ENGINEERING IN SOCIETY– THE ROLE OF AN ENGINEERING INSTITUTION IN THE 21ST CENTURY.

Institution of MECHANICAL ENGINEERS

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Presidential Address 2018

Our engineering profession is in the process of radical change. Change that is challenging, not just people's perspective on our profession but also the way it has operated for the past 170 years.

Geoff Baker FIMechE
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Cover: The iCub is a humanoid robot developed at Istituto Italiano di Tecnologia (IIT) as part of the EU project RobotCub and subsequently adopted by more than 20 laboratories worldwide. It has 53 motors that move the head, arms & hands, waist, and legs. It can see and hear, it has the sense of proprioception (body configuration) and movement (using accelerometers and gyroscopes). Image courtesy of IIT.

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FOREWORD

Since our early ancestors first picked a stone from the earth and formed it into a tool, we began to shape the world we live in. That process has continued for millions of years, driven by our basic instincts: to eat, to protect ourselves and to survive. Society has been created and transformed by the people who have taken resources from our planet and transformed them into everything that makes up our modern society.

Today we call it engineering, but the Bronze Age, the Iron Age, the ancient Greeks and Romans, through to the great inventors that started the Industrial Revolution, were the engineers of their time.

It is the same today. Engineering is the heart of our society; we depend on engineering for all our needs, our wealth creation and everything we produce and consume. Society will call upon engineers to solve the challenges the world is now facing: how we will live with an exponentially increasing population, how we will feed ourselves, and how we will deal with the challenges of climate change.

During the course of this address I will be exploring the role of engineering in society, but more specifically what the role of an 'Engineering Institution of the Future' should be. I will try to show how, in my own engineering career, my experiences have led me to believe that change within our profession is not just an option, but a necessity for our very survival.

Our engineering profession is in the process of radical change. Change that is challenging not just people's perspective on our profession, but also the way it has operated for the past 170 years. Change can be uncomfortable; it is often easier to do things the way we have always done them. Change of the type and scale we are now looking at, and that the profession needs, will require us to move out of our comfort zone and create an Institution that is relevant and fit for purpose for the 21st century and beyond.

This is something that has driven me throughout my career in engineering, and my message to all the younger engineers is: jump out of your comfort zone throughout your career in engineering, because you won't know what's in you until you try.

The other thing I would like to say to younger engineers is: although you may not have all the knowledge and experience that you will gain over your career, your mind now is at its most creative and inventive. So, have the courage and confidence to believe in your ideas and dreams and turn them into reality. The knowledge you will require to achieve what you want to achieve is the easy bit. Your creativity and inventiveness are unique and precious things that you possess in abundance now.

Society will call upon engineers to solve the challenges the world is now facing: how we will live with an exponentially increasing population, how we will feed ourselves, and how we will deal with the challenges of climate change.


BRITISH AIRWAYS

INSPIRATION

Inspiration plays a huge part in why youngsters decide to go into engineering in the first place. As an Institution, 'inspiring the next generation into engineering' is one of our key strategic objectives. As engineers, it is important that we maintain that excitement throughout our careers, so that we can inspire the engineers of tomorrow, but also so that we can inform and enthuse people more generally, even those who are not engineers, about the importance that engineering plays in shaping our society.

My inspiration to become an engineer came in 1968, when I left school to become a Mechanical Engineering Apprentice working on one of the most inspirational engineering projects of the last 50 years – Concorde.

When I joined the British Aircraft Corporation, as it was known then, Concorde had not flown; the first prototypes, 001 in Toulouse and 002 at Filton, were being built. On 9 April 1969 the UK prototype of Concorde had its first flight from Filton Airfield, where I was based. The wonder of watching that event from the side of the airfield has been one of my personal highlights and helped inspire me still further about engineering.

As a young boy I was crazy about aircraft. I was also crazy about this new science of electronics, but I was forced to make a choice, and I chose mechanical engineering. Clearly, no regrets, but even as young boy, I did not want to be siloed into a particular discipline of engineering.

If the first flight of Concorde were not enough, three months later on 20 July 1969, my fellow apprentices and I were gathered around a television at Filton watching Neil Armstrong become the first human to step on the moon.

These projects captured my imagination.

Society needs inspirational projects, and inspirational people, to capture the imagination of young people about science and engineering. Projects like these inspire people and fuel people's imaginations. They show that things we once thought impossible can become a reality with enough imagination, hard work and ingenuity.

Elon Musk is an example of one of those inspiring people today in engineering, but he is not an engineer or a scientist. Musk is the founder of PayPal, but the visionary behind Tesla electric vehicle development and SpaceX; he has shown just how much can be achieved with ambition and vision. Musk is challenging the barriers to what we once thought as unachievable.

It is what the science of engineering is all about: to set a seemingly impossible goal, and then to engineer a solution around every single challenge that may first appear to be impossible.

