SESSION 4

FEEDBACK FROM SYNDICATE GROUPS

Hugh Norie: We do not see this session as being the end of anything but rather it is the beginning of something – at least, I hope it is the beginning of something. What is vitally important about the whole of this workshop is to bring out the issues. The answers will be very difficult and the actual resolution of the answers will take a long time and it will involve other people such as government departments, and it will take time to do that. However, I would like to feel that we are going to keep this group involved and, after this workshop, as we move towards the starker answers – the really practical answers that we can put into effect – we would want to keep you involved again.

Within that framework, perhaps we could start. Let me ask the syndicate leaders to come up here so that we can deal with it. We will ask you to comment as we go in this first section, rather than keeping your questions until the end. We look upon this as being just a continuation of the debate. Please keep pretty focused on these issues. If there is anything that you feel we have lost or forgotten about, then please raise it, but we do not really want to deviate too much onto new subjects if we can help it, just because we are short of time.

John will take us through this, and lead and discipline us through this session.

John Mills (University of Cambridge): I shall be hosting this. The best way to do it will be to take each question at a time and then, after the syndicates have expanded on what they mean, we can take questions and move on to the next topic. We will capture any issues that came up here, and any extras over there, and David will help me to do that.

First, principles of design.

Geoff Kirk: First, let me thank all the team that was involved in this. They all worked very hard and I have tried to capture some of the points that they made. If I did not capture them correctly, perhaps they will help us out as we go along.

We can see from the first one that I have mistyped that. Change is constant – that is the first point that was made. It is not new – change has been happening, and we must take it as being the norm.

We should regard it as an opportunity, not as a threat: it is going to happen, so we should make the best of it.

Universities should concentrate on the fundamentals of engineering design and the IEE should take a lead in concentrating on the issues that affect society.

John Mills: For me, would you like to give us an example of that one?

Geoff Kirk: It was on things like energy resources: what would engineering do in order to capture and alleviate some of the problems on water supply, energy supply, limited resources, costs of resources. The RAE should address those issues, and be seen to be addressing those issues.

Speaker: In what way should we be seen to be doing that? Do we lobby government? Do we make friends with ….[*Barely audible*]. How would we do it? It is grand to say that we should do it, but how?

Geoff Kirk: There are a number of mechanisms that could be used. There are obviously the papers – the normal technical papers, learned papers that we could do – but we also need to have a higher profile within the media. That will come along later on. We need to have something so that we have a higher profile within media and entertainment.

Richard Dodds: We are the sustainable development group. We had an interesting discussion on definitions and the availability of methodologies but, essentially, we came to the view – and it was quite a heavily biased discussion towards sustainable development – that the real issue that has changed in terms of forces is that we now need to take account of society. This is very much mirroring the point you have just heard. Most engineers are trained to deliver product, and fitness for purpose. That definition of fitness for purpose does not usually consider the effects on consumers and society, and that issue needs to be brought through.

It might sound obvious, but in fact we have been to a number of these meetings – sustainable development gatherings – and the societal issues are now coming to the surface much more. Many of the earlier meetings were very much about the environmental and the technology stuff. The issue for the Academy is probably to think more about managing the public perception of engineers, in terms of the effects they have on society and the responsibilities they have to society.

John Mills: That is good – are there any points about that? You have lined up very well, as you said, with the lower one.

Speaker: If you want to do that, managing public perceptions, there is a very, very important role for the Academy to take on board the skills that are necessary, which

most engineers do not have. In other words, there is branding, marketing and handling techniques [?and it is well known that] engineers do it on their own, but if you use the professional skills that are available, it could be a resounding success.

John Mills: The third group was dealing with integration of design.

Peter Deasley: This has to be regarded as an opportunity because otherwise you are sunk on day one.

In our field of systems engineering and integrated systems, of course some of the things that are happening in this area are those which systems engineers are comparatively used to. The kinds of projects they become involved with are international and they have international teams. They are very holistic and far-reaching in nature.

Industry obviously needs engineering graduates who are able to think and act globally and this is something that the universities have to address. We are now talking about distribution of a project on a scale which we have not had in the past and therefore, if students and graduates are going to address this sort of market, then they really have to learn all sorts of new skills in working with people of different cultures and backgrounds, working together, and so on.

The second point is that companies will be part of a large, distributed, multinational and multidisciplinary team as well, and they have to recognise and concentrate on maintaining their independence. They need to be able to preserve what they are good at, and not let it be diluted by the other partners.

John Mills: Thank you very much. Are there any immediate comments on that?

Speaker: This point could be a little controversial and I need to give you some explanation. This was on the basis that people around the world will want to be educated, and they will be educated one way or another. Universities should regard themselves as the educators of the world's engineers. We should be the best educators of engineers and face up to the fact that they are going to be educated, and that we should be doing it.

We should also be recognising that the intake would be different. It would not be an intake from conventional UK secondary schools but it may have to accommodate entrants from different ethnic minorities, different groups, different cultures and different societies. We should tailor courses to reflect that.

John Mills: Shall we do the next two and then come back to that? Sustainable development?

Speaker: I am in that box, there. There was a good deal of discussion about multicultural issues, such as the migration of jobs with manufacturing, and the service issue as well. There is the role of engineers in addressing climate change. We came round to a couple of views.

First, the Academy already does quite a bit in terms of publicising technology solutions to various issues. Obviously, it can move into that mode on issues to do with climate change, new technologies and best practice, and it should do more of that.

The other issue is that of expectation versus allocation. There are not enough resources to go round. It was suggested that we could consider a one-planet living exercise, just to understand the constraints that that would impose. This is something that we could do as an academy and produce something, and that might sharpen minds on the issue that really faces us.

Speaker: That expectation versus allocation captures a very powerful point, which was made a good deal when we were looking at drivers of change. That is an important point.

John Mills: Integrated systems design?

Peter Deasley: As we say, globalisation increases complexity, which demands and stimulates integrated system design, so this is in our area.

There will obviously be linguistic difficulties when you have these international teams but we think that is actually a secondary issue. We are privileged to speak English here, which is almost an international project language – but we think that it is not linguistic problems that get in the way, but cultural problems. We do not understand the cultures of the BRIC nations and this is something that we have to address. We have to learn to work with these people. We have to learn to appreciate the way that they think, which will be different from our own. Similarly, in the world into which we are moving, universities will have to give students the opportunity of working with people from these countries. This probably means that they will need to form some joint ventures with academic institutions in other countries, and also industries in other countries, so that they can give their students a rounded picture of how to work in these international teams.

John Mills: Are there any comments on that?

Speaker Prof. Karayiannis (Brunel University): With regard to the educators of the world's engineers, we are already doing that on a very large scale now, in postgraduate engineering. If you go into postgraduate courses at many of our universities you will see that many of the students are from overseas.

David Foxley: Andrew Day from Bradford unfortunately had to leave during the lunch period but we were talking about the issue of seeing foreign students as a resource rather than just as a source of revenue. They can bring a good deal and something he has begun to find is that SMEs, even in places like Yorkshire, are beginning to learn the value of a secondment for overseas students. This means that they have someone who could help them to plug into overseas markets and, heaven forbid, speak the local language.

Patrick: I just have a comment on that. The point needs to be made that we have to stop thinking from an imperialistic point of view – that is to say, that all the people come to us. One of the ways in which we can respond to that is to say that some of our excellent educators need to go and spend some time working in universities on the other side of the world, so that we really have a cultural understanding on both sides of the process, rather than just that we are selling to Chinese students in our own country.

John Mills: That chimes with me.

Geoff Kirk: The most important point I would take from that first bullet is that, if we are going to be educators, then we need to be able to have local people doing the education. It is no good just sending people from here, out to do the education, but it has to be local. We have learned from Rolls-Royce business that it is no good having an office overseas which we staff with UK people – we really need to staff it with local people.

John Mills: You teach the teachers?

Geoff Kirk: Yes, and you sell the process.

