVING CHANGE”

Dr Chris Luebke
Director for Global Foresight, Arup

It is a great pleasure not only to be back here in Cambridge, but to be here with you, with the charge that we have just heard. These issues are absolutely vital. I deeply believe that when we look at the challenges that we will be facing together, those of us in this room, are absolutely fundamental to confronting, dealing with and turning that change into opportunity. If we do not, who will?

The future is very interesting. Many people have looked at the future and, in fact, the future is always over-sold and under-imagined. No one in this room can actually foretell the future – or at least, I cannot, and I assume that you cannot. However, when we look back at what people have thought about the future, one of the points that comes up for me is this one.

This is the world of *Bladerunner*, which came out on the market in 1982, which is not that long ago. This was for Los Angeles in the year 2026, so we are about halfway to that future – at least as it was presented in 1980. I would suggest that, although Los Angeles can be rather a jungle, it is not yet like that – we do not have the *Bladerunner* world of those robotics. Perhaps, if you listen to some, we will be there in 20 years although I am not quite sure.

Around that time, there was a wonderful quote which I think is right. “A hundred years ago [*sic*], after we are gone and forgotten, those who never heard of us will be living with the results of our actions.” To me, that quote sums up a good deal of what this workshop is about. It is about setting a course, recognising that the winds are changing. We have to set a course that will impact the next 100 years of our students, of our families and of our friends and – if you will – our enemies. The odds are, quite frankly, that in 100 years from now, no one will know who the heck I was, although perhaps they will know about some of you in here.

For sure, however, they will be living with those actions that we will be suggesting that the Academy takes and, through that, the communities which we influence. Even though you might not come to this with such a degree of severity, this is absolutely vital. The same question is being debated and discussed in similar groups all over the world because of this recognition that the winds are indeed changing. Everything that we do drives change

because all of our actions, all of our decisions that we make today are driving change. These are the decisions that are being made all over the world.

What is interesting to me when we think about that are these six assumptions that I and my team at Arup work with. The first one is that change is actually constant and what we have to understand is our evolving context. The delta has always been here, but what is now our context that we are working with? Trying to define our understanding of that context is, for me, what much of the next couple of hours will be about.

The second working assumption that we have is that there are three methods of understanding or analysing information – the gut, the heart and the head. The gut is what we as animals, as humans, relate to. Human resources research says that in 13 seconds you have decided whether or not you are going to hire somebody and you spend 59½ minutes rationalising that decision. It is a gut reaction and we have that to so many things.

The second one is the heart, which is our belief structure, concerning the things that we believe are true but which we cannot prove. Nevertheless, we believe them to be true, and this is therefore an important value system, just like our gut reaction.

The last is our head. I would probably suggest that most of us in here are most familiar with the head. As engineers, this is where we like to run to, because we can get answers very quickly – or perhaps not. However, we have to remember that this is just one of three systems. I would encourage you over the next 36 hours to try very hard to engage all three of these systems which we have been given, or which we have evolved into – whatever your belief structure is. These are vital: we have all of them, so let us use them.

The third working assumption is the wisdom of crowds and emergence, so it comes out of the flocking theory. I do not really like to talk to experts too much, because they know an awful lot about nothing. However, if you talk to a whole bunch of people who consider themselves to be semi-expert, you begin to hear things and subtle movements of opinion that you could not have before. This is the whole internet, the blogs, that you should be listening to, and which our students are talking about. There are industry blogs that come out of the whole world and you can begin to have a new wisdom of the crowd. We are a crowd here, 100-people strong: we are a *crowd*. We are not experts – this is the wisdom of a crowd.

The fourth working assumption is that we only have one planet to share. Everything that we do must be aimed at recognising that. Every development, every innovation and invention, should be looking to reduce the utilisation of resources on the planet, rather than increasing it. That is vital because those who do not have, want what we have. History shows this again and again and again. If we can work towards an equitable distribution of

resource and opportunity, then there is greater opportunity for all, and greater opportunity for us. This has to be one point, this one-planet principle.

