

PROFESSION

Putting passion back into the profession

New ICE president **Mark Whitby** believes ICE members should be more passionate about their Institution if they want to raise their status in society. He sets out six ways to make this happen.

I am passionate about engineering and I am passionate about our Institution. As I take up my presidency, however, I feel that we risk losing our way. The global warming, energy and transport debates are raging but we are speaking so softly as to be all but inaudible.

We are in danger of becoming decoupled from the political process that has helped to build this country. We must not forget that the engineering institutions—the ICE and the other 33—have a strategic role to play not only within the national economy but within the national consciousness.

We are part of the ‘visions and solutions’ business. Institutions are where ideas are formed and tested and they should produce connected intelligence. However, if this is to happen, we must all engage with this process. There are real consequences when we fail to do this.

No more wobbly bridges

If we had had a meeting to address the engineering principles of lightweight bridges, the underlying knowledge that existed might have surfaced. Still more recently, we have all been surprised by the vulnerability of buildings. While we have designed buildings to withstand the impact of an aircraft collision, we have failed to take our thinking further and consider the effects of an aircraft’s fuel.

We are losing our way as institutions because we have become over-specialised and we don’t spend enough time working with one another. At the ICE, we spend the Council’s time talking about management issues rather than engineering and we find it hard to manage the plurality of views that exist in any contentious area.

The result is that it is usually easier to say something bland and balanced than to be challenging. This, in turn, fuels the cycle of disengagement that exists between the membership and the Institution in its organisational sense. This disengagement is serious.

A plan for re-engagement

As members, however, we can reverse this process and begin to engage more fully with our Institution, and through it with the other

engineering institutions. I would like to suggest the following six-point programme as a way of doing this.

- **Refocus ICE Council activities**

The ICE Council’s time is precious. At present, we scrutinise but do not really address any of the big engineering questions of the day. We need to put the big issues on the agenda but we must also feel that there are consequences to how issues fare in debate. If Council’s activities are refocused, we can set the priorities for the profession and send clear messages to the Government. We can become more project-centred and use the Council to set budgets for the projects it agrees.

- **Strengthen the regional contribution**

We are too centralised and have become too used to having staff at Great George Street acting for us – the members. There are many practical reasons why we have allowed this situation to develop, which are to do with efficiency, expertise and speed of response. However, as a result, we—the members—have become disconnected from what is being done in our name. We must ensure that the regions are celebrated, have the power and are the source of the ideas and projects debated by Council.

- **Celebrate the Institution’s role as a learned society**

The sharing of knowledge is the reason we exist. To be effective in a multi-disciplinary world we need to see beyond the walls of our respective silos but we need our Institution to help us do this. We must ensure the continued development of the Institution’s learned society function, so that it will be able to feed us with the necessary information in ways that fit modern working patterns.

- **Remove the barriers between institutions**

To be effective in a multi-disciplinary environment we need to make it easier for engineers to move between institutions and to belong to more than one. This enriches debate and creates better engineers. We have taken the big step with the transfer arrangement. We now need to extend this thinking and encourage other institutions to introduce similar reforms.

- **Develop a joined-up approach to the major problems engineering can address.**

The big issues that face engineering are generally wider than the remit of any one institution. We need to find ways of working together to develop collective solutions. The Urban Design Alliance is a useful model in this respect. We need to apply it to other areas of pressing concern, such as sustainability and education.

- **Reform the role of president**

If Council is to be refocused on engineering issues, we need presidents for whom these are also of central concern. We need people who are prepared to be ambassadorial and evangelical about engineering. The presidency, however, can make such severe demands on people’s personal and professional lives. Reform of the role is necessary in order to attract the widest possible range of candidates.

The full text of Mark Whitby’s address can be found at on the ICE website at www.ice.org.uk/rtf/pdf/MWhitbyaddress.pdf. For further information, please contact Adam Poole on 077 7918 8715 or adam@fairseat4.freeserve.co.uk.



River Lune Millennium Bridge at Lancaster – meetings at the Institution can help to push engineering boundaries forward with more confidence (courtesy of Richard Bryant, www.arcaid.co.uk)

ENVIRONMENT

Waste management removing the barriers

It is estimated that construction and demolition waste account for nearly 20% of all UK waste. **George Fleming**, chairman of the ICE waste management board, argues for wastes to be redefined, for landfill taxes to be raised and for better guidelines to be produced.

The National Waste Management Strategy for England and Wales¹ published in May 2000 sets out to break the link between economic growth and increased waste arisings by improving overall resource management and reducing the amount of material disposed of as waste each year.

The strategy also aims to ensure that the UK meets its obligations under the EU Landfill Directive (99/31/EC) to reduce progressively the amount of material disposed of to landfill. It includes a number of targets

- by 2005, to reduce the landfill of industrial and commercial waste to 85% of 1998 levels
- by 2020, to reduce the landfill of biodegradable municipal waste to only 35% of its 1995 level
- by 2010, to recover value from 45% of municipal waste (at least 30% by recycling or composting).