John Mills: So it is a collaborative process, working together there and here. It is not just them, and it is not just us.

Geoff Kirk: Just with skills and knowledge, one of the points that came out here – and this was from an academic view – is that university departments need to be clear about what their own vision is. Where do they think they are going? Most businesses have a vision and a forward plan of where they will be in 10 or 15 years. I understand that that does not necessarily exist in a lot of departments but they need to have a very clear vision of what they are about and where they are going. What are the resources and what is the gap analysis? What resource do they need, in order to get to where they want to be?

Something for the Academy was that there should be some mechanism whereby the Academy encourages collaboration between VPs and a sharing of best practice. The booklet that Ken Wallace did was a start on that route, but there is probably more that the Academy could do, in sharing best practice in teaching, both with VPs and with engineering departments.

John Mills: And sustainable development

Richard Dodds: I would like to take that middle point there first. It was recognised that we have 26 visiting professors in 26 HEIs, and some of us hit more than one department. Generally, however, this is a long way short of the 240-odd departments that exist in the UK. There is a role in terms of getting information out of what has been done, which probably needs some concentrated effort because it needs wheedling out. It is not just about case studies but it is about teaching materials and lessons learned. The Academy should try to facilitate the spreading of that knowledge across the difference between 26 and 240 – although obviously not the 240 – because there is a role there. It is difficult enough, where the university has the benefit of a visiting professor, to get sustainable development in on the curriculum. If you do not have that, then it is even more difficult quite often.

I have grouped the other two together, although I have positioned them wrongly – they are the influence in the UK spec, and the continuous professional development and understanding fundamentals. We think there is a role for the Academy in engaging perhaps a little more strongly in discussions with the institutions on providing a little more detail to what is actually in the UK spec. This should take account of the fact that it is not just about undergraduates, but it is about undergraduates plus certainly the first few years and continuous learning. However, it is very difficult for the Academy to do that without progressing further with this discussion that keeps coming back on understanding what the fundamentals are that we actually need in the courses.

This comes up time and time again and it is an issue which needs to be resolved by more Henley study type work, and more interaction between industry, the institutions and the Academy. However, it is impossible for the Academy to take a view on this until we have gone a little further down the track of defining what the fundamentals are, what industry wants as fundamentals, and what are the nice-to-have add-ons.

Peter Deasley: On integrated system design, once again we are fairly upbeat because we feel that the Anglo Saxon culture is suited to it. Brunel used to write, 'I K Brunel, Engineer' on top of the bridge, and not, 'I K Brunel, Civil Engineer', and we rather admire these sorts of people. However, the current trends have forced this multidisciplinarity out of our way of living – not only in engineering, but in sport as well. It is almost impossible these days to play two or three sports at international level, because it has become so competitive and the different sports invade each other's territory in terms of time.

One of the things that we have to do in systems engineering and systems design is to learn from the experts. There is a great deal of expertise in the USA and probably in Hong

Kong as well, which we need to tap into, but we are not doing that with anything like the depth that we need.

We also advocate multidisciplinary education, to a degree greater than we generally have at the moment. We need to avoid these silos from day one. We would advocate a common first three years for the MEng programme, rather than the one or two years which is more usual.

John Mills: Are there any questions or comments from the audience?

Tony Stevens (Loughborough University): On the subject of multidisciplinary education, I went through the degree system at a time when it was considered that British engineers had to stand on their own feet anywhere in the world. Therefore, my mechanical engineering degree not only included other parts of engineering but also included basic contract law. I have to say that that has been brilliant.

Speaker: I have a question about the 26 and the 240. Does it actually follow that the 214 are behind the times in terms of incorporating issues of sustainable development into undergraduate provision, just because they have not had the benefit of the VP scheme? Or do you just not know what is going on in the other 214?

Richard Dodds: I am sorry but I did not quite hear that. Are you saying that I am making the assumption and statement that the 240 minus 26 are not doing anything?

Speaker: No, I am asking you about the extent to which you know what they are doing, because the assumption is that the other 214 need either the equivalent of a VP scheme, or they need to learn from the current VP scheme.

Richard Dodds: We are making the assumption that we have done a good job by hitting 26, but we are clearly a long way short of hitting a critical mass of the engineering departments in the UK. We therefore need to look at ways in which we can consider the value of putting that out to other departments. We know that there have been other departments who have applied for money but who have not got it, for example, and we are in discussion with departments who have not done anything and do not wish to do anything extra. We have a basis of knowledge and it is a discussion that needs to be had. However, to bite off all that lot would be totally unrealistic.

Speaker: That is not the point I am making, Richard. My question is really not to dispute anything about the VP scheme and the qualities and the achievement of it. It is just to wonder whether, in places that have not been reached by it, there might not be good practice.

Richard Dodds: I am sure that is the case.

Speaker: And if there is, how will you learn about it?

Richard: We would need to interact. It is part of the exercise.

John Mills: The point, if I could make it, was that those other universities need to be reached, whether to get best practice from them, or to promote best practice. Is that reasonable? [*Yes*] Are there any further points on that?

Speaker: Prof Karayiannis Can you please expand a little on what was discussed, perhaps in summary form, but expand on what was discussed about Bologna in your group? What was discussed there?

Speaker: We did not discuss Bologna as such. We just felt really that, in a normal MEng degree programme and things like it, there should be more general engineering years, if you like, and fewer years of specialisation.

Hugh Norie: Could I just say one thing about Bologna? The Academy has a very active programme on the Bologna issue and how to respond to that. In fact, we have been discussing it elsewhere a little today. To some extent I would like to keep it away from this conference because we are dealing with it properly elsewhere. We would need to talk with you, with a different hat on, if that is alright.

John Mills: Let us move on to the next question now. Schools issues

Geoff Kirk: This was a very wide-ranging discussion, as you can see from the notes. The essence of this was that we needed to improve science and mathematics teaching and the way to do that was to provide better pay and training for teachers. We did not debate the actual mechanism by which that would be achieved, but that would be the objective.

There was a proposal that we should have a visiting teacher scheme, which would be parallel to the visiting professor scheme, where people could perhaps spend time in maths and physics departments in secondary schools.

The institutions need to do more on public relations, getting across the message about how exciting engineering is as a profession. We could do that both from an institutional level and on an individual level. Every time we meet people, we should tell them how excited we are at being in engineering.

There was a feeling that there were too many initiatives around within schools – all sorts of initiatives. If they could be brought together under something like the TESS programme, then there would be better value for the money that is being invested – instead

of spreading it around very thinly, it would bring it all in and make a good effort in focusing the efforts into TESS and things like that.

The RAEng should take an interest in the curriculum within schools. We should say – and this really echoes what Ken Fulton said this morning – what we expect students to have. If we speak from an industry point of view, schools are the second tier suppliers – secondary schools supply universities, and universities are suppliers to us. We should therefore be saying what we expect our second tier suppliers to be doing, and we should be very forceful in doing that.

I think George Cox made the point today, and I have heard him make it before, that we should be promoting engineering as a gateway. If you study engineering, it is a gateway to many jobs and it is an enabler into a number of professions. It does not necessarily mean that you will stay in engineering, although hopefully more of them would, but it is a gateway and it is a good subject to study.

Speaker: The issue that arose on schools was that the Academy already does a fair amount with schools. One message was, for heaven's sake don't stop doing it.

There is an issue about developing role models and influencing teachers, but also communicating enjoyment with the career without trivialising it. These are many of the points that were made in previous sessions. The Academy does stuff and it should continue to do stuff, but it should think about these issues. The lack of role models arose a couple of times – whether it is through soaps, or through advertising, and through identifying people through communications.

Speaker: We are very keen on the Academy's Best scheme. Any activity with schools is to be applauded, be it through local ambassadors, engineering fairs, examples of 'cool' engineering – although someone will have to explain that to me, because I am too old to understand. Any interaction with schools is a good thing.