Society needs inspirational projects, and inspirational people, to capture the imagination of young people about science and engineering.


Castrol EDGE
Rolls-Royce
BLOODHOUND SSC
EPSRC
serco
UWE Bristol
STP

Another current project that is inspiring the next generation about science and engineering is the Bloodhound SuperSonic Car (SSC). This project aims to design and build a car that will travel at over 1,000mph.

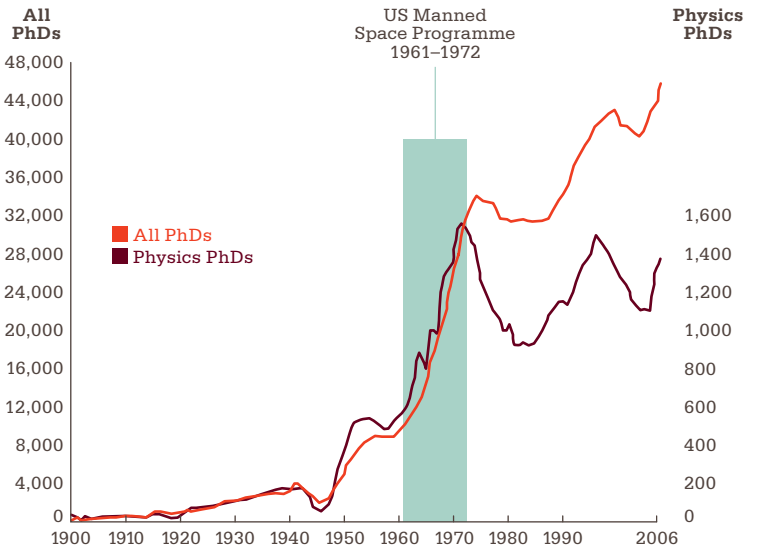
The Institution backed Richard Noble and his team, when a lot of people thought he was crazy, because we saw that it would inspire people. The Bloodhound SSC Project is now a global engineering adventure, using the 1,000mph World Land Speed Record attempt to inspire the next generation about science, technology and engineering. The Institution has created a Bloodhound ambassador programme, which has taken the Bloodhound SSC project to over 50,000 young children, teaching them about engineering principles as well as showing them what engineering skills can achieve. When Bloodhound finally does its world record attempt, thousands of children all over the world will be monitoring the data live in their classrooms.

So, why are projects like these so important? You could argue, and a lot of people do, that they are a waste of money; for example, Concorde was a great technical achievement, but a commercial failure. Some people will even challenge the fact that we actually landed on the moon, however no one can dispute the huge technical advances and successful commercial spin-offs that are a direct result of these projects. We will see the same with Bloodhound SSC.

Furthermore, these projects have a clear and direct impact on science and engineering graduate intake; it has been termed the 'Apollo effect' (**Fig 01**). After every high-profile engineering achievement, there is a significant increase in graduate intake into science and engineering.

We need to inspire young people to pursue careers in engineering not just because we currently have a shortage of engineers but also, and perhaps more importantly, because we need the best talent to be working as engineers to solve the huge challenges that society is facing.

Fig 01: Apollo effect 1961–1972:
Physics PhDs and all PhDs Conferred in the US 1900–2006



Change is not just an option to be considered by us – it is essential.

THE CASE FOR CHANGE WITHIN THE PROFESSION

I would like now to turn to our profession and more specifically to our engineering institutions. I want to explore whether engineering institutions are relevant and fit for purpose in the 21st century.

You can say that, as an Institution, we have done a pretty good job over the last 170 years in just surviving in a world that has changed beyond all recognition from the one that existed at the time of our founders. Our founders' vision, as written in the first version of the Institution's 'committee rules' was, 'to give an impulse to inventions likely to be useful to the world'. What a profound statement. We recently spent six months in committee meetings talking about our future purpose and our vision and could not come up with anything but a modern version of the same statement:

'Improving our world through engineering'