Environment Agency figures suggest that in 1999, 72 Mt of construction and demolition waste were produced in England and Wales.² Government figures suggest that total waste arisings for the UK as a whole—including municipal, commercial and industrial, mining, agricultural and construction waste—are around 420 Mt a year and rising.³

Creating a market for recycling

To assist with the implementation of the strategy, the government has formed the waste and resources action programme (WRAP) to operate on both the supply and demand sides of the economy, helping to create strong markets for recycled products while ensuring a continuous supply of high quality feedstock to reprocessing industries.

Landfill tax was introduced in 1996 and currently stands at £12/t for non-inert waste and £2/t for inert waste. The landfill tax credit scheme introduced in October 1996 allows landfill operators to redirect, as part of a voluntary donation, up to 20% of their landfill tax liability for the year to registered environmental bodies. Operators can then claim a tax credit worth 90% of that contribution. Environmental bodies must use these funds for projects that encourage more sustainable waste management practices, including recycling or to deliver lasting environmental and community benefits.

An aggregate levy will be introduced in April 2002 set at £1.60/t of extracted sand, gravel and crushed rock from April 2002. The revenue from the levy will be used to cut employers' national insurance contributions as well as to finance a sustainability fund, the use of which is currently the subject of a consultation exercise.

Barriers to be removed

One of the major barriers to delivering the waste strategy is the legal definition of waste and the guidelines and interpretation of the exemption scheme for waste licensing. The construction industry deals with particularly large volumes of soil and sub-soil materials that, under the current classification, are firmly treated as waste. Removing soil and sub-soil from the list of materials classified as waste, with the necessary controls over quality, would facilitate the cost-effective re-use of this natural resource.

The current level of landfill tax on inert materials is appropriate and the current level of aggregate tax about to be introduced is also appropriate. However, the current level of landfill tax for non-inert materials is too low and inhibits the re-use of construction and demolition waste as new products within the construction industry, for example glass, plastic, wood, brick, masonry, tile, slate, tarmac and general excavation material as they exist within the mixed waste stream. A raising of the landfill tax would be seen as a great incentive to recycling.

The exemptions covering re-use of waste material, while representing a reasonable initial framework, need to introduce more practical guidelines that control the standard and specification of waste streams which can be re-used, and the necessary treatments to make them fit-for-purpose for recycling. There is also a lack of a co-ordinated research strategy to enable the standards and specifications for the re-use of recycle to be established and incorporated in the procurement process for new build.

References

1. Department of the Environment, Transport and the Regions, Waste Strategy 2000 for England and Wales, National Assembly for Wales, May 2000
2. R&D Technical Report P402, Construction and Demolition Waste Survey, Environment Agency, Spring 2001
3. Department of the Environment, Transport and the Regions, The Environment in Your Pocket 2000, January 2001

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Construction and demolition produces over 70 Mt of waste a year, much of which could be re-used

SAFETY

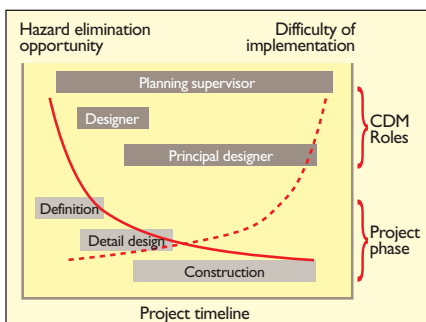
The no-compromise approach to safety

A successful health, safety, environmental and security policy means never turning a blind eye, according to Colin Smith of Foster Wheeler Energy, a company whose no-compromise approach has resulted in over 50 safety awards in 10 years and a phenomenally low injury rate.

Walking along a main London thoroughfare one Sunday morning, I passed a major hotel where work had been recently completed to the façade. The scaffold canopy temporarily erected over the pavement to protect the public during the work was being dismantled.

While a steady stream of the general public continued to pass under the structure, scaffold poles were loosened and lowered from above onto the pavement for loading onto a lorry. It was a scene that filled me with horror – but one which seemed perfectly acceptable to the scaffolders, scaffold company and, presumably, the main contractor allowing the work to be performed during the least busy time of the week, but at a time which still put people at risk. I did not walk on by, action was taken!

The incident reminded me of the need for constant vigilance throughout the duration of a construction project in order to ensure all members of the team share and work to acceptable standards.



Safety chart – designers can eliminate construction hazards much more easily and readily than contractors



Daily site safety briefings should be part of every contractor's training programme

My own company is well experienced in the application of health, safety, environmental and security (HSES) procedures designed to minimise exposure to potential site incidents and to ensure that there is adequate response capability in the event of such occurrences. This is no more in evidence than in the approach to the civil engineering phase, of necessity at the front end of an oil and gas, refining, pharmaceutical, power or petrochemical project, and in parallel with general overall project mobilisation.

Rigorous approach saves time

A 'no-compromise' approach has been adopted, involving the application of planning, supervision, training, motivation, monitoring and reward. Nothing is new here – it is just rigorously applied.