We are worried by the word 'engineer'. This is an old cherry, but there is a great deal of confusion among young people about the guy who comes to service the washing machine, or the man who designs the Trent 900. We need some careful thought about what we do with the word 'engineer'. Perhaps we should couple it with 'professional engineer', or 'chartered engineer' or something, but there is confusion to the detriment of the profession.

Speaker: Are you saying that I can't fix a washing machine?

Speaker: Monday morning, ten o'clock, at my house! The Academy is doing a great deal in this area but perhaps the programmes need a little more co-ordination across the board. There are a number of programmes going on, which are very laudable, we felt

that perhaps there needs to be some coherence across them. There should also be a better understanding by fellows and other professionals about exactly what is going on there.

John Mills: Are there any thoughts on that?

Charles Ainger (VP, Cambridge): I was just wondering whether you could connect up some of those things by more greatly incentivising young engineers to go out and talk as role models in schools. All the professional institutions have a strong requirement for the minimum things that young engineers have to do, to qualify for a professional interview. What would happen if each institution insisted that every engineer who goes up for professional interview has to have learned communication and presentation skills by some interaction with the local school? Would that be too much of a burden to expect, or would that be a way of driving that much more strongly than at the moment?

John Mills: It is an idea – let us put it up here.

Alison McKay (Leeds): There are two ideas that I have thought of during these past two days, to do with schools. This is largely because I have two children in high school at the moment. The first is that, when they are 14 or 15, they look for work experience, and I wondered whether the Academy could do things with local engineering companies, to have some sort of scheme that children of that age could attend. For example, my daughter told me that you can go to the village sandwich shop and get cans of coke out of the fridge, but you cannot make the sandwiches. There must be things that young people could go into companies for two weeks and do.

Secondly, I know that our high school funding runs out this year, but I think it is a scheme that is ongoing. If we want to attract the best young people, then in many state schools there are the Gifted and Talented programmes which aim for the top 10 per cent of students, either in terms of their academic ability or things like sports and musical skills. It may be that the Academy could do something to target those schemes. For example, there was one this summer where they did a 10-day workshop in the summer holiday, with the Gifted and Talented programme, where they did creative writing. They took the kids on a coach trip to a stadium and they actually had a professional writer – a poet – who came in to work with the children. It just seemed to me that, if engineers could do that, it would be more engaging with young people, rather than just going and telling them what to do.

John Mills: Yes, those are two good ideas.

I was one of those people who read the material that we were sent. I was also impressed with the 2010 or 2020 thing from our American brethren. In particular, there was the idea about ‘surviving the storm’. It seems that the academies over there take a rather

more active message to government than we do, in terms of saying that they need some incentives and scholarships. It is quite an interesting read, only about six pages long, but it gives an idea of the sort of things they plan to do in America. It is not exactly what we would want to do, and it is another scale, but it gives you an idea that if they were to get onto that track, they would make a difference. Underneath it, there is a certain amount of passion there as well, and belief that they can do it. Much of their stuff is about the pipeline, teachers, schools and so forth.

Next question: undergraduate issues?

Geoff Kirk: We were in the Jock Colville suite within Churchill, and we thought that was an appropriate statement. Basically, universities want to say 'give us the tools and we will finish the job'. What they are saying is that they need the resources. We insist on having design and make which requires manufacturing facilities, and technician support. It is expensive in materials and labour, but we expect it to be done on a shoestring. We need to fund engineering courses properly – so that is the first statement.

There should be some sort of funding scheme for VPs. Perhaps this should be on a fixed tenure basis, and honoraria presented for that. It should aim at recruiting younger VPs into the scheme. The basis of paying and having a tenure was the fact that it would be limited and the whole scheme would be refreshed over a period of time.

Another suggestion was that there should be summer experiences, and this is something that the Academy could do. They could have a summer school, where there may be workshops or masterclasses from renowned designers who would come along and do a masterclass in particular things. This is something that could be set up.

At the Royal Designers for Industry Faculty from the RSA we run a summer school every year and this is very well attended and very worthwhile, and this is something that the Academy could do, aimed at engineering.

Speaker: I am not sure that my syndicate would be comfortable with me accepting the chairman's embargo on Bologna. It is quite an important because it was said by one member of our syndicate that he wanted to communicate what Bologna was about but was not able to. There is quite an interesting thread coming from a number of discussions. We should be a little more enthusiastic about looking at the capabilities of overseas graduates, who many companies are looking to employ. We should not simply look at our emerging graduates versus their emerging graduates, but our emerging graduates plus a couple of years of experience versus their emerging graduates.

In other words, we were saying that there is a Bologna issue and there is also an extension of the Henley study issue for looking overseas, because they are obviously doing some things right, but this has not come back to us in reported form.

There is also a thread about moving from teaching to learning. There is a feeling that perhaps there was too much concentration on teaching a module and examining it, and letting the student forget about it, instead of building on knowledge. It is also a matter of preparing students for lifelong learning – and I can see some of the points coming up with Peter in a moment. Those were the points from our syndicate.

Peter Deasley: We rather liked John Roulston's slide yesterday, which concentrated on the fundamentals. Maths and physics were at the top and business studies were at the bottom. However, we were slightly worried that when industry says that they can provide the business study tuition for their members – that is OK if you are a large company, but it is certainly not OK if you are an SME. There is a problem in that people who work in SMEs are expected to be jacks of all trades, and one of those trades is some knowledge of business studies.

We wondered whether there could be a collaboration between SMEs and their customers, to share some of the business studies educational programmes of a larger customer, with the smaller SME.

We also think we need to take a look at the whole CPD issue. We need to encourage education as a lifelong journey, and integrate and co-ordinate the many aspects of CPD so that people can make an informed choice about what suits them, and also to ensure that they gain appropriate qualifications by making those choices.

John Mills: Are there any comments on that?

Chris Elliott (VP at Bristol): I just wanted to clarify the integrated systems design point, because a few people have been up and bent my ear since we wrote that down. We were not saying that the aim should be to turn out calculating machines. There is the context that the gentleman behind me mentioned, about learning some law before you get out into the real world.

We were saying that engineering graduates should know a little about all of those topics, so that they have a context for what they have learned. I do a two-hour lecture for Bristol undergraduates – 'all you need to know about law as an undergraduate engineer'. At the end of it, they know what a contract is, they know what negligence is, and they know that health and safety legislation applies to them. That sort of level seems appropriate. It was put in there to emphasise the point that arose this morning, about the mixed message that

industry was putting out a few years ago – it appeared to be giving the message that we were prepared to sacrifice fundamentals in order to do more of the business issues. We wanted to capture the point that that is not the view that industry actually takes.

Peter Brooke (Qinetiq): I just wonder whether those two columns could not be taken more holistically, as a pair. We are in some sense looking at a supply chain or a pipeline, or a through life set of issues. We have talked at various times about primary and secondary. There are some funny interfaces and because of the lack in A levels, people are having to do foundation courses. Is there some way in which we could look at how that pipeline could be harmoniously balanced through life, rather than taking snippets? That is probably implied but not stated – and of course, it goes on through life and that is what the final bullet says. I suspect that we might do ourselves a favour if we brought those things into some kind of joint paper that looked at how that could be balanced in a harmonious through-life fashion.

John Mills: Are there any other questions or comments on this one?

Hugh Norie: There is just one other question that runs through both of these which is, who writes the curriculum? We always have this issue that we want universities to be completely independent and yet the Academy might be put more and more into a role of prescription, which it really wants to avoid. There is a really difficult issue about how you balance this issue, like how you meet in forums perhaps like this, where you can actually start to get an agreement on curriculum. I doubt whether we will ever reach a position of saying what they are, because there is always a difficult balance between the Joint Board of Moderators, the Department of Education and what everybody wants. We will need to think more and more about that issue. Should we become more prescriptive? In some ways, that is what Bologna is starting to do. Or should we go in the traditional British way, which means that we rely on each individual university to create its own standards, and its own standards of excellence?