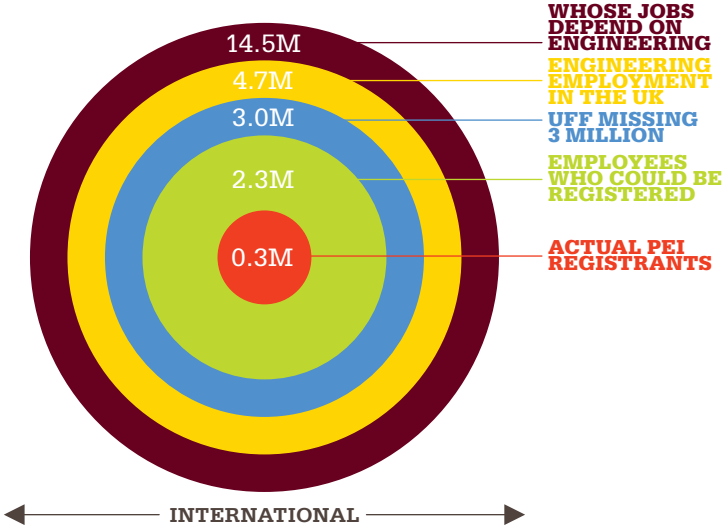
The Institution has achieved a huge amount over the past 170 years, and the UK's Professional Engineering Institutions (PEIs) have some tremendous traditions and history. However, I wonder if we have lost sight of that founding purpose 'to give an impulse to inventions likely to be useful to the world'. Are we doing enough to drive the agenda and put forward the importance of engineering in our society? Are we effectively pushing forward the message of how important engineering is to almost all aspects of our society? Are we spending too much time looking inwards and not enough time considering the big picture? Is the Institution increasingly relevant to only a declining minority? These questions may seem harsh, but should be considered in the context of following figures.

Are we spending too much time looking inwards and not enough time considering the big picture?

Professional Engineering Institutions attract only 10% of qualified engineers in the UK today as actual members. Three million qualified engineers who presumably do not consider any current PEI to be relevant to them. These are referred to as 'the missing 3 million' (**Fig 02**).

The problem was summarised in an independent review of the UK engineering profession by John Uff QC in 2016, commissioned by the Institution of Civil Engineers, the Institution of Engineering and Technology and the Institution of Mechanical Engineers.

Fig 02: The missing 3 million



The report said:

- **The Professional Engineering Institutions are too numerous and have failed to engage with the profession**
- **The leadership of the profession is fragmented and ineffective**
- **The UK is failing to produce enough skilled and motivated engineers**
- **The promotion of engineers and engineering is ineffective**

These are the conclusions from extensive independent research done on the state of the UK engineering profession.

The Professional Engineering Institutions are too numerous and have failed to engage with the profession

The UK has 36 separate PEIs, each one representing a specific engineering discipline. While it is important to have technical focus on different aspects of engineering, do we really need this many separate institutions? This means 36 separate executive organisations all managing similar processes, 36 separate complex governance structures, 36 presidents and 36 chief executives.

What about disciplines that are not represented by an institution or cut across several institutions' activities, such as the internet, graphene, artificial intelligence, social engineering or robotics? Do we create yet more institutions to cater for all these equally important technical disciplines? Do we need to repeat the governance and management structures, the accreditation processes for our degrees and the modern IT systems that are needed to communicate and deliver services to members?

While it is vital to have technical focus on different aspects of engineering, do we really need separate engineering institutions to achieve that?

These are challenging questions which raise sensitive issues, particularly as we start discussions about integrating our profession. It is not about turkeys voting for Christmas, it is about accepting the situation we are in. The harsh reality is we need to consider these issues, as many of our institutions will not be able to survive financially in the future.

Certainly, none of them alone will have the financial resources to create an 'Institution of the Future' that is relevant and fit for purpose in the 21st century.

The combined membership of the UK's Professional Engineering Institutions is declining, and it has been declining for the last 10 years. Yet, in contrast to this trend, membership of our own Institution has grown by over 50% during the same period. In 2017, the Institution was the top performing PEI for the sixth consecutive year for newly registered members, growing our total membership to over 120,000 members worldwide. If we look at the demographic that will hit us in the next five to 10 years, engineers of my generation will be falling out of the picture in huge numbers, and not in time for the younger generation to take our place.

Despite this success, the number of engineers choosing to join any PEI is still extremely low.

Feeling depressed? Before we move on to the positive, here is another quote from the Uff Review to consider:

'…if you don't like change you will like irrelevance less'

Change is not just an option to be considered by us – it is essential. In order for PEIs to have a bigger impact on society, we need to represent more than just 10% of the engineering community.

'…if you don't like change you will like irrelevance less'

THE SECOND LAW OF THERMODYNAMICS

I would now like to bring into the discussion the 'Second Law of Thermodynamics' and the concept of 'entropy'.

I seem to recall the lecturers at college and university tried to make the maths of it complicated, but it really is quite simple.

The reason why I want to talk about the Second Law of Thermodynamics, apart from fulfilling a lifelong ambition to talk about this subject at the Institution of Mechanical Engineers headquarters, is to show that everything in the universe and everything we create, including companies, organisations, cities and even Professional Engineering Institutions, obeys this universal law.

They will respond to the environment around them and they will eventually disappear, or more specifically they will go from a low entropy state to a high entropy state.

We must put energy into something to create order in the first place, and it's the same with our engineering institutions: we must keep putting energy into them to counteract the drive to increasing entropy. However, we must ensure that we put our energy into creating something that is viable and fit for purpose.