The company's lost-time injury frequency rate for 2000 was 0.05, based on the industry standard of number of lost-time injuries multiplied by 200 000 and divided by the number of at-risk man-hours worked. Lost time is considered if the injured person does not report for work on the following shift duty. A rate less than 2 is considered very good by the Engineering Construction Industry Association and a range of awards over the years recognises our continuing achievements in regard to this.

However, such merits have been achieved by attention to the systems rather than solely the historical results. The highly HSES-conscious approach to all aspects of construction has spread from the attitude necessarily adopted when working with inherently volatile hydrocarbon materials association with the oil and gas, refining and petrochemical industries. This starts with a thorough planning phase, involving the construction group from the outset, usually within the concept design phase of a project.

Removing hazards from the outset

Early contributions from installation experts are an important factor in ensuring engineering maximises construction safety features, designs out dangerous installation requirements and mitigates the risks involved with the work ahead. At this stage, a comprehensive risk analysis and appropriate method statement development may save lives and prevent damage to property and the environment.

General civil engineering companies are usually first in the field and so often start while development of plans and procedures has yet to be completed. Nevertheless we owe it to ourselves to be fully prepared in all respects prior to entering into a potentially dangerous situation.

The Construction Design Management (CDM) regulations of the UK are moving the civil engineering industry a long way towards adequate planning, forcing the industry to 'think before it acts', and are likely to be applauded further once statistical evidence can be tracked to record actual effects of their introduction. However, it is already recognised that removing a hazard is easiest early in the project phase when opportunities for elimination are at their peak (see chart).

This theme is further developed as the construction teams enter the installation phase. It is a fortunate contractor which has a fully trained compliment of employees conversant with all the requirements of the latest contract. Reality is that, however good the team, it will include a number of new personnel, trainees, promoted personnel in new roles and personnel who simply need a refresher course. Site training must start with a project induction course and continue through daily briefings, specialist courses and on-the-job training. The more structured the approach, the less will be forgotten and the more trust will be placed in the system to capture all requirements.

Importance of supervision

While training takes effect, supervision must be adequate to protect individuals from naive unsafe acts. This is no different to the principles of child education and it should come as no surprise that many of the techniques are the same. The process continues to the end of the project, acknowledging that new personnel will start on site and new environments will emerge throughout the construction phase.

A range of audits must verify that good HSES practices are observed, ranging from daily observation walks to regular structured detailed inspections. Each serves a different purpose.

Motivation techniques, to promote good performance, are found in many forms and are generally understood. However, all must be applied as people all respond to different factors on different days. Similarly, recognition of good achievements and application of good practices must be directed towards individuals, groups and companies if they are to be successful.

Once the site is an HSES showpiece, do not let up – the slide towards mediocrity and worse will be swift. 'No compromise' can be the only attitude. Never walk past an unsafe act, never pass an opportunity to plan ahead. Good HSES practices are actually not rocket science, but sometimes common sense needs a helping hand.

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MARKETING

Measuring consultants' performance

The Association of Consulting Engineers has teamed up with Government, ICE, RIBA and RICS to develop key performance indicators for UK construction consultants. ACE's assistant director, Craig Beaumont, says it pays to measure up.

Clients in the construction industry are looking harder and harder for the best deal and they are getting cleverer. The days of simply seeking the cheapest consulting engineer (but with the best name) are gradually dying out as selection methods become more sophisticated in nature and longer term in scope. Welcome to the age of 'smart selection'.

Consultants themselves need to make sure that they are ahead of the game when clients select smartly. *Striving for Business Excellence*, a project led by the Association of Consulting Engineers to develop key performance indicators (KPIs) for consulting engineers, architects and surveyors, is laying the foundations for a system that will do just that – promoting firms that demonstrate the best and most consistent performance, and helping others work out where they are falling behind.

The first set of indicators have just been published and consultants across the country are grappling with them and attending seminars to see where they stand against their competitors. The initial data is not currently being used by clients for selection, but it is being used as a platform for dialogue between consultants and their potential (and, in some cases, existing) clients. The list of curious public and private sector clients attending our KPI seminars is growing longer by the day; ranging from local authorities to Sainsbury's and the Welsh Assembly.

Why the project is working

At present, the performance data is useful for consultants to test themselves internally against the industry to see how well they are doing. As soon as underper-

formance is identified, steps need to be taken to improve that performance gap. The scheme is annual, so it is simple to check 12 months later as to whether those steps have been successful—and to what degree.

There are a number of initiatives aimed at the industry, some of which are related to performance measurement and benchmarking. So, in an era of initiative fatigue what makes this project special? There are two fundamental reasons. Firstly, the project is precisely focused on improving a firm's bottom line. Many other initiatives have appeared to be nebulous and worthy, but without measurement have not met expectations.

Secondly, and unlike other initiatives, this project was born in the industry itself, not on the crowded desk of a well-meaning civil servant. Industry has bought into it. Far from being a civil service initiative focused on industry, this is an ACE-led exercise backed

by government.

Using survey data from architects, chartered surveyors and consulting engineers, plus information held at Companies House, performance of consultants was mapped across performance indicators including profitability, productivity, training and repeat business. There is also a healthy and comprehensive focus on client satisfaction, dealing with timely delivery, quality, value for money and health and safety. With the results plotted on easy-to-use graphs, firms of all sizes can quickly check out how they measure up to their competitors, and the best in the industry.