Bob Ditchfield: The feedback we had on the study was that the universities really take their instructions on engineering by adhering to the QAA and the ECUK benchmark statement on UK spec. The people who are the ghosts at the party are the accreditation boards and they will not do anything which they fear could jeopardise their accreditation.

John Hill: I answered some questions earlier as JBM chairman. I would just like to say that the JBM approach is to identify three, central core subjects which are fundamental to civil engineering. I do not think there is too much complaint as to the curricula content of these courses except to say that sometimes practising engineers will ask

questions about the absence of understanding of classical theory or whatever. It is very important that there is not too much emphasis on using black boxes and so on, and this is particularly so in the structural area where, when we are talking about fundamentals, we are referring to the ability of people to do a back-of-the-envelope calculation, without having to resort to software.

I am rather concerned about the notion that accreditation is about stifling change, improvement and innovation in courses. That is not how I see it at all. My colleagues in JBM welcome and encourage diversity and development. Even now, as I speak, there are several courses that are being looked at by JBM, that we have been asked to give an opinion on. They are completely new directions and so on, and we welcome that. We want to see these things evolving, improving and more fit for better day requirements.

At the heart of it, however, there is this question about fundamentals. I do not know how many times this has appeared on these charts of yours but there it is, yet again, in the bottom right hand corner. It is the fundamentals that we need and, yes, OK, introductions to all these other things like business, health and safety and so on. These will essentially be required in employment, and in experience of life and so on.

Speaker: So you are saying that the accrediting organisations are open to –

John Hill: In my experience, that is the case.

Speaker: - there are some places where they will not move, but they are open to change.

John Hill: In my experience, we are very open to change. We also recognise the fact that departments are addressing their own markets as they see them. The markets of different establishments are really quite different. Some of them are looking at the local requirements of industry around them, and others are looking more internationally. It is all quite different and so to lay down the law as to how it should be would be quite wrong. We have to encourage that diversity.

John Mills: Thank you for that.

David Raffo (Leeds): I would like just to connect two things you have on there, and two things that have arisen time and time again.

The first is from that top box, principles of design. Amongst that, you have the whole idea of making engineering exciting. Then, in the bottom box, you say that you want to concentrate on – if I remember John's slide – Victorian maths and classic physics. What ideas does anyone in the room have for making Victorian maths and classic physics exciting to school children?

Speaker: Could I refer to the comment made just now about the back-of-the-envelope calculation? If you get students to work out that it is complete nonsense to build a Maglev train by the back of an envelope, they suddenly become very interested. If you do those very things – those simple calculations, using classical physics – I have found that it brightens them up enormously. It is a matter of putting it to work on something that is real.

Ugur Tuzun (University of Surrey): I am referring to the comment made by the chairman about differentiation between the degrees offered by different universities. There is a danger here of being over-prescriptive, from the Academy's point of view, saying that everyone should adhere to a very closely prescribed formula, so that we have graduates with a very strong fundamental footing, and they will all fit into the same camp.

The problem is that it is the distinguishing features, the differentiating features, which make the graduates marketable in the market place. We want these graduates to find employment. I am from the University of Surrey and we take pride in that we are always among the top three for placements and jobs for our engineering graduates. We are doing that first of all by placing most of our students in industry for professional placements, so that most of the courses are sandwich courses, and some of them thin. We are also introducing elements which we believe are innovative and which may subsequently be copied by others. There is therefore scope for differentiation here, as well as maintaining standards.

My theory, which I expressed this morning in my group, is that we do not want to end up with a 'one prescription fits all', so that all of our engineering graduates should have common teaching and a lot of common practice, with very little scope for differentiation. I do not think that is desirable in a commercial sense at any rate.

Roger Venables (Queen's Belfast): First, could I support the last speaker, because I think differentiation is very important.

Secondly, I would like to offer a comment about this balancing act between fundamentals and what we might loosely call the extras that are desirable. One of the things that we are trying to do at Queen's – it is not easy, but we are trying really hard – is to review a number of modules. Ideally we would review all of them, although I am not sure that we will have the time or the willingness of the academics to let it happen. We are doing this in such a way that I can help the leader of that module to tweak it just a little, so that the sustainability message, as far as I am concerned, is reinforced by something really quite minor in terms of scale and the time it takes to do it, but it just presents a consistent message that reinforces the extra sustainability stuff that I am currently leading.

One minor example is that you might be surprised to know that the person who, a couple of years, was leading the timber design, bridge design project, did not think that there

was any link between this project and sustainable development. Actually, however, all we needed to get them to do was to add to what they said a few very important messages about sourcing. Material resource efficiency and all those kinds of things were there already, but they did not consider them to have a sustainability angle. Therefore, all they added was something about sourcing. Secondly, they labelled some of the issues that they were mentioning as part of delivering the sustainability message.

I do not think that the sustainability message has to be consistently delivered as something separate, but it is about how you consistently present a message through other modules that people are doing anyway.

John Sims Williams (University of Bristol): Back-of-the-envelope calculations have been mentioned twice. They are very good for motivation. Chris, amongst others, has provided us with one or two, but these are actually enormously difficult to generate. We have all these VPs here. Perhaps the Academy could help to build a database of back-of-the-envelope calculations, because they really get to the fundamentals. They test whether students really understand what it is about, in a way that switches them on.

John Mills: There are many of them. One of the main methods of questions they ask at Cambridge are exactly those things to the potential students coming along. Do people really understand?

I will make that the last comment on that one – we have done that one to death.

Let us go on to No. 6: industrial relevance.

Geoff Kirk: I think I can summarise the whole flavour of this discussion here. There really needs to be greater involvement and exchange between industry and academia – and, by academia, I am talking about universities and secondary schools as well. I am including the whole of what I would call the supply chain.

Industry should look upon academia as a supplier. I do not mean that in any derogatory way. We would never dream nowadays of throwing something over the wall to a supplier, but we like to involve the supplier in the definition of the product that we are making. We have the suppliers working alongside it and we have people working within the company of our suppliers – our prime suppliers and our second tier suppliers.

In terms of hardware, we would always involve the supplier and yet we do not do that with universities or academia, and there needs to be more of that. That would enable us to understand exactly what we want. This is a point that Ken Fulton made this morning, which

is that we do not express our needs very clearly, because perhaps we do not understand half of them very clearly. If we were to work with suppliers on a *quid pro quo* basis, that may enable us to do that. That was the basis of this whole point.

Some of the points that were raised were that perhaps the 3 plus 2 intern was that perhaps there was the possibility of a three-year degree, with two years of internship within a company, where they would have six months in university and six months in industry. That was the idea there.

There was the idea of dual appointments, where someone would perhaps be employed by industry but they would spend time within the university – more like the German model.

We have talked about an extension of the VP scheme for a number of years, and whether we should be employing people as visiting lecturers. One of my guys, as part of his own personal professional developing, spends three hours a week at Nottingham, helping out in some of the design courses there. I did that for his professional development: he derives benefit from it, as does the university.

The most important point is that one of the issues for SMEs is the ability – and the affordability – to be able to mimic the VP scheme that some of the larger companies can support. There should be some mechanism whereby there is a tax incentive for SMEs to release people to work with universities. It is not the big companies that are a problem, but it is a question of how to get SMEs involved with universities and the whole academic structure.

Robert Ditchfield: I would make the same point as I made earlier about internationalising the Henley report, both in terms of what we find attractive about overseas graduates in UK companies and what might attract international companies to pull on UK graduates.

'Build on fundamentals' really refers to the fact that it may well be possible to meet many of the demands for more general capabilities that appear to be coming through from industry, by building on the fundamental knowledge and fundamental courses, rather than seeing them as separate entities, and embedding some of these capabilities and learnings into the curriculum. This would be based on a strong use of the fundamental knowledge.

The other point was that a large number of engineers are not actually employed by industry. I would have to re-visit the Henley report to check how well that was covered, but a significant number go into health and safety and regulatory areas. They are attractive careers and very influential careers, at this technology/political/regulatory interface. This is

where we probably ought to see more engineers going, but we may not have paid the right attention to that.