Fifth, so far as I know, only humans know how to make boxes. There are many vessels in nature, lots of sacs and other kinds of containers, but only humans make boxes. Therefore, only humans can get rid of boxes. By this I mean that we have to think more and more about systems and systemic design, systems of thinking, and actually going beyond, out into the layers of systems, to understand the ecologies that we need to be working with, to get away from boxes and to think about total systems design.

The last working assumption for us is that no one person has the key. If you do not believe that you have a key to the future, or a part of that key, then we have thrown away – it is only through believing that you have a part of the key that we actually have a key to unlock that potential.

It is very interesting when you speak to many students, who believe so fervently that, when they come to our company, to Arup, they are coming to us to make a better world. They want to do that, and they *believe*. You talk to so many people who have been in our industry for 30 or 40 years and they have seen it all, heard it all, and say ‘forget it!’ We have to capture that belief that we can unlock the potential – it is not dismal, but it is full of opportunity.

Global scenarios to 2020

That brings me to this, our global scenarios to 2020, the beginning of the workshop for this afternoon. James, one of the interns in our team at Arup, will be handing out a card to each of you, and you will need to have a writing utensil of some kind. You are about to become a futurist group right now, and we will check the wisdom of our crowd right here. I will then share with you what others have said, exactly in response to the same thing.

We will chart two axes. The first is economic growth and this, of course, is how we evaluate ourselves – by economic growth. The second axis is global governance and here we have a positive or a negative growth versus a cohesive convergent world, where the rules governing global society are more cohesive, coherent and together. On the other side, there is a more fragmented, divergent, diversive world, where the rule of global governance is starting to fall apart. WTO loses strength over here, and WTO gains strength over there. The United Nations is very strong over there, but very weak over here.

I have created four scenarios. This is very dangerous in a group of highly intellectually endowed individuals. With CEOs I have never been worried about it, but with you guys I am worried. I have four of these, each one of which is valid and each one is

flawed. What I want from you is a gut reaction – but do not tell me what is wrong with the scenario. Do you agree?

Global scenarios today

The first one is what we call 'bloc islands'. Bloc islands is where we have economies recovering at varying speeds. You have regional economic trading blocs. This is also an eye test. [Laughter] Global dynamics are driven by ideological differentiation, labour reforms positively impact our economies. Basically, you have growth but there is global dissonance. You have, say, a regional trading bloc, which is France and the UK. [Laughter] I know that is fantasy, but that is OK – but let us pretend that could occur. There is Western European/Eastern European, and lots of regionalism, with all the governments being shoved out to the regions, and all the money. It is hyper-regionalism. That is one point.

The second one is what we call 'reglobalisation'. Economic growth is positive and global governance is positive, so here we have Iran and the United States in a new trade agreement – all kiss and make up. The United Nations is restructured and revitalised. Terrorism and geo-political instability is contained. The WTO's trade and influence increases. Inflation grows a little – and a little bit of inflation is OK. Basically, the world is rosy. That is up here [on slide].

Here, at the bottom left, we have what we call 'flat-lining'. In flat-lining, essentially Switzerland and Japan become the roadmap. They have had very little growth – they are waving around in what we might call 'sustainable economies' but somehow, that is considered to be negative. There is rising isolation and protectionism, so that you have a negative economic impact globally. Consumer confidence hits new lows and governments renationalise utilities. The United Nations and the WTO significantly fractionalise and their strength disappears.

The last situation is what we call the 'global yo-yo'. This is where governments and businesses work together for positive governance but we have economic difficulties. There are financial and terrorist shocks, or another tsunami. There is a global statement that everybody, even George Bush, agrees that global warming is real. There are huge floods and Tonga disappears. Big shocks – but there is a will to overcome them. There is a greater risk of systemic shocks in the global systemic market because things are getting riskier, but there is a will to work together.

Those are four scenarios, each of which is problematic and each of which is valid. What I want you to do now – you are making vectors, and you know what those are, do you not? Vectors have an origin and they have a direction. The origin is where you think we are today, and the direction where the arrow ends up is where you think we will be in, say 2020.

In the next fourteen and a half years, where will we be heading? So we have a dot and then an arrow. Please go ahead and do that, but do not look at your neighbour's paper. When you have done that, we will take a quick look at those cards and compare your opinion with the world's opinion, the global opinion.