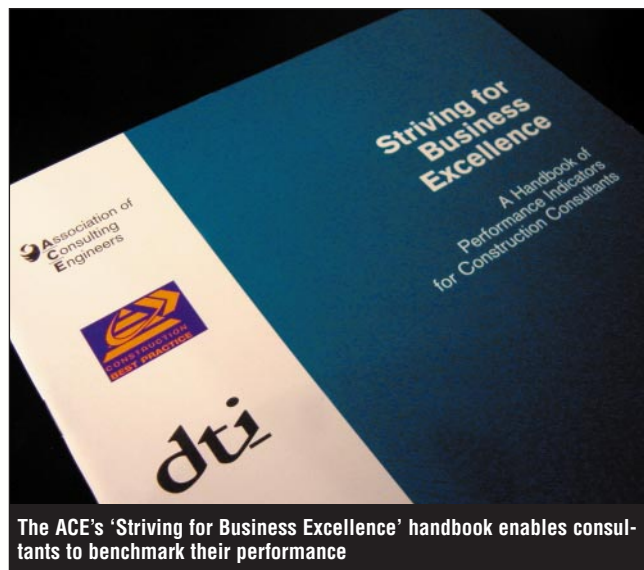
Using performance as a marketing tool

The announcement of the project results has created an attentive ripple across the industry, as consultants come to grips with the reality that performance measurement is the central driver to performance improvement. With clients also searching for consultants committed to performance improvement, those that can demonstrate that they have a definitive mechanism to benchmark themselves against others have a distinct commercial, competitive advantage.

Having set the pace, the ACE is itself using performance improvement on the project. The KPIs over the next year will be refined in a number of ways—how and when the data is collected, whether to develop an online questionnaire, how to strengthen the results' reliability further, and looking at which professions and organisations the KPIs cover. Government has pledged its full and financial backing in 2002 and the questionnaire and details are included in the present handbook.

KPIs, performance measurement and benchmarking together make up the biggest shake-up that industry has seen in some time. The original 1970s US management concept has at last been molded into an essential best practice mechanism. Leading UK businesses have been measuring themselves internally on a regular basis and over a number of criteria over time. *Striving for Business Excellence* provides a means for these firms to test and demonstrate definitively just how good they actually are. Don't get left behind!

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The ACE's 'Striving for Business Excellence' handbook enables consultants to benchmark their performance

MANAGEMENT

Teamworking is not rocket science

It has now been demonstrated that construction meetings work better when they are not dominated by a few individuals. **Jason Foley** and **Sebastian Macmillan** of Cambridge University reports on a study of meetings on the National Space Centre project, which concluded that a cultural shift to collective decision making is needed.

'What happens when people are locked together by force of circumstance in a working association into which not one with any advanced knowledge would have entered freely?'

Belbin's question illustrates very clearly the problems which new teams face when they are formed to tackle a complex construction project.

As part of a jointly funded DETR and EPSRC research project at Cambridge University, entitled 'measuring the effectiveness of interdisciplinary teamwork in construction', we set out to discover what happens in project team meetings when consultants come together during a complex construction programme.

During the year-long construction phase of the National Space Science Centre in Leicester (see page 15 for full article), we were able to monitor

four different types of meetings, with the aim of identifying interactions between the parties. Table 1 and Fig. 1 illustrate variations in team interactions across the different meeting types.

Mapping interaction patterns

The combined communication input for the three main players in the team—the contractor, architect and project management—amounted to 78%. Surprisingly, a clear pattern emerged in the form of a triangle focussing on these three team members. The triangulation of interaction in a team averaging eight consultants is surprising if only for its very defined pattern (see Fig. 2).

However, the apparent total domination of three team members suggest that purely construction issues may not be the reasons for such a defined pattern. After all, there were four different meeting types and three distinct types set

up by the team itself. Could it be the nature of the project that the team were involved with, or was it the nature of the individual parts that made up the team?

Work undertaken with our industry partners suggest that these are common findings in teamworking during the early stages of a project, as this quote from a team member indicates.

'Early in the project was when team members didn't know each other; and when respective organisations were being more protective of themselves regarding their own interests. There was, therefore more polarisation and less positive teamworking.'

Encouraging a cultural shift

So, how can we forge teamworking interactions that are based on integration and support?

The dominance of particular interests is, in part, an inevitable consequence of the information that has to be transmitted from one key party to another. However, when proceedings are dominated by a few interests and the communication pattern is too restricted (Fig. 1c), conflict in the team is more likely.

In the strategy/problem solving meeting (Fig. 1d) the communication patterns are more elaborate and rich. More players had the opportunity to contribute to ideas, suggestions and solutions. At the conclusion of this particular meeting, it was suggested by the whole team that they had performed more satisfactorily than during any other meeting type.