Peter Deasley: This was the last question we dealt with before lunch and the group was hungry and belligerent.

At their most belligerent, they wanted to abolish the RAE because they felt it was useless! However, they were very strong in saying that we must be able to appoint academics on the basis of their industrial relevance as well as on their academic publications. One way that was suggested to do that was to de-couple the RAE, if we are going to keep it, from the amount of monies that go to their departments. So you should not make a department suffer if you recruit an industrialist.

The last point is one that Julia made this morning. It is off-subject here, but we thought it ought to be stated somewhere on this slide. There is this funding gap between what a student costs in actuality, and what HEFCE pay, and this must really be addressed with some urgency.

John Mills: Thank you. Are there any comments on that?

Bernard Hon: I have a comment about the funding gap. I think you are quite right that HEFCE is not funding enough on unit costs for engineering education. Starting this year, every student has to pay an extra £3000. Have you taken that £3000 into account in the funding gap? If you add the £3000, do you find that the funding gap is just level.

Speaker: That is a good point, Bernard.

Mike Withers (VP): I am involved in a number of activities in the Best programme at the Royal Academy.

We talk about having VPs from SMEs going in to universities but, looking at the American scene, you have very many academics being involved in local companies, but I do not see the same situation in the United Kingdom. I wonder why we do not find – it may be that the RAE is a part of that, but I was involved in university life well before the RAE was invented and there was generally a lack of universities being interested in what companies did. I do not think local companies know how to talk to universities, to gain that benefit. We need a closer link between the two.

Speaker: There are things like knowledge transfer partnerships and quite a few universities make a good success of those.

John Roulston: There was a point I wanted to make - Julia surprised me earlier. One good scheme that I see working well in Scotland, which is funded by the

Regional Development Authority, is the Technology Transfer scheme. This basically enables the SMEs to go to a university department and to get some help, which is paid for by their local/regional development authority. It is normally a specific topic – a single problem, a problem that they cannot solve or a calculation that they want done. The amount of money involved is relatively small at about £5,000, but it is extremely enabling because it can get them over an obstacle. That certainly does work very well – and I have seen it working.

I would also like to pick up the point that is on the screen about people who are educated as engineers but who choose not to follow an engineering career. Their influence to the profession can then become lost and perhaps something the Academy should do is to try to capture the influence to the profession of those people who are engineer-trained and then subsequently very successful in their business life, really as a product of the logic of their training. We should point to that as a success for engineering as a discipline. There is some lost influence there.

John Mills: Yes, and you are reinforcing that gateway idea with that example.

John Miles (Warwick University): We have three issues there: schools, undergraduates and industrial relevance. They all have to do with how we address ourselves to people coming through the pipeline into engineering. We then have to think about the tools that we have to use, and this might take us a little off beam. It seems to me that one of our problems is that of fragmentation. As we address the universities and we ask questions about industrial relevance, we begin to distance ourselves from the coalface somewhat, and the institutions come into play. I wonder why it is that we, as an Academy, do not use our influence a little more to try to unify the proliferation of institutions which we have. It seems to me that that gets in our way and we could do without it.

Speaker: When you refer to the proliferation of institutions –

John Miles: The mechanicals, the structurals, the civils, the electricals – we are engineers, for goodness' sake.

Speaker: There has been a little bit of that, but not much.

John Miles: I would say not very much at all. I hear a lot of people talking about that and, in fact, in these last two days, I have heard quite a few people say that we are not organised properly in order to get effects. We are the most senior body in engineering. You have our view – why do we not do something about it?

Hugh Norie: Could I just make a comment? John, perhaps I could just say a word about that. One of the reasons why we invited the institutions to be represented at this conference is exactly because we are very aware of the fact that we are not all joined up. The institutions at the moment have very specific roles, and the Academy has very specific roles, but they do not always interleave or overlap. Undoubtedly, if we are to make progress in the future, then we all have to come more closely together.

The institutions have been aware of this for a long time and there have been various, mainly abortive, attempts at mergers – this is partly due to financial problems, but it is also partly to do with having greater influence. As a profession, we need more and more and more influence over wayward governments, which do not see things in perhaps the straight, logical and longer-term ways in which we do. It is a real issue and it is one of which we are becoming increasingly aware. It will take a long time to sort out because there are hundreds of years of baggage if you add up that of all the institutions. The Academy is the new boy on the block.

Speaker: Are you assuring me that you are doing something about it?

Hugh Norie: Shall I say that we are definitely talking, but there is no question of talking about one single academy that does everything. Initially, it is a question of getting greater co-ordination and greater community of aim between the institutions, and between the institutions and the Academy. That needs to start, hopefully.

Speaker: Do you want to go on with discussing this issue of the institutions?

Hugh Norie: No, we need to get on to the next question.

Speaker: I would just like to take issue with influence being lost. Certainly, in industrial design professions, we graduate far too many graduates for the jobs that are available. Research that I did towards the end of the seventies demonstrated – and it was statistically significant – that the influence of those who manage design projects is far greater than the creatives involved.

One of the initiatives within the industrial design professions is to encourage employers to consider design graduates as being equal to graduates from other schools from universities. The benefit to the industrial design professions is that we will have clients who are trained in design and who then manage design projects and therefore get more out of those projects. I would have thought that if you have engineers who go perhaps into marketing or whatever, and go up the management hierarchy and are then commissioning engineering projects, they would be far better clients. They would probably get a great deal

more out of the engineering projects and we would all benefit from that. It is better for them than being unemployed.

John Mills: Are there any other comments here, without talking about the institutions.

David Foxley: Could I just add something to what Alan Topalian said. Charles McCaskie, who some of you might well remember, used to be technical director of Baker Perkins, who made food processing machinery – although not the sort of stuff that you would consider to be the realm of an industrial designer. His view was that, whenever you put a project team together to promote a new piece of equipment, he would find an industrial designer to head it, and graduates from the highly esteemed technical universities to the technical groundwork. The reason why he would construct a team in that way was because the guy at the top could explain to the board of directors, in fairly simple terms and with fairly simple pictures, what the machine would look like and what it would do. That would get the case approved so that they could do all the work.

Patrick Godfrey (University of Bristol): I would like to reflect on the EngD as a process – on its industrial relevance and continuing professional development and various other things to do with the relationship between universities and industry.

Having come from industry where I spent six months engaging industry people in the EngD, I discovered two things. First, it is highly regarded, once industry realises what it is. Second, most of them do not know what it is at this moment in time. In fact, I would venture to suggest that most of this room does not know what an EngD is at the moment.

The Academy can do a very good job in communicating to the world, and supporting the communication of what an EngD is and how it is different from a PhD, and how it actually helps to get the whole process moving. In doing so, it is supported by some research that was done by the EPSRC with branding consultants, who went out and discovered the evidence behind what I had said, and which supports what I have said. The evidence is there but it needs somebody to take that and authoritatively use it to project a really strong image of what it is and how it is being successful. Also, it is a British invention which, if we do not get on and project it, will be re-invented by our American colleagues and pushed back in our faces as if we did not know anything about it.

John Mills: Thank you very much. We will go on to the final question now: the future of the Academy of VPs. Are there any ideas on that?

Speaker (Geoff Kirk): This was probably one of the most contentious parts. The idea there was to extend the pool of VPs. The perception was that visiting professors are drawn from quite a narrow group of people and there needs to be some mechanism whereby we can extend that pool.

Many of us felt that we were appointed as VPs and it was a matter of turning up on Thursday and doing what we needed to do. There was no kind of introduction and no idea about what we should be doing, or any kind of induction process or mechanism. Was there any sort of quality control on what we were doing? Are there any guidelines about what we are doing, and what should the guidelines be? Who should we be talking to? It was very much left to individual VPs to set their own agenda and do what they wanted to do. Perhaps that was a good idea at the start, just to see what would happen.