Everyone has to put a mark on their card – this is how we are taking attendance. Do not put your names on them. I was doing this with a group in Sydney, Australia. The mayor was there, and a group of journalists and a group of lawyers. They all sat and looked at that piece of paper, but did not touch it – there was no way they were going to give their opinion on a piece of paper, until I said they were not to put their names on them.

[Cards completed and collected]

Let us have a quick show of hands. How many of you put us in A (bloc islands) today? That is exactly 42.5 per cent. How many of you put us in the top right (reglobalisation). That is seven per cent. What about flat-lining? That is about the same. And what about the global yo-yo? That is the other 35 per cent. So the majority of you put us up in bloc islands, and secondarily down here.

Global scenarios 2020

What about the future? How many of you think we will be up in bloc islands in 2020? Fewer. And what about reglobalisation? I see there are more this time.

How about bottom left [*on slide*], flat-lining? There are significantly more down here. And then what about the global yo-yo? That is very interesting.

I have done this with groups from five to 300, and this is typically the outcome. They don't have a clue. [*Laughter*] Just like you, they have no clue – but that is good. This is what I love the most.

If we go back to the context, it is very important for me to remember that all of our contexts are quite different. There is no such thing as a unique global context and it is very important to recognise that – depending on our individual personal context, as well as professional, within our region. It can be within a school, a region or part of a country. There are then our other external relations. All of our contexts will be quite different and this will be one of the challenges that you will have over the next 36 hours, in how to make sure that you are defining the context within which we are working. That is extremely important for me and for us.

That being said, of course statistics always lie. Here, up to six months ago, there is this summary. I have done this now with almost 8,000 people around the world and the only continents I have not done it on yet are Antarctica and South America. This is the origin, and

that is where the arrow ends – the direction. So 33 per cent of those asked in Europe said this was where we begin. These give you the magnitude of where the arrows were going. Some of you probably had an arrow which began here and perhaps went out further, and that was this one. Or perhaps you had an arrow that started here and went down this way. That gives you the relative magnitude of the movement from that origin.

I will show you this one [*on slide*] and Asia, which are interesting to note. Take a look at that. Look at this 38 per cent. We are starting here with 16 per cent, and 20 per cent, but then where are we heading in the future? Sixty per cent, just about, have said that we are heading up to bloc islands. Sixty per cent: 14 per cent, 20 per cent and 10 per cent. So you can see that the vast majority of Europeans are happy to be in the European bloc and they want to stay there – or at least, that is one interpretation. Recognition of this, as ideological differentiation, will be more and more important for our world.

If we look at Asia – so that is Singapore and China, which is where I have done it mostly, and I have not been in India yet – there is a different picture. The first thing you see is that 59 per cent put us here in the yo-yo. We think of the tsunami and the economic crashes, that is logical, but they have all said that we are heading up to bloc islands – they do not believe they are staying down in the yo-yo. They believe they are heading up here, because this is economic prosperity rather than negativity. Getting into the future for Asia, again 50 per cent, 20 per cent, and very little down here. Very few put us down here in the flat-lining, in the sustainable economy world and that is quite interesting.

[*Slide*]

The global summary looks something like this. Again, where are we heading in the future? Fifty per cent say that we are up here, and about 20 per cent down there. Twenty per cent for globalisation? You did not put your hands up. I was with the building industry in Denmark two weeks ago and the majority of them put their hands up for this. That was unique, I have to say. I do not know whether that was aspirational, and that they were hoping that their industry would become more globalised, or what it was. That was 20 per cent down here, and a good 10 per cent down there.

There are two interesting points here. At least 10 per cent of the global population has said that we are going to be down there. Ten per cent. So if you had never even thought that we might go here, 10 per cent say that we are here. Now, if we assume that everyone here is equally smart, then 10 per cent could be right. The question that I always ask for this is, what could we do in each on of these worlds, because the context will be a mixture of all of them and it will be different all over the place. Do we wish to survive or thrive?

We in this room are not interested in surviving. Would you like £1.85 a day for the rest of your life? Do you want to go there? No. That is survival – equitable survival – if we take the money and spread it around. What we are interested in is thriving. What you have to do today, and in the next 36 hours, is to consider what is our strategy for ‘thrival’ – to thrive in this new economy, this new world. It is not about *surviving* the change, but *thriving* in it. To me, there is a fundamental mind difference between survival and thrival – small, but it is huge.