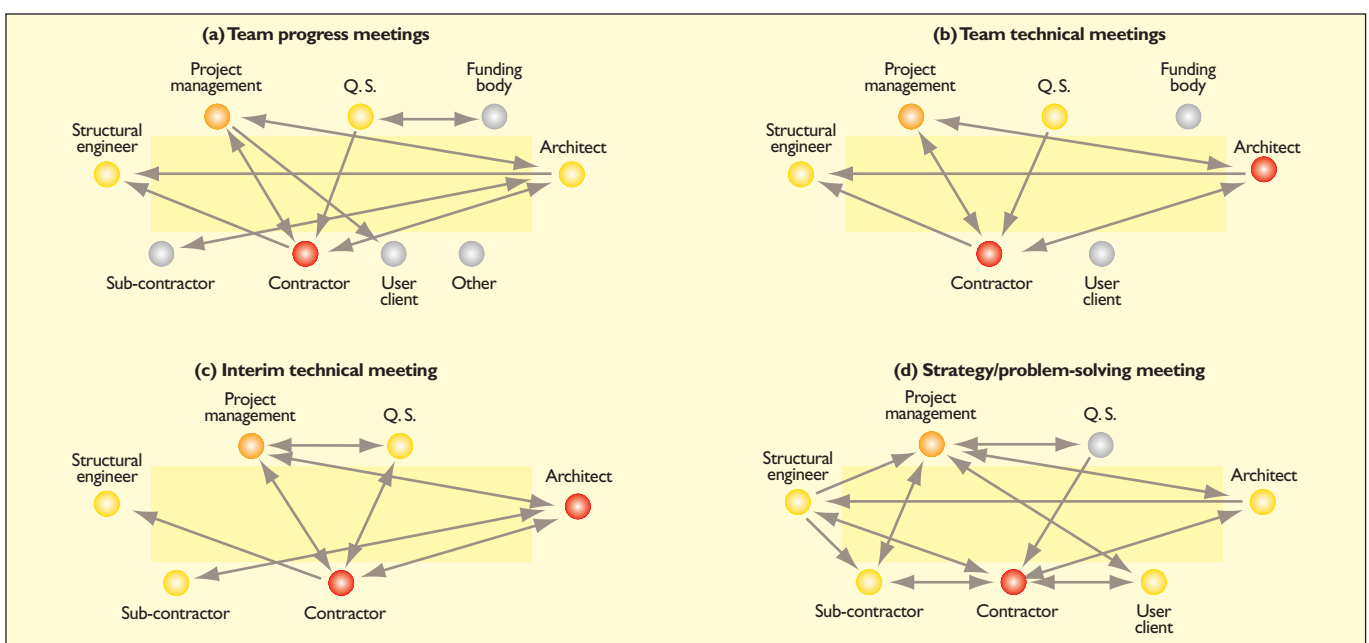


Fig. 1 Different interaction patterns between parties in each meeting type - (a) team progress, (b) team technical, (c) interim technical, (d) strategy/problem-solving

MANAGEMENT continued

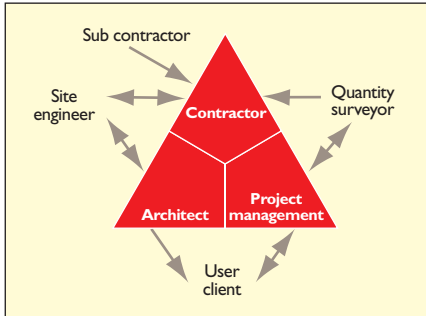


Fig. 2. The 'golden triangle' pattern, showing the core group within the team and communication interaction with other team members

Team member Discipline	Progress meetings	Technical meetings	Interim technical meetings	Strategy meetings	All meetings
Contractor	46%	37%	29%	27%	40%
Project Management	15%	14%	15%	21%	17%
Architect	16%	33%	37%	16%	21%
Structural Engineer	9%	7%	6%	18%	10%
Quantity Surveyor	8%	5%	6%	2%	6%
User Client	3%	3%	0%	9%	3%
Funding Body	1%	1%	0%	0%	1%
Sub-contractor	1%	0%	7%	7%	2%
Other	1%	0%	0%	0%	0%
Total time observed in meetings	14h 25min	2h 55min	2h 40min	4h	24h

How individuals act within a team is affected by the uncertainty surrounding individual behaviour in the context of the integrated group. If the 'project team' is to be more than a symbolic reference to a set of individuals working on the same project, then the process and success of communication rely on interaction where relationships are based on the contributions and skills of each other.

A willingness among the parties to communicate ideas and proposals across discipline boundaries needs to be acknowledged as necessary to

the whole enterprise—in short a cultural shift to collective thinking. As Nick Raynsford suggested, writing in the IUKE-Construction brochure

'The one ingredient vital to the improvement of competitiveness is the creation of networks of firms to share practices that have made them successful. By pooling the collective practice of the industry, individual companies can continuously improve their performance.'

Arising from the study, the researchers have devised a simple self-assessment tool to help teams identify whether they are pooling their resources effectively and harnessing the combined expertise of all the parties.

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EDUCATION

Civil engineers and maths the changing relationship

Mathematics has always been vital to civil engineering. However, Arup chairman Duncan Michael believes it is no longer necessary for every individual engineer to have a high level of mathematical ability to be good at their job.