The point about visiting practitioners came up again. This is where we had practitioners who would spend some time – like one of my guys is spending time at Nottingham for three hours a week – it is really at a level of whatever you want to call it, as visiting lecturer or visiting practitioner, with more involvement.

There is also this point about how can we involve SMEs more in the visiting professor scheme, and how could we fund that. Could we find a mechanism to fund that, because all SMEs can think about is how they will pay the wage bill at the end of the next week – if they can think that far ahead.

Speaker: We are not all that bad.

Speaker: No, but there is a pressure on SMEs.

Next, we should regard the VP within the university as an agent for change. There was a good deal of discussion about what we mean about that, but this is a point where the VP could be someone who could go and say, 'Look, this is what we need to do.' It is not necessarily a part of the academic structure and there is no axe to grind, but it is there as a counselling role, acting as an agent for change.

John Mills: That is very plausible.

David Foxley: I would just like to pick up on what Geoff said. The places where we considered the VP schemes had been most successful in the past are the places where they have acted as agents for change – fifth column or whatever you like – and where something significantly different has happened, which would not have happened if they were not there. The ones that have been less successful are the ones that have been buried without sight inside departmental silos – sometimes even as the personal toy of head of

department, who likes to have a high profile name to list among his department visiting professors. Perhaps I am being a little cynical there!

Speaker: This is probably in the wrong box, but it came up time and time again. The Academy should influence the RAE system to cherish and not destroy teaching – it is a long-term constructive job that should be undertaken, and so we parked that.

Extend VP activities to spread available material. And then, to turn the existing scheme on its head, which goes some way to what was mentioned over here – namely, instead of having visiting professors, you actually have visiting technical directors. You would take an academic out of a department and link him to a company. He would then interface with that company in a similar way – the reverse happens at the moment.

We actually had three suggestions at that point, and we had a little vote. Just to state the extreme case, should we have visiting professors for climate change, for example, for a topic? There was a very low vote.

Should we have visiting professors for overseas? Should we have a China VP, for example? There was a very low vote here too.

Having a visiting technical director – the sort of mirror of what we have – was overwhelmingly supported. That might also prove to be a route to get some slightly younger VPs on the patch.

Peter Deasley: We came up with many of the points that the other groups have raised.

We were interesting in teaching material. We felt that some documented experience of engineering case studies, especially describing mistakes and lessons learned, could be very valuable. These come into universities via the VP but perhaps some of those of a more general nature would be a valuable teaching aid.

We thought that perhaps one of the roles of the Sainsbury fellows could be to interact with the universities as visitors.

John Mills: Are there any responses to those comments?

Mike Wood (University of Nottingham): Does the panel have any ideas about perhaps producing a fourth stream of VPs? You have Principles of Design, Sustainable Development and Integrated Systems Design, but have you actually looked at what is needed strategically in the next generation of new designers that we produce from universities? I have an idea, but I will not mention it at the moment.

John Mills: Are there any thoughts about another VP scheme in addition to the three that you have now?

Hugh Norie: Yes, it is the case of the 'fourth VP scheme' as it is called. It is being discussed but, as yet, there is nothing concrete. Certainly, one of the outputs of this workshop will be to take that further, but we want to scheme the VP scheme regenerated. A new scheme is very much a possible way forward.

Bernard Hon (Liverpool University): I have a comment about younger VPs, which I think is an extremely good idea. Let us look at a different field – mathematics. It is generally said that the mathematicians make their greatest discoveries when they are very young. In fact, the most prestigious prize in mathematics, the Fields medal, is given to mathematicians under the age of 45, while they have plenty of energy, while they are extremely innovative, and while they are making huge break-throughs. This is awarded every four years.

If you are thinking about a younger VP scheme, perhaps we could think about some kind of age guillotine at 45, or something like that, when we can capture all their energy. They are on top of the technology, and they could bring a lot of new, fresh people to the VP scheme.

Charles Ainger (Cambridge): I just wanted to pick up on the point about VPs related to change, in the top box. Within the sustainable development VPs, we have circulated a questionnaire to all the universities, sponsors and VPs, asking for their experience of how they have changed things. If any of the VPs in the other two schemes would be interested in examining that exercise, we would be very glad to send you the same questionnaire, so that you could see whether it was useful to you.

Speaker: We could certainly send that round. It is pretty straightforward and it only takes a little time to fill out.

Roger Venables: Just three quick points – the first on the younger VPs. Yes, that is a great idea. It will come up against the challenge that the younger you are, the more likely you are to be hammering away, developing your career, rather than being reflective. It is much, much more important how young you feel between your ears than how young you are in age.

On the second point about the future of the Academy VP schemes, could I say to the plenary group what I said the sustainable development group, and this is a huge plea. I think the sustainable development VP scheme is worth repeating – by which I mean carrying on,

appointing five or six a year, for a few more years yet – because we have hardly scratched the surface of changing the way people think about engineering in their new world context.

Third, following on from that, I think there is a huge resource amongst the 26 of us, and a huge willingness, to spread what we have learned amongst other people. If the Academy could find a way to tapping in to some of the stuff that we think we have learned in a way that would perhaps even spread that amongst all the other members of the Academy – even before we have started on people who are not yet members of the Academy – that would be a beneficial way forward.

There have been one or two – how shall I put it politely? – blind spots, about sustainability, displayed by some of our contributors today. I would love to have the opportunity to fill the blind spot in. Thank you.

Hugh Norie: Chris, you might just want to respond to that, on the creativity point – that it can be taught.

Chris Elliott: I do not believe it can be taught –

Hugh Norie: No, but how do we do it?

Tony Stevens: After 40 years of trying to find out what makes us a creative nation, I believe that this is not something that can be taught, but an environment can be created in which it exists.

Speaker: That was exactly the point that Chris Pearce made in his presentation.

Peter: 'Don't teach me and try and judge me. Just give me the tools and let me do it.'

Chris Elliott: The reason I mentioned it at lunch time, Mr Chairman, was that I did not want your comment this morning to hang in the air unanswered, that creativity cannot be taught. I want to take issue with that.

Clearly, creativity is the intrinsic possible of people, but it is not binary: everybody has some of it and, by teaching, you can bring that out. I will give a quick analogy. I confess, for those of you who do not know, that I had a mid-life crisis and went and qualified as a barrister. I suddenly saw how a different profession has dealt with this. Someone used the term 'old farts' yesterday for the management of engineering, but you should see the old farts in the Inns of Court. They are completely stuck in their ways and it was a strongly held view that you cannot teach advocacy – advocates are born. In the training of the barristers, however, the people who ran it said that that was wrong, and that they could teach advocacy.

They have developed a whole set of techniques and tools that bring out the intrinsic ability of everybody. There will still be some who are better than others, but everyone who has been through that course is a much more effective advocate. Advocacy is like creativity, in that it is something that comes from within. It is a very similar process to design in many ways – you create a story, a synthesis out of a lot of facts. That can be taught and what you end up with is enhancing the creativity that everybody has.

I will close with a remark which I think is attributed to Jack Nicklaus: 'The more I practise, the better I get.'

Speaker: I can endorse that, 100 per cent. We have some pretty good evidence. We put all our designers through a basic course on creativity techniques, and we also put them through a course on how to gain credit for your creativity – so we tell them how to communicate their creativity. That is something that designers are not good at – communicating to their seniors and others about how creative they are.

We have really good evidence that, when we put designers through these courses, the mediocre designers become much better, while the better designers do not actually improve significantly because they are doing it already. We have really hard evidence for that.

Speaker: Of course, we have a serious problem here that what is considered by many people – certainly when writing their CVs – as being creativity is in fact innovation. Creativity is a step situation – you step off the planet with creativity and you do not do it to order.