To do that, what I have been able to do – and Arup has allowed me to do this – is to go around the world to about 8,000 people in cities all over the world, asking the same kind of questions. I also said, ‘OK, you can’t agree on the context right now.’ Even in South Africa, I was with the CEOs of the five big banks and they had five different arrows. That is pretty unique – they are all in grey suits and white shirts and red ties. All over the world, I have been asking the question, ‘What are the driving forces?’ I was trying to paint a picture of the context and get some hierarchies for that.

STEEP drivers

We take the STEEP drivers, which are Social, Technological, Economic, Environmental and Political. There are lots of different ways we can do this - Pestel and so on. This is what I find the most robust and this is what we have been using and I like it. I believe that you have to disaggregate issues and focus on one family of issues, so that you can re-aggregate them and think of the influences across the different categories. Normally, we only like to talk about three of them.

If you think about it yourself, when I first started doing this work, I only liked to talk about social, technological and environmental issues, ignoring politics and ignoring money. I came from MIT, the ivory tower and I was not going to talk about politics, thank you very much. Now, however, if you do not get involved with politics, you do not change the rules of the game and you cannot be clever. So we have to get involved in politics, to help change the rules of the game, so that we can actually be clever. That is really important. My mind has been changed during my tenure with Arup so far.

Now, we will move up to another room where you will find 10 flip-charts. There should be about 100 of you here, and you can do the maths to see that there will be 10 people per group. When we go up there, please do not stand with your friends – do not hang out with the same people you hang out with at lunch and everything. Go and stand at an easel with somebody else. The question we will ask there is, what are all the drivers that you can think of that are vitally important to Europe and specifically for the United Kingdom, over the next 15 to 20 years – because 100 years is too far to imagine? You should think of

the driving forces, the social drivers, perhaps – only focus on one letter. I warn you that I will move you. If you are brain dead for 15 minutes because you have not had enough caffeine today, that is OK – we will move you, so that you can think of a couple of the other ones. You can go to your favourite letter first if you like, but then you will move.

We will then prioritise them because what we like to talk about, and what we think is very important, is very often too different things. At the end, right after the coffee, I have been allowed five minutes in which to share with you what other groups have said are their top issues that are driving change in different parts of the world. We will then be able to compare what you have said – the wisdom of us as a crowd – with that of others.

Is that charge fairly clear? Please choose a scribe for each group and write down ideas, with no big editing. I expect each group to fill up at least two flip charts on the first round. [*Arrangements for break-out session discussed*]

[*Break-out Session*]

Driving forces results

Chris Luebke: You have done a fantastic job. First, I have the results of the four-square. This is very interesting to me and, once again, I am happy to send this back out to all of you today. It seems that we are pretty clear on where we are today. Forty-one per cent said that we are up in bloc islands, up in the top left; 29 per cent said that we are down in the yo-yo, and then it was almost evenly split between the reglobalisation and flatline, with 16 and 14 per cent. Those of you who are quick at maths could probably check that that is 100 per cent.

According to the wisdom of this crowd, the future is almost exactly split between all four scenarios. [*Laughter*] I have to say that I have done workshops like this 82 times, and no one has ever had an almost equal split – 27, 24, 25 and 24 – and statistically, that is equal. That fascinates me, because your world view is, on the one hand, fractured, and the challenges that we face, because of that radical distribution – if we had a very clear world view of where we were heading, as there is a very clear view when you are in California about how the future will be, or in Shanghai, it is very clear. It is much easier to plan than when you are trying to answer the questions that you are. Your challenge now is that, with

this being such a different context, you should come together with some visions for the Royal Academy, for yourselves and for us – for UK plc. That is the first point.

Secondly, as all good academics, there were four of you who absolutely did not follow directions. These people split their vectors into two – and perhaps you cannot see that. That was quite interesting and, of course, someone also said that they were very confused about the polar co-ordinates versus Cartesian, which was fine. I would love to talk to this person at some point, to find out how they make one vector into six. All of us would love to do that.