Mathematics is an essential tool for civil engineering and this will always be so. Mathematics is beautiful and many engineers are brilliant inventors and users of mathematics. However, to have inverted the logic—and arranged that every would-be engineer needs a lot of mathematics as a precondition for even studying to be an engineer—was a serious error and is a greater error today.

In their work, many engineers do not need to be especially competent in mathematics. There is a significant lack of correlation between mathematical competences and engineering abilities. To survive and flourish in today's world one needs a fair level of mathematics.

We have to ask how much more mathematics

are needed to enable a person to be a successful civil engineer, beyond the mathematics that goes with general success in life.

Communication skills more important for some engineers

One has to face up to whether language skills and communication skills are in real life a higher priority for some or even many engineers. When scanning the great engineering achievements and also the dramatic failures of engineering works, one does not conclude that a key cause was either a flood or a deficiency of mathematics. Failures arise sometimes as a gap in knowledge, occasionally as illogic in procedures and most often in the area of relationships and communi-

cations. There can also be what we call human failure, deliberate or unintended, but these cases can be seen as part of the relationships class.

It is a nett weakness for engineering that mathematics had become established as the no-go gate for every individual who wants to start studying to become an engineer. We can safely be much more free and the profession, the industry and the nation would all benefit from such a change. It is not necessary today for every engineer to have a high competence in mathematics.

The young seem to have worked that out already instinctively. But the reducing school interest in mathematics is not the same as the Roman Empire failing from the inside due to the corruption of its leaders' lifestyles. It is not the end.

Older generation inhibiting change

We operate in a dramatically different knowledge context to that of our immediate predecessors, so that anyone over 50 today is unlikely to be able to break out sufficiently from their acquired beliefs and presumptions.

The power and control over university course content and over the pre-qualifications of would-be qualified engineers remain largely with the

EDUCATION continued

older generation. This inhibits a serious and free look at what matters for our future.

There is too much career success and loving achievement to be defended. How can we get the baton not to be so smoothly passed on to the newly arriving leaders, to the between-generations cohort, so that they can use their arrival to move us all on? How can we avoid choosing the ones who are highly in tune with the old thinking?

An example of changing attitudes

To illustrate how far the context has moved, here are quotations from two outstanding brains. Ove Arup in 1957 said of shell structures

‘there is the problem of calculation, for a rigorous analysis requires that the structural forms be expressed as some fairly simple mathematical function. If the functions are too complicated one has to approximate which affects safety and inhibits the realisation of the possibilities of a chosen shape.’

By 1998 Martin Manning was lecturing on lattice shells, saying

‘we have the ability to perform sophisticated structural simulations, all well and good for final justification but no one should pretend that this constitutes a design method. Our ability to analyse is now largely based on the analyst’s skill and time, rather than the ability to perform calculations’.

Arup found the supply of mathematics to be a limit on his engineering; Manning inhabits a world which takes the mathematics for granted, a commodity to be procured from whomever and not necessarily or exclusively from inside himself. Manning today is no less an excellent engineer than Arup was in his day.

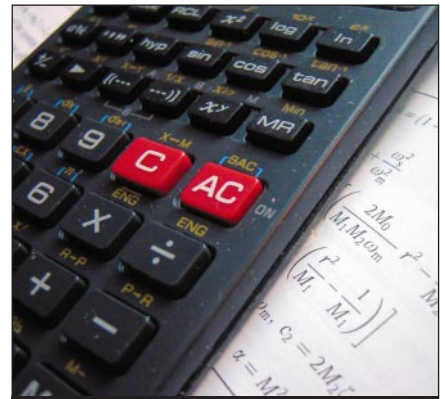
The relativity of expertise

Knowledge is for practical purposes a relative or comparative substance. To be a specialist or expert is relative to what the populace knows. As against the general public, all engineers are great experts. Within engineering, we each rely for maybe 99% of what we use on the superior knowledge of colleagues sitting physically near us or electronically near us or through books and magazines.

Expertise is as much relative to one’s colleagues as relative to the problem. In no single activity is it essential that each and every engineer is competent. We are hugely diverse and the open society, where many are accessible to most, is an essential foundation of healthy engineering.

So it is with mathematics. The holding of knowledge and skill not only need not be highly or equally held by each person; indeed it is a benefit if the knowledge and skill holding is highly differentiated as amongst engineers. Mathematics is a language that engineers use to think and to communicate with each other, but it is not our only available language. We have words and images also.

There is no useful upper bound to the mathematics that we could know, use and



A high level of mathematical ability should no longer be a pre-requisite for becoming a civil engineer

enjoy. Then it seems that the current quantity of mathematics held to be essential cannot be a natural or absolute or demonstrable matter. It is just what we have previously agreed upon. Our next review and agreement on the essential mathematics to be held by every engineer could easily reach a big reduction in the demanded mathematics for and from each separate engineer. This could possibly be associated also with a welcome for individuals with a vastly greater mathematical fluency but less of other skills.