Global warming is eroding our habitable land space; we can build walls and levies to protect our living space, but only for a limited time; entropy will eventually take over and these efforts will be futile, and we will be forced to move to higher ground.

When I am talking to young entrepreneurs about starting up new businesses, I refer to 'entrepreneurial energy'; it's the energy that creates a business in the first place. I also talk to large corporations about how they can maintain that entrepreneurial energy or entrepreneurial culture as they grow and get bigger; because entrepreneurial culture is key to the success of any company, no matter what size.

The statistics in business are quite concerning. If we take for example, the Fortune 500 or top 100 companies of 50 years ago, the world's largest global companies, and compare them with the global companies of today, only 10% of those top global companies of 50 years ago exist today; 90% have either gone bankrupt, been taken over or just faded away.

They have, quite simply, done nothing to stop themselves obeying the second law of thermodynamics.

You can argue that as PEIs we have done quite well to have survived 170 years.

But the writing is clearly on the wall.

As PEIs, we are all in decline due to the second law of thermodynamics, and the timescale of our decline is that it is happening now, and it is happening very quickly. We could say, 'oh well why bother, we are doomed anyway', but that's not how human beings react; we have an instinct to survive, and certainly as engineers we have an instinct to fix things that are broken.

Our 'Engineering Institution of the Future' not only needs to be fit for purpose for the world we live in today. It must be able to adapt, so it remains fit for purpose for a future society that will change beyond anything that we can imagine today.

As we create our 'Engineering Institution of the Future', it is important that we look to learn from things that are particularly good at adapting and surviving.

HOW CITIES AND SUSTAINABILITY ARE RELEVANT TO AN 'ENGINEERING INSTITUTION OF THE FUTURE'

Our cities and towns are remarkably resilient and, in some cases, have survived for thousands of years. So why do cities survive, while companies and organisations fail?

I am going to draw parallels and refer to some very interesting work that has been done by an eminent physicist turned futurologist called Geoffrey West. West applied his theories to why companies and organisations fail, and cities don't. Many of our great cities have been around for thousands of years; they are dynamic and adapt to the environment around them, and they adapt to change and to the people who choose to live in them. Some of our major European cities were rubble after the Second World War, but today they are modern thriving cities, full of culture and enterprise.

Cities are also the place where more and more people are choosing to live. Every week from now until 2050, one million people will be added to our major cities around the world.

West puts forward the idea that expanding cities will not only be where the problems and global challenges will emerge, but they will also be the places where the solutions to these problems will emerge.

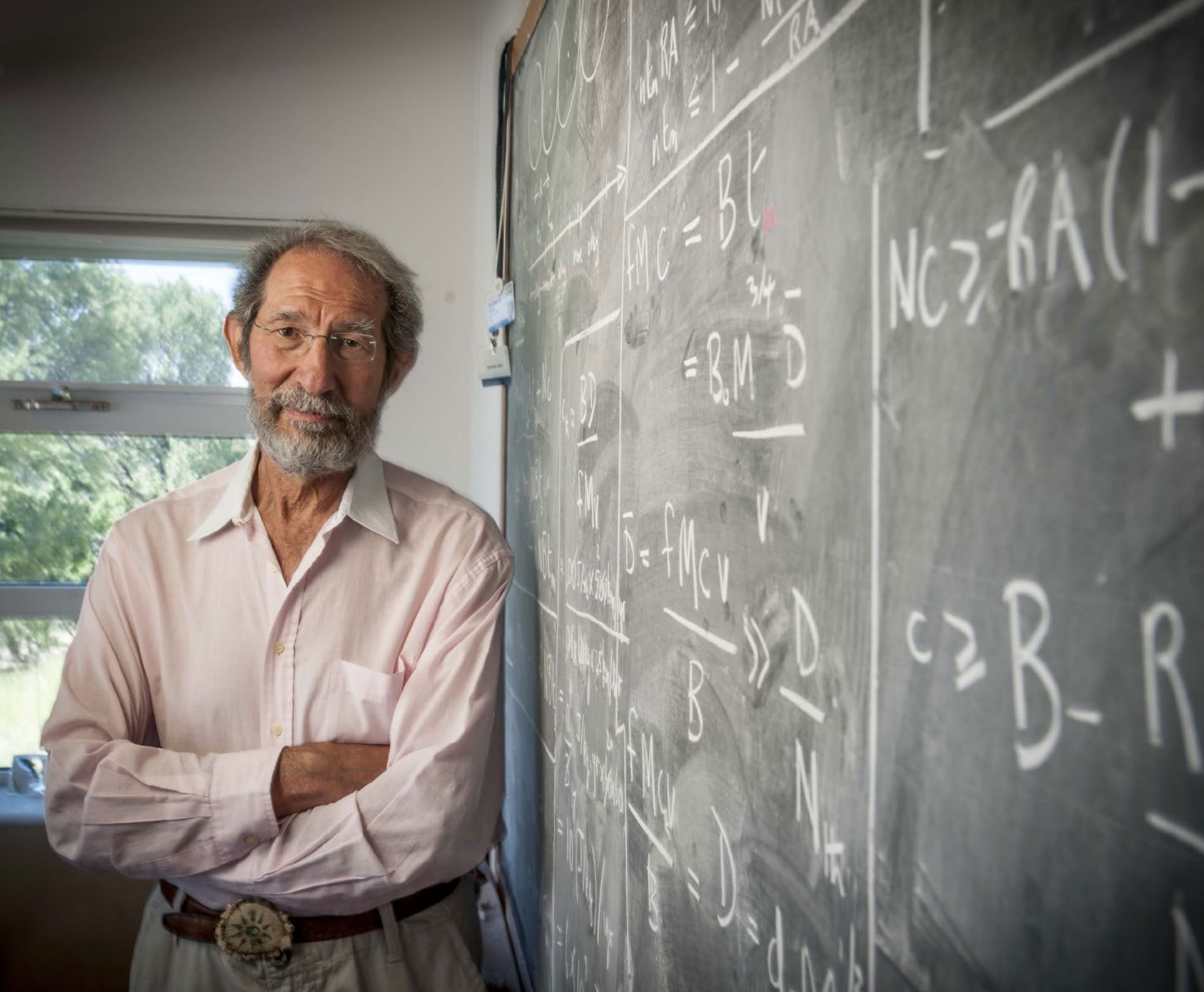
Cities will be where these solutions are developed because they attract and encourage the talents of the best people – the sort of people that will be able to solve the problems that come from this expansion.