What did you say before, in your exercise? It was really quite interesting and this was what you said. These were your top six and, when we were calling them out all together in the big room, hopefully those would look familiar to you. These were the things which you said, in your groups, were important. Then, if you were permitted or encouraged to take your personal opinion and express it, that came up with something slightly different – not radically so, but slightly different, and it always does.

You said that education was the No. 1 social driver, and I will challenge you about that and say that I would discount that with this group because that is fairly self-serving and we all tend to believe that to begin with. That is not intended to be insulting at all, but I would then go right to the next one and say that ?ballooning expectations – and this, again, is thinking that this was what you said were the top things that the Royal Academy needed to think about. How do we deal with this collapse – and I put collapse there – or the changing of the social structures? This is family structures and things like that. I have just put that as ‘social structure collapse’.

You overwhelmingly said that energy, under technology, was the No. 1 vote-getter. That is what you have overwhelmingly stated and I will come back to that in a moment. Next came resource depletion and the IT plus coms. There are these two coming together.

BRIC was overwhelmingly the No. 1 economic driver for which you individually voted, and then energy, once again, and globalisation – whatever that means.

Resource depletion came under ‘environmental’. Some gentlemen and I were just briefly chatting before this and we said that we believed that this was the first generation who were graduating from university and who were coming into a world which is clearly resource-constrained. That leads to a very different mindset, compared to that of the 50s, 60s and 70s, where it was unexplored and you could do anything and everything. Now, however, we have to make do with what we have, and that is a whole different ballgame.

Education and behavioural change, climate change – this was quite interesting. These two – this was 36 and 33 and so, if you add those together, that comes up as No. 1

amongst everything. However, there are two that are slightly different and so I had to leave them separate. The role of the UK and the vision for the UK, and the clarity of that – this is something that all of us would wish was better, with a clear understanding of what is our role. This is one of the questions for this group today in the next 36 hours.

Question: That, coming in the top third, is the same thing as having an equal input about what we will do in the future, because we do not have consensus about where we are going.

Chris Luebke: I would not doubt that. This is one of the few countries left, I would suggest, where there is still a real political debate. You might not like him right now, but at least we have an articulate prime minister. Whether you like him or not is a completely different issue but at least he can make a sentence! *[Laughter]* You know – noun, verb!

We laugh at that but, actually, what is vitally important is the articulation of where we are and where we are going, and where we want to be, so that we can get those vectors – which are all over the place – somehow aligned. To me, that was one of the reasons why I was very pleased to be able to help start this exercise. This is about looking for vector alignment for the programmes with the Academy. Our charge right now is to create that vector alignment. They will not all become parallel – and that is impossible – nor should they be, because that would be a weakness for our culture, society and system, if they were all parallel. However, we need some kind of alignment so that at least one of the two components is somehow – or the majority – are heading in a direction. That is extremely important.

I was not going to do this, but let me show you something. I did a workshop out of my industry – the construction industry – with the 65 top CEOs from the North American construction industry at the Harvard Club in New York. It was very interesting – this is a real eye test. I made it a little bigger just to see a few things that these people were thinking about, and how they could really map very well with what we have been talking about. There are a couple of things which I would say are unique, or which are the other side of the ocean – there is terrorism, homeland security and civil liberties – but there is this attitude of younger generations as an environmental driver for renewable energy. What I want to show you here is that everything in red is energy. This is on the clear agenda of many people. The only reason why I have included it here is because it was your No. 1 vote getter – with 55 votes, which means that half of you voted for that as the No. 1 issue under technology.

That is very interesting, especially if you look at this graph which some of you have seen me present before. This shows the relationship between GDP production and energy

consumption. This was a one-to-one relationship between a nation's economy and its energy availability, and these are time series. That is the States up there, and this year the United Arab Emirates have topped the Americans as the great energy hogs. This is where we are, halfway, but the two biggest nations in the world, China and India, are right here. We know what is happening: there is one coal-fired plant a week being opened in China. As you go up your GDP, you go up your energy – so, no energy, no economy. This is for me the No. 1 thing that we have to remember – that there is one relationship between those two. We have enjoyed energy from the North Sea for a long time, but where is it? It has all pretty much gone, and so now we have to figure out what we will do for our energy. This is of vital importance.