Electronic computation reduces errors

Electronic computation has hugely changed our mathematical landscape. The facilities are so clever, available, reliable and cheap as to be irresistible or, as we are coming to describe them, essential. For practical purposes much of the material is black box, but this is not as dangerous as it might seem. The overall error rates in engineering work have reduced from when mathematics was purely a manual activity, and probably the risks also.

The distribution of errors has changed as well as the amount. We should feel great freedom and empowerment in this new mathematical world. However we seem to spend a lot of effort regretting the loss of the old world, though even that memory is a selective one. We are through the entrance to a new state and we can settle into exploiting, sharing and enjoying it if we drop some more of the customs and certainties from our pasts.

To the angry reader I say do not be angry—the anger hurts you not me. Try to build a superior alternative view for our future and publish it. If I turn out to be more wrong than right I will be delighted and we will all be the beneficiaries.

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MATERIALS

Concrete for the third millennium

A new type of concrete has been developed in France which combines the benefits of very high performance, fibre-reinforcement and self-compaction. Rob Williams of the French Technology Press Bureau introduces the new material.

High performance concretes first appeared in the early 1970s but have been slow to catch on. The benefits of reduced materials and increased durability have not really compensated for the extra time for preparing the precise mixes as well as lingering doubts over fire performance.

On the other hand, the tremendous growth in self-compacting concrete over the past five years shows that what the construction industry really wants is materials that can offer time savings and improved aesthetic qualities.

A new concrete called BSI has been developed by the Eiffage group in France to offer the benefits of high performance and self-compaction in addition to increased ductility from fibre-reinforcement. The material was originally developed to meet the requirements of Électricité de France, and was first used in 1997 to renovate four cooling towers at the nuclear power station at Cattenom.

Similar ductility to steel

BSI has a compression strength of up to 150 MPa and, thanks to its fibre reinforcement, a tensile strength up to 10 MPa. It has a ductile performance approaching that of steel, which—in addition to eliminating the need for passive reinforcement—allows the possibility of using pre-stressing by adhesive reinforcement.

In December 2000 the material successfully passed a full fire test. The ISO test, which took place in laboratories of the University of Ghent in Belgium, demonstrated full resistance for 90 minutes to temperatures greater than 1000°C. Low porosity concrete of this nature tends to split in high temperatures as moisture is unable to escape. However, by using polypropylene fibres which melt at 150°C, a network of capillary voids is formed to allow steam to vent safely.

Following a performance assessment, BSI has now been adopted by the French Ministry of

Transport and its Roads Department for construction of two raised sections of motorway close to the city of Valence in the Drôme region. The results of this project will make it possible to validate the cost-benefits of the material as well as help to refine design codes.

Glass finish is possible

Other possibilities for increased use of BSI could stem from its creative potential. Its self-compacting properties and mechanical performance allow prefabrication of large but lightweight façade panels that compete directly with stone facing. Such panels can be up to 10–20 m² in area but just 15–30 mm thick.

Regarding surface treatment, Eiffage is exploring the possibilities offered by various types of formwork—such as PVC, wood, aluminium—as the high fluidity of the mix allows faithful rendition of the slightest relief. Casting tests performed with glass plates have, for example, made it possible to obtain true glazing in concrete, while placing sheets of crumpled paper in the bottom of the formwork produces surprising and novel facing.

In summary, BSI appears to represent an opportunity for complete architectural freedom that could also open up the design of elements of street furniture. It is a concrete for the third millennium that can consign to the past all the connotations of dreariness and ugliness that are so often associated with this material.

For further information, please contact Rob Williams 020 7235 5330 or rob.williams.ftpb@cfme-actim.com.



BSI concrete beams are being trialled by the French Government on new motorway bridges near Valence



The fibre-reinforced material has a compressive strength of up to 150 MPa and tensile strength of 10 MPa

Global collaboration needs better software

A recent study of major civil engineering design firms in the US and Europe reveals a massive growth in cross-company and cross-border working. Jim Paton of Infrasoft reports on the findings and concludes there is a real need for better collaborative IT systems.

As an international supplier of civil engineering design software, we wanted to get a better understanding of how the profession is changing in the light of increasing globalisation. In August last year we commissioned a survey of nearly 150 of the larger civil engineering design firms in Europe and the US.

The survey covered 77 chief executive officers, 82 IT directors and 91 project managers in 142 organisations with over 50 design engineers. In Europe, 27% of respondents were from organisations with over 1000 design engineers and 25% were from organisations with between 121 and 500.

The distributed nature of projects and engineers was a common theme throughout

the research findings: 44% of the European respondents had design engineers located at multiple sites in different countries; 42 were operating in more than seven countries and 62% had more than seven sites operating in their own country. This contrasts with the US, where only 15% operated outside the country, with a similar 63% with more than seven sites in the home country.

Sharing information—the big problem

Nearly every organisation questioned was involved in partnering agreements with other companies—88% of European respondents said they partnered with other companies. In

Europe, 46% of projects actually involved more than six partners (compared with only 28% in the US).