Among those people will be engineers and scientists who will develop solutions to solve the challenges that our society and our cities will be facing.

Our 'Institution of the Future' must be the magnet for this talent. We must attract the widest community of people who can play a role in helping to shape our future.

We must uphold the exemplar standards of engineering with our Members, but we must also encourage a wide range of people to be associated with our Institution. People such as social scientists, architects, educationalists, medical professionals, lawyers, political and community leaders, even artists. Because the problems we will be called upon to solve will be multi-disciplined and multi-dimensional. We must create an environment where that talent can come together.

We must attract the widest community of people who can play a role in helping to shape our future.



The other premise that West puts forward about cities, which he says is key to their survival, is that they are built as 'open systems'; they are able to adapt and change to the environment around them and the situation they find themselves in.

Coming back to the Second Law of Thermodynamics; 'open systems' can still have low entropy, but they can exist in different states and they respond to the environment around them.

It can be argued that when our institutions were first formed, they were formed with open systems. In the case of our Institution, with a very grand mission… to provide an impulse to inventions likely to be useful to the world. But their 'rules', the equivalent of our by-laws and Royal Charters of today, were written on a few sheets of paper. If I were to bring together all the constitutions, by-laws, terms of reference, rules, guidance documents, of all the boards, committees, groups of all the engineering institutions, you would have to wheel it in on a trolley.

When we created our institutions, some nearly 200 years ago, we created them with open systems, not constrained with overburdened complex governance structures. However, over the years our institutions have developed closed systems of governance. Because of this, we are finding it increasingly hard to adapt them to the rapidly changing environment we are now facing.

In our habitation analogy of living on lower ground, we must stop building walls and levees and now move to higher ground.

We must address the challenges we are facing; otherwise, we will obey the Second Law of Thermodynamics and we will disappear!

What lessons should we learn from this as we look to create a new integrated 'Institution of the Future'?

We must attract into our 'Institution of the Future' the widest community of people who can play a role in helping to shape our future. But we must also create our new institution with an open structure, which is not bound or restrained by rules and laws that stifle the creativity and inventiveness that we need to perform our role in the society of the future.

It is only by doing this, that we can adapt to the world we will be facing in the next 200 years.

We must address the challenges we are facing; otherwise, we will obey the Second Law of Thermodynamics and we will disappear!

Our work as engineers should be driven by the needs of ‘people and society’ and not by ‘technology’.

WHAT COULD THE FUTURE LOOK LIKE?

Our 'Engineering Institution of the Future' by definition, must respond to the needs of society in the future.

But what will that future look like?

The problem is, of course, that we do not know what the future will look like. However, we can look at global trends and then look at the implications of those trends. As engineers it is important that we look to the future, because we will have a huge impact on what our society will be like. The society we live in today has been created and shaped by engineers, and it will be engineers who will continue to shape our future.

We all tend to have a positive view of what the world will look like in the future; what our cities will look like in 10, 20, 50 years' time.

Those of us who want to live in cities, want to live in cities that are technologically advanced and affluent but are also harmonious. Cities which allow us to have a lifestyle with lots of leisure time, with robots doing all, or at least a substantial amount, of our work for us.