Speaker: While we are thinking about the future of the schemes here, I just wanted to lodge a little vote for a sustained and integrated design one. David might correct me if I am wrong but the impression I have is that after two years of appointing a fair number of people, we will perhaps hit some saturation or budget limitation points next year, at the same time as a number of us, labouring under the editorship of Chris Elliott, will hopefully launch a report which will stimulate the demand and point to the importance of the subject. I just hope that we are managing to sustain the rate of spend, at least in the two or three, and the one I care about, the Integrated Systems Design.

Hugh Norie: I would like to bring the more general discussion to a close now because we only have 30 minutes to go and I am very keen to get a little further towards a conclusion.

The first point is that this exercise has been very helpful this afternoon, partly because you have been able to get away from the great world issues that we cannot resolve – like what do we do about energy? You have come down to some points here that really are within our scope to do something about. That, in itself, is very helpful and it makes the next task of the Academy much easier. I would like to thank the syndicates and our members for that.

In the remaining time, I would like to revisit the five points I put up at the beginning of this workshop, to see whether they look appropriate. In putting those up, they were a hostage to fortune, but I feel that there are some elements to some of those which we probably feel now that we could do something about. I would like to get a little focus on that.

The first question here is a very general one, to do with schools. What sort of people would we identify at a young age and encourage, to bring them on such that, in the future, they can contribute? What we are looking for here are people who are bright and who can deal with mathematics. They should be ambitious and want to earn good money, but also have a slightly wider view of the world than the inside of a banking hall. They also need to be people who will respond to encouragement and who are themselves enthusiastic.

In this area, the Academy is doing a good deal through its schools programmes, but it may be that we should do more. The question arose of the co-ordination of these programmes, and co-ordination with other purveyors of such programmes, so this is an area where we can go a little further. Is there any comment on this one?

Speaker: What about board directors being educated?

Hugh Norie: Sometimes it is a bit late. There is in fact an interesting point that we have skirted round today. First of all, there seems to be a greater division between industry and government here compared with, say, the United States or France or Germany. This is partly, as I have been saying today, that we seem to be almost against networking – meeting the people at an early age and then keeping up with them. We almost create barriers. If you go into the departments of state of this country and say that you have some influence here, they all go and hide.

How can we actually get back to networking in such a way that there is a natural means of influencing the people at the top, on your board or wherever, and that they understand why you are influencing them and why it does them good? We are just not very good at that here, while other countries are surprisingly good at it. There is a whole mindset that we have to deal with and there is no easy solution. We have got into the way, if you like, of putting ourselves in boxes. As Chris Luebkeman said on the first day, only the human being can un-create the box.

Sally Heslop: If I were to look for one other characteristic, I would suggest that you should try to engage people who really have a passion to solve problems – who actually want to make a difference to the way the world is going to look. They should be willing to engage in the messy process of politics. Somebody made a comment yesterday about either a political way of thinking or a rational way of thinking but you need to have people who do both of those because you cannot live in a parallel universe where you are being entirely rational. If you want to make a change, you have to get in and solve real problems with real people, and this means getting involved with politics at some level.

Hugh Norie: Yes. In fact, a good deal of the engineering profession do not always like that, because it is a left-brain or right-brain activity – whichever it is that we, as engineers, do not do.

Sally Heslop: So perhaps you are looking for people who can use both halves of their brains effectively.

Hugh Norie: Yes, but I think you will see more and more of that. I have great hopes that, with this extraordinary technological revolution that we have been going through, and which George Cox talked about very effectively yesterday, you are seeing a new generation of very entrepreneurial people coming up, who are both logical engineers and politicians and so-said entrepreneurs. They are undoubtedly starting to set an example for others, as to what you actually can do in this world. There is nothing to stop anyone here now – you can do anything you like, if you just have the courage and the energy to do it. In America, it is very much the same, but I still find the problem that there is a disconnect. Quite often engineers, and indeed universities, do not want to become too enmeshed in the dirty stuff of influence.

David Hicks (University of Bath): If you want a world class footballer now, you pick them at age 11 or 14. Should we look to develop a better understanding of what attributes make for excellent engineers, so that we can let those 11 to 14 year olds know that they are candidates?

Hugh Norie: That is another fascinating issue which we have to address, but have not – which is that of selectivity, or what politicians would call elitism. Do you look to create a cadre of very high-class people, and concentrate resources on doing that so as to give yourself future leaders? At the moment it is very politically incorrect to do that, but other countries do it. France is a perfect example with the École des Mines, which has three per cent of the engineers being trained in France and with 50 per cent of the resources. It produces a small number of extraordinarily competent people. That is one way to go, but this country does not like doing that.

The problem is almost a social or an ethical problem at this stage, rather than any difficulty in doing it because, clearly, if you choose to do it, you can do it.

David Hicks: Actually, all secondary schools now have to identify their 'talented and gifted' – the group of the best.

Hugh Norie: Yes, but do they then have, say, a quarter of the money for the whole school thrown at them?

David Hicks: No, they do not get the money, but at least they are identified and there is a process there.

Hugh Norie: So that is a start but, once again, that is a big issue and not one that we will solve in the next year or two. It is a mind set, a mind cast, which we have to start thinking and talking about.

Patrick: I have a slightly different slant on your challenge here. Basically, as I see it, we actually have a crisis on our hands with this issue – with the challenges that we identified yesterday. The crisis is to seriously change the way in which we develop the future engineer. Governments tend to be very good at putting all problems which are not too important out of the way. So, unless we can engender a sense of urgency around these issues, then probably nothing will happen at all.

Hugh Norie: Yes, I agree, but I am afraid that we will have to move on because we only have 20 minutes until we have to leave this room. We will move on to the next question and we will talk afterwards.

The second question that I have here, which I feel that we do not need to discuss because we have covered it quite well, asks what is the role of education, at both school and university level. We are dealing here partly with the question of what you should teach, and whether you should teach in a general way. Should you teach people to think? Or do you teach actual specific knowledge? I feel that the consensus here is very much that you teach people to think and, if you like, industry recognises that the details are what they can fill in, as long as the guy has a working mind and a fairly wide spectrum of ideas and thoughts.

Speaker: Could I just say that, as far as the national curriculum is concerned, you will have to fight every inch of the way against the Qualifications and Curriculum Authority. They have a very clear idea about how they want teaching and curriculum to go on in schools. The issue is that we have specialist diplomas coming in and that will absorb

about 220,000 young people a year across a whole variety of subject areas. You have to work within the constraints that currently exist, or try to change them politically, but that will be an uphill struggle. I do not think that we have a clean piece of paper there to work with, but there is a whole infrastructure to be moved or changed or persuaded out of the way.

Hugh Norie: Yes, I agree.

Fred Maillardet (Brighton): I would like to follow on from that by reminding us of Geoff Kirk's comments yesterday, when he pointed out that compulsion might be necessary in here somewhere. Do you remember the question about whether the youngsters have too much choice.

Hugh Norie: Yes, that is a very good point – it is the father who usually tells them what to do.

The next question is, what should industry do to assist in this process? I feel that we have covered this fairly well but are there any further points on this? I have a good deal that we can use to work with on that one.

Roger Venables: I would gently suggest that it is not just about industry. We talked earlier about losing engineering graduates from engineering and we separately talked about the fact that not all engineers work in industry. Could I just put in the middle ground, which is that there are many engineers who do engineering jobs in organisations that are not industry – for example, the Environment Agency, but there are a great many others. We either need to change the terminology or explain that, by 'industry', we mean that there are other employers of engineers who do engineering jobs, as opposed to going to do financial jobs. They are a resource to universities, to help in the processes that we have been talking about.

Hugh Norie: Thank you.

The next question we have – and, again, we have talked about this to some extent – is why are we not doing better? What is holding us back? Why is this country not doing even better than it is towards meeting these aims? Is it because we do not have the forums to discuss them? Is it because we are too beholden to our political masters who control the money? What is it? Are there any further points on that?

David Hicks: I have a rather bothered view that we have not realised how bad the problem is. We have been rather reluctant today and yesterday to admit that our

engineers actually do not compare favourably with engineers overseas – which Ken Fulton was too polite to say, but that was what he actually had on his slide.