Other people have said that these are what No. 1 issues were from a number of other places around the world. I have paired these, where the No. 1 things came up together. Melbourne and Hong Kong both said that resource depletion was the environmental driver. For the technology driver, there was the age of the population. I loved the description today, when Hugh mentioned the cost of conflict, because that is a good thing to remember.

I added Bristol and Cambridge, because they were quite local. I did a workshop at Sidney Sussex College about a year ago, about changing demographics, which you also mentioned; renewable energy; biotech; climate change. The notion of a fragile global stability came up as a driver. And then there were the last two, from Africa. There, I will say that education came up in 12 of the 14 workshops as the No. 1 issue in at least one category. In our offices in South Africa, we offer them pensions and medical care but what do they want? They say that they want continuing education and that we should forget the other stuff. They just want to learn, because that is the only way forward. That is quite interesting, to see what we think is important and what others have thought was important.

I forgot to mention Zurich and Seattle. Zurich was worried about immigration and Seattle was worried about polarisation, and that is very obvious. There is ageing and wealth distribution.

My top five, from looking around the world, are demographic change, which we picked; convergence – and you picked ICT information and the convergence of nutraceuticals and biomedical and so on, and the zones in between. There is 'Chindia' – we call it BRIC but, to me, I think Chindia is the big one, with China and India together, because I think those two are the ones to watch as the driver. Then there is resource depletion and globally, as you have pointed out, there is this lack of vision and leadership.

In this room there are 100 leaders and you need to make sure that you, individually, are playing that role in your communities. There is no politician in the world who will ever

make a parade happen, but every politician in the world will stand in front of a parade which is moving. Part of the role of the Academy is therefore also to create parades which the politicians will stand behind and which have to do with the education of our future generations. This is a hugely important role, just to make those parades.

All of that said, you never know. [*Laughter*] Sir George Cox came up to me after this morning and said that with all these things – he calls them ‘events’, which I agree with, and I call them the wild cards – you just do not know whether they will happen. No matter how we organised our thinking, there will always be things that are completely unanticipated. However, I believe that the more we organise our thinking and disaggregate and re-aggregate, then the more prepared we are to deal with those unknowns as they then confront us and as we confront them together. I embrace things like this and we know that they will come. We have to think about them, but we cannot get all twisted about them.

We have started to think about our future. I remind us of Wendell Holmes’ statement that none of us is that important, actually, but it is our kids, our grand-kids and those who follow us who are our mandate. That, to me, is the important point about our future.

You have done a fantastic job in coming up with that list and, again, I promise that you can have those back if you would like to, and if the Royal Academy lets me give them to you in whatever form they see fit. Sadly, I have to leave in about half an hour, but this has been fantastic. You have done a great job and thank you for making a good start to the next 36 hours.

Just one last thing – how many of you have seen this before? Edward Bear is coming downstairs, bump, bump, bump on the back of his head behind Christopher Robin. As far as he knows, it is the only way of coming down stairs. It is the only way of teaching, the only way of learning, but sometimes he feels that there really is another way – if he could just stop bumping for a moment and think of it. That is the investment that we are making now – to stop bumping and to think about a slightly different way.

Thank you very much. [*Applause*]

Hugh Norie: Thank you, Chris, that was tremendous and it has given us a great deal to think about. The slides that were shown at the end – possibly not the penguins – will be brought back to remind ourselves tomorrow about what you had thought and decided today. That does not mean that you have to think and decide that tomorrow, but we will want to come quietly back into this idea of looking at the real issues and the big focus. Thank you, Chris.

We now have two presentations this afternoon, from Sir George Cox and Professor John Roulston. After they have each given their talks, we will have time for a discussion. We would very much like to open their ideas and views up to you to talk about.

First, let me introduce Sir George Cox, who is the author of the recent and very relevant *Cox Review* which was commissioned by the Treasury. He is Chairman of the Design Council, a member of council at Warwick University and a visiting professor of Holloway College in London. He started life as an aerospace engineer and spent much of his career in IT, including being CEO of the Services Business for Unisys. He now holds various non-executive directorships and trusteeships. He is also President of the Royal College of Speech Therapists, so he covers a pretty broad spectrum. Sir George, we are very pleased that you could come and talk to us.