However, with demographic changes, the movement of people, jobs being replaced by the robots and artificial intelligence, it could be that 'entropy' will take its course and our future cities could end up as dystopian nightmares. With the rise in population we could see an increase in poverty, slums, overstretched infrastructure and social inequality wars and refugee crises. Both of these scenarios are possible.

As engineers we are creating the future and we are proud when we create things. However, robots are going to play an increasingly bigger role in creating things. Robots are already replacing mundane, repetitive or dangerous jobs once done by humans. But soon professions based on knowledge and skills, such as lawyers, doctors, bankers and traders, will also potentially be replaced by computers and artificial intelligence. Even jobs in engineering; if they involve following a process, they can potentially be replaced by artificial intelligence.

The global economy is being transformed with jobs outsourced to developing nations and artificial intelligence. As engineers we create this world, but the implications of our work will extend far beyond the technical challenges we will need to address and overcome. Our work has social and political implications.

We cannot abdicate our responsibilities for the potential implications of the work we do.

Robotics, artificial intelligence, the exponential growth of technology, the opportunity to free humans to live longer, to be more creative and live more fulfilled lives, but only if we address the social and political question:

Who will own the robots? And who will benefit from the rapid deployment of robotics and artificial intelligence in all aspects of our work and social life?

We cannot abdicate our responsibilities for the potential implications of the work we do.

If our work only serves to divide society between those who have and those who do not; everything we achieve as engineers will have no value to society. It will only take us further down the path shown by the second scenario of a dystopian society.

Our work as engineers should be driven by the needs of 'people and society' and not by 'technology'.

We must develop solutions for society that address our needs, not just for the basic things, such as energy, transport, food and housing, but for other things that make people's lives better.

I work as a mentor with an organisation called Future Worlds, based at Southampton University, the brainchild of a visionary called Dr Reuben Wilcox, who saw from Stanford University in the US what could be achieved with the right co-operation between university research and business.

Future Worlds takes innovation and technology across all the faculties and spins out that innovation into commercial businesses.

Professor Tim Leighton, of the Institute of Sound and Vibration Research (ISVR) at Southampton University, has come up with the holy grail of cleaning: by injecting ultra-sonic bubbles into cold water in a particular way, it gets rid of bacteria on hands and wounds and has huge implications for cleanliness and infection control in hospitals.

Leighton has recently been to Northern Ghana, where new-born babies get sepsis at an alarming rate from infection at the severed umbilical cord. His 'Star Healer' device is being used to reduce the appalling new-born death rate in that country, where the StarStream not only cleans wounds, but also vastly increases the rate at which infection heals.

A clear example of creating solutions for society that can make people's lives across the world better.

Last year, at the Institution of Mechanical Engineers, we ran a hugely successful conference on incontinence, which perhaps is not an obvious topic, but engineering and medicine came together to discuss approaches and solutions to a very personal and distressing problem in our increasingly elderly population.

At Future Worlds, I am helping a young Bioengineering PhD student, Ali Mosayyebi, who is developing a new type of urinary stent that will improve the lives of thousands of people and could potentially save the NHS millions of pounds a year. Future Worlds is also working with engineers and medical specialists who are involved in the design and manufacture of new types of heart valves and replacement joints.

Engineers are working with doctors on the design of revolutionary prosthetic limbs. While at the Royal Academy of Engineering last year, I saw a prosthetic limb being controlled by the thoughts of the wearer.

These are all examples of engineering and medicine coming together to improve people's lives. Robotics have huge potential to help with care of the elderly; an increasing problem for our society where in the future one in three people could well be living over the age 100.

As engineers we are also putting our energies into ‘cities of the future’. There is a lot of work being done here in the UK and across the world on so-called smart or intelligent cities.

Some of these projects are financed by unimaginable wealth from oil and gas resources, but do these seemingly inspiring projects really show us the way forward for what our future cities should look like?

These projects certainly showcase the latest innovation in energy, transport and sustainability, but are they cities we aspire to live in? Smart cities must be driven by the needs of people and society, not by technology.

There are alternative projects that I believe are showing the right way forward for our future cities. To illustrate this, I would like to bring you a little closer to home, where I live on the south coast. Fawley Power Station was an oil-fired power station at the bottom of Southampton Water, whose tower is used by sailors, like myself, to navigate safely around the Solent.

The site of the old Fawley Power Station will be used to build a new intelligent merchant city. A project that, I believe, is a better example of what a future smart city should be. I am privileged to be connected with this project, which is the vision of Aldred Drummond, assisted by Brett Trafford, Director of Innovation and Investment on the project.

Drummond’s family history goes back a long way, over 1,000 years. His family owns much of the land in the area, called the Cadland Estate, and more recently and more relevant to the story, he has now secured all the land on which Fawley Power Station stands. For those of who don’t know this area, Fawley is surrounded by beautiful countryside: the New Forest on one side and the Solent on the other side.