Beyond that, I worry whether there will be engineers around to keep our infrastructure going when I am old. I think we have a bigger problem than we are prepared to admit.

Jonathan Seville (University of Birmingham): We have rather kept off this subject since we saw the figures on how much it costs to train an engineer, but the unit of resource is still one of the biggest issues. It simply is not big enough to enable us in the department to do the sorts of things that we would like to do.

Hugh Norie: There is an interesting follow-up on that as you can divine, in a way, from the Engineer of 2020 American study. The Americans are looking to tackle this, of course, by importing and retaining in the country engineers from overseas. They recognise that they will never train themselves the engineers that they want, and that is another interesting approach, although it is not an approach that this country has ever even considered. To do that, you have to think about it as a national issue, but we do not do that. The shortage of engineers is certainly not seen as a national issue here, but it is seen as 'one of those things that will be alright in the end, won't it?'

Bob Brewer (VP, Oxford): In all these discussions, it strikes me that we have perhaps been rather kind to industry or, to take the point, other employers of engineers. Perhaps we have not pointed the finger as much as we should.

I am an electronic engineer and, over the last 20 or 30 years I have watched the UK electronics industry being systematically destroyed by underfunding and meanness in terms of companies rewarding engineers and putting money into R&D and engineering education. We need to point the finger much more clearly at industry and tell them that, if they want good engineers, they will have to pay them. That could be done directly in the form of salaries, which sucks good engineers through the system, or it could be done through investment in training, or funding universities. There are a great many ways, but we need to point the finger there rather more directly than we have.

Hugh Norie: Do you think the Academy should do that.

Bob Brewer: The Academy has a role. How successful you will be, and how tactful you want to be about it and so on, I do not know, but there is a real issue there. It is probably more marked in some areas of the engineering industry than others.

Hugh Norie: Something that the Academy could help with would be at least to acknowledge that this is a point that needs to be debated. Some of these points are not even out there being debated, and that may be one of them.

Speaker: I think this point was made before, but the engineering institutions need looking at in greater depth. The amount of institutions that we have in this country and the influence they have on the educational system, as far as accreditation is concerned, is a problem.

Hugh Norie: Yes, we will take that point.

Chris Pearson (VP Brunel): I am also with Unilever, which probably lets me look at things across the field of engineering.

Why does the Royal Academy not promote engineering as a 'can-do' activity, rather than a 'can't-do' one? One hears a number of times in the press that health and safety have stopped this or stopped that, and this is one area where we could actually show young people that you can do things differently, and we should encourage them to do so. This is an area where we could encourage them to be very much more open.

Hugh Norie: To a large extent, the Academy tries to do that, although perhaps it does not do enough. Certainly, much of the move in the Academy is actually to encourage engineering and show people what a good thing it is. This is very much on the Academy's current agenda.

Speaker: Could I just remind people, when we did our STEEP analysis, that one of the biggest issues for us was the UK role and vision of the government. Surely, it should be the Academy's task to ensure that the Government has a clear vision of how the engineering industry wants to move forward in this country.

Hugh Norie: It would be difficult to deny that. I think that is right and it certainly should be moved towards.

Raj Agrawal (University of Bath): One of the difficulties we face is that there is a whole plethora of well-trained engineers in the Eastern European countries and, very often, UK industry goes out there to recruit engineers.

Hugh Norie: Yes, and you could ask, what is wrong with that?

Raj Agrawal: There is nothing wrong with that but it is just that, in a sense, it is not creating the type of engineers within the UK.

Hugh Norie: What I think it means is that, unless we are very careful, we will actually lose the capabilities ourselves and then, when we need them, we will not have them. That is absolutely right.

Alan Emery (VP, Bath): My comment relates to the penultimate point, about talking to governments. From my experience of having been involved with governments who have changed, you actually ought to talk to Oppositions and get your issues onto the agenda so that they can formulate policies. This then becomes an issue that is debated at elections and – who knows? – people are elected and you might then influence change. Spending time with governments with policies that they have already thought out, five, seven or 10 years earlier, does not get you very far.

Hugh Norie: And then we will get the Maglev!

Alan Emery: I have no comment on that.

Chris Elliott: The Opposition at the moment has a group called STEM (Science, Technology, Engineering and Maths). This is part of the David Cameron technique to avoid answering difficult questions, by saying that he has a group studying it. I am a member of the group, although I am not a party member – I am just doing it because I think science, technology, engineering and maths are important. That group is crying out for inputs and suggestions. If anyone has anything that they want to get into the Opposition, you can send it to me and I will forward it on. It is through the Conservative Party office, and there is a group that is actually worrying about it now.

Hugh Norie: That is very helpful. I am afraid we will have to press on.

Turning to the last question that I have, I feel that we have very largely answered this today. On my list, there are these 12 points for the Academy, although I will not rehearse those now because we have a good deal to work on there. Are there any further points that you feel we may not have touched on?

Ken Wallace (Cambridge): We have to be careful to distinguish between a curriculum or a syllabus, and teaching. I remember my physics teacher, who was called Archie Roberts. I am sure that his syllabus or curriculum was the same as nearly all the

others in all the other schools around the country. All of us – myself, and all the other students in that class – were always there early, always just waiting for him to come into the room. He is one of the reasons I am an engineer. Really, a curriculum does not make a course – it is the *teacher* who inspires.

Hugh Norie: That is a very good point.

Keeping an eye on the time, I will have to draw everything to a close. Are there any further points? Harvey, did you have anything?

Harvey Perkins: Just one small point, which concerns something raised by Ken yesterday. There is the need to manage the interface between industry and universities. Sometimes, there is room for an independent agent to manage that interface, rather than having one dictating to the other.

In the answer to the final question, the words refer to, 'the VP as an agent for change'. I would simply ask you to include one of those possible changes as 'acting as a broker between industry and universities in encouraging co-operation.' That would be very useful.

Mike ?...: In the hope that the Academy is actually successful and manages to persuade the Government to give more funding for undergraduate teaching, could you keep it in mind that this money, if there is actually an increase, is ring-fenced for the teaching of engineering? Some universities have the habit of allowing things to disappear to the centre. That is just an observation.

Hugh Norie: Thank you very much indeed – absolutely so.

I will have to draw this to a close now. A measure of the success or at least the usefulness of this workshop is that we could have gone on much longer. However, the real purpose here is to gather your views, thoughts and criticisms so that we in the Academy can settle quietly down and work towards a plan of action. I hope to have that ready in a few weeks – if David was not going on holiday, we would have it even sooner.

When we have the plan, I would like to feed that back to you. We will email it to you and I would like us to keep in touch on this. It is very easy, after a conference like this, to say that it was very good but then leave it and have nothing happen. The real problem is to make things happen, and the next stage of *actually* making it happen is very difficult – we must not delude ourselves on that. The first step will be to come up with a plan, with the

points whittled down even further. Perhaps we will have four or five things that we feel we can do, and then we will have to decide how. That is the way I see forward, and I would like to keep in touch with you all if we can.

I have found this meeting immensely useful and I hope you feel it has been worthwhile. I hope that the VPs feel that it is helpful that you and the Academy can get together and talk about these things, and look realistically and constructively at how the whole VP project can go forward. This has been a great success for the Academy to date but, unless it can be renewed and regenerated, it could fade away. This is all a part of seeing what will be necessary to go forward.

I would like to say thank you formally to the Academy staff, and to David and Bob in particular, who have put a tremendous amount of work into this. It has all gone surprisingly smoothly, which is a mark of the effort that has gone into the organisation. Thank you very much. [*Applause*] Let me also thank our speakers and syndicate leaders, who have done a fair amount of work beforehand on all of this.

I would also like to thank formally the group that I chair at the Academy, called the Design Matters group. This dreams up these things and puts a great deal of work into the preparation. Thanks therefore to the Design Matters group, too.

That is all I have to say today. I hope you have enjoyed yourselves. [*Applause*]

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