However, the area around Fawley itself is quite poor and it has social problems: transportation links are not good and with the closure of Fawley Power Station, and major redundancies at the neighbouring Fawley Refinery, unemployment in the region is now very high.

The vision of the project, is to create an intelligent merchant city, enabled by technology but built around the needs of the local people and the people who will be working and living in this future maritime city. A place where employment, residential and leisure will come together in a new maritime community, enabled by new technologies and engineering solutions serving the basic living needs of the people and companies that will inhabit this Future Town.

This vision has inspired the likes of Cisco, Siemens, IBM, Vodafone, the Web Science Institute of the University of Southampton, the Local Enterprise Partnership and local community organisations. The Institution of Mechanical Engineers is also now a partner in the project.

Our own Institution is a thought leader on the issues associated with development of smart cities, and has recently published a milestone paper on this key subject.

It is very early days for the Fawley project, but I believe it will be an exemplar of how innovation, engineering and technology can come together with architects, social scientists and planners to create a future living environment built around the needs of people.

Merger, integration or amalgamation alone will not solve the problems we are facing within our profession today.

THE 'ENGINEERING INSTITUTION OF THE FUTURE' – WHAT WILL IT LOOK LIKE?

What else do we need to consider when we look at shaping our 'Institution of the Future' for the unknown world we will be facing? Let's take a high-level view of how an institution is structured. Put simply, an institution consists of three parts: membership, administration or executive and governance (**Fig 03**).

Membership – the people who choose to belong to the institution, which needs to be much bigger, far more representative of the engineering profession than it is today, and far more inclusive and diverse.

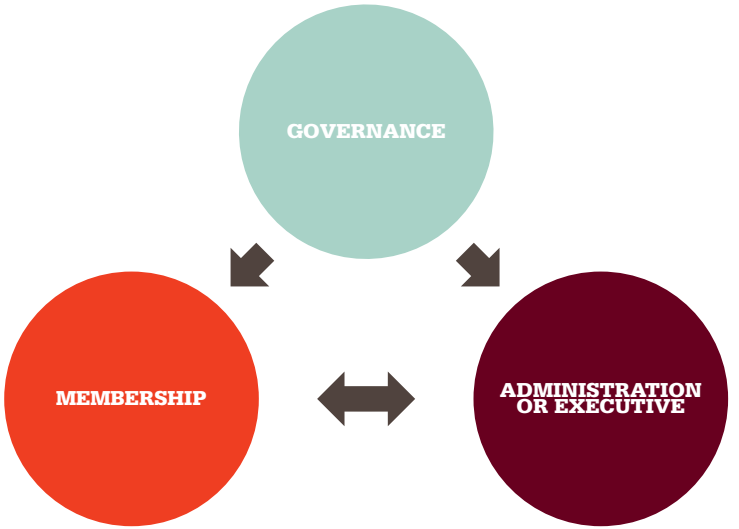
An administration or executive – those who deliver the strategic and business objectives of the institution; a structure that basically runs the institution.

Governance – this exists in any organisation to ensure that the whole organisation – the membership and the administration – conducts itself in a proper way, commensurate with its own constitution and by-laws and the broader legal requirements that exist at any time.

With all this in mind, it will be within the membership of the institution, by its sheer numbers and depth of expertise, that it will have the power and influence to help shape our society in the future.

When I spoke about 'opens systems', this is where we need to have a structure that is dynamic and able to adapt to the rapidly changing world we will be facing. Yes, we must have the technical focus that is currently provided by our 36 separate institutions. And, yes, we must remain the custodian of the exemplar technical standards required for these technical disciplines within engineering.

Fig 03: Institution structure



However, we must have an open environment within our membership. One that allows for technical groups, divisions and communities to be created around the existing and the new technical disciplines that will emerge, and also around society's needs associated with engineering: from energy, transportation, healthcare, global warming, social challenges, the list could be endless.

To achieve this, the power of the membership of the 'Institution of the Future' must be enabled by modern digital platforms created by the administration which will allow these 'global communities of members' to come together. This is why the structure of our 'Engineering Institution of the Future' must be 'open' and 'adaptive' and have the ability to change, driven not just by the needs of our members, but more fundamentally by the needs of our society.

While the institution's administration, as the enabler and deliverer, must be structured more like a 'not for profit' organisation with the power and authority to deliver the strategic and business objectives of the institution, it must also have accountability to an independent, suitably qualified, non-executive, governance structure or board, much like any other large plc.

The interface between all three parts of the 'Institution of the Future' will be critical, but it must be a partnership, working together with a common vision and purpose to:

'Improve the world through engineering'.

We have started some very critical discussions between the different Professional Engineering Istitutions, and we are considering different options for bringing our profession together.

Progress is being made, and I have every confidence that this will eventually happen, and that we will ultimately create a single 'Institution of Engineers'.

However, merger, integration or amalgamation of two, three, four or 36 separate institutions alone, will not solve the problems we are facing within our profession today.

We must change the business model and become an organisation that attracts not just the 'missing 3 million' engineers of today that we are not currently attracting, but also the broader range of people, such as architects, social scientists and politicians, who are passionate about the role played by engineers and engineering in our society. To achieve this, we need to understand the fundamental reason why, as human beings, we want to belong or to be associated with any organisation or body.

We must be 'open' and 'adaptive' and have the ability to change, driven not just by the needs of our members, but more fundamentally by the needs of our society.

It may be because we get something back in return for our membership or association with an institution. But there is a more fundamental reason behind our desire to belong to or be associated with something.

The National Rifle Association of America has an estimated 5 million members and although the concept is abhorrent to most of us, I am sure that not all these members have an active interest in playing with guns. However, I would imagine that the 5 million members believe in the US constitutional right to bear arms, and that's what the NRA stands for, and that is why it has 5 million members.

Religion has been so powerful throughout the ages, because people believe in what a particular religion stands for.

Greenpeace has nearly 3 million members; they aren't all chasing around in boats and climbing up the side of ships, but they are members because they believe in what Greenpeace stands for.

We belong to something because we believe in its purpose and the values it stands for, not just because we may get something in return.

Our 'Institution of the Future' therefore must have values and purpose at its core. Not only must it define these values, but it must be seen to stand up for and uphold these values. Values that define how engineers should behave and values on the role that engineering must play in society.

Engineers and engineering will shape our future, and with that comes a huge responsibility. Society will look to engineers and our institutions to be custodians of those values. Because of this, not just engineers, but people from all walks of life will want to be associated with and become part of our 'Institution of the Future', because they will believe in what we do and what we stand for.

Our 'Institution of the Future' therefore must have values and purpose at its core. It must not only define these values, but it must be seen to stand up for and uphold these values.


élan

Values have been at the heart of everything I have done throughout my business career in engineering. I believe that if you build something on values, if your management decisions are based on your values, your company or organisation will be much stronger.

My two business, ATL and Plant Asset Management, were built up and run on three fundamental basic values:

- **Technical excellence**
- **Business excellence**
- **People excellence**

These values came from the Structural Dynamics Research Corporation (SDRC), an entrepreneurial American organisation I worked for in my early career. SDRC that played a huge role in shaping my approaches to business and organisation structure:

Technical excellence – being a technically based engineering company, everything we did had to be to the highest technical standard.

Business excellence – our business had to deliver consistent financial performance to meet the demands of our shareholders.

People excellence – recognising the quality of our people, as individuals and as teams, was the cornerstone of the achievement of our other two values.

We even created sophisticated business management systems to support our work across five continents, which were built around these values.

Engineering today is multi-disciplinary; we need specialist knowledge, but knowledge now is so extensive that we cannot begin to teach at our universities and colleges, all the knowledge that engineers will require throughout their whole career. Engineering education must focus more on how to be an engineer and what it means to be an engineer in society. Technical knowledge is now instantly accessible and available to us as engineers, in many different forms.

Learning today is not just something you do at the start of your career; learning is now a life long process and our 'Institution of the Future' must play a key role in managing this lifelong learning process for our engineers and members.

This is a great opportunity for our 'Institution of the Future', but it will require huge investments in information technology to deliver to millions of members across a global community. This is another reason why we cannot do this alone; we have to combine our resources if we are to achieve our vision of the future.

The future of engineering is not about people like myself, we have had our day; it is about the new generation of engineers starting off their careers and the young children we are inspiring to become engineers.

Learning today is not just something you do at the start of your career; learning is now a life long process

CONCLUSION

Everything we do and any changes we make, must be driven by what our younger and our aspiring engineers want from an ‘Institution of the Future’.

Engineers will be called upon to shape and influence every aspect of our society in the future. Whatever the first steps will be in creating an ‘Institution of the Future’, they must be viewed as just that, first steps.

First steps in a journey to create something new.

We need an ‘Institution of the Future’ that:

1. Recognises the technical disciplines within engineering, but also one that unites us together with common purpose.
2. Speaks for all engineers and not just the minority.
3. Has a common purpose to serve society to create a better world for generations to come.

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To the Chief Executive and the staff at the Institution who have opened up the debate within the profession and continue to show great thought leadership in the journey ahead.

Finally, to all my colleagues, friends and business associates who over my many years in business have made my career in engineering a constant pleasure and privilege to be associated with them. And to business partner of 30 years, Roger Smith, who has helped to make the journey together both rewarding and fun.

To all of you – thank you very much.

Geoff

For more information about Geoff's work on Engineering in Society please visit:

engineeringinsociety.com

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