We quickly built up a picture of the way the industry operates today—large numbers of engineers in many different locations and countries working together on complex engineering projects including design, build and operate and public/private partnerships. Clearly the one big challenge they all face is sharing information and drawings—more than 50% of those we asked said this was the biggest problem they face.

Improved communications and sharing of information are perceived to be vital to the goal of managing projects profitably with 61% of chief executive officers interviewed stating that the ability to work collaboratively is vital to winning new business. While US companies are looking to expand their geographical reach to gain business success, European companies are more interested in working with partners and utilising information technology to improve communications and reduce costs.

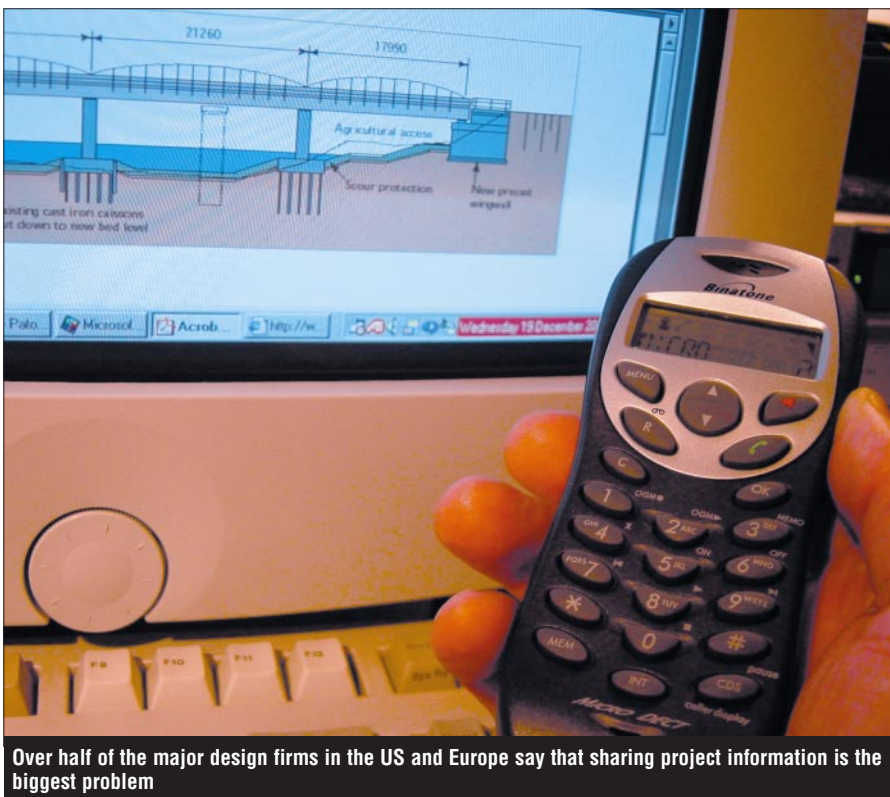
Fewer designers and better communication

The survey shows that in Europe, improving project communication is ranked just behind using fewer design engineers as the most important influence on project profitability. Eliminating re-design and reduced design time are also important.

The trend towards collaboration looks likely to accelerate. When asked how they think their companies will evolve in the future, 78% of all respondents predicted an increase in the occurrence of engineers working together across multiple sites and 75% saw an increase in partnering agreements with other companies. According to the European chief executive officers who responded, over 80% saw growing their global presence as key to ensuring the future success of their organisations.

With the survey results clearly pointing to massive growth in collaborative, cross-company and cross-border working, it is obviously encouraging from the IT sector's point of view that 54% of European respondents are looking to IT to improve communication and to help reduce costs. The challenge is now for IT suppliers to develop and deliver new collaboration technology that gives the industry the greater flexibility and faster sharing of engineering project designs and information they really need.

For more information please contact Jim Paton on 01403 259511 or jim.paton@infrasoft-civil.com.



Over half of the major design firms in the US and Europe say that sharing project information is the biggest problem

ENVIRONMENT

New approaches to recycling organic waste

Organic waste from a variety of sources including supermarket produce waste looks set to become a valuable resource in the future. Ben Purcell of WS Atkins reports on a pilot study that demonstrates the potential economic and environmental benefits of co-digesting organic matter with sewage sludge.

By the year 2020, the management of household, commercial and industrial wastes is likely to be considerably different from today's waste management operations. Waste minimisation schemes will be stabilising waste generation and greater proportions of organic wastes will be recycled for beneficial use by technologies such as in-vessel composting and anaerobic digestion.

In addition, the continued development of energy-from-waste plants will raise energy recovery from household wastes and landfill will have become increasingly more engineered, providing both treatment and disposal for a number of waste streams.

Six month trial proves benefits of co-digestion

WS Atkins Research and Development has been involved in investigating the potential process benefits of co-digesting supermarket wastes with sewage sludge in a six month laboratory-scale project. The project was funded by landfill tax credits from Waste Recycling Group plc managed by Waste Recycling Environmental.

A total of eight reactors were operated through the project and comprised four control reactors and four co-digestion reactors. All eight digesters were contained in a water bath maintained at 35°C using a heat pump with a 20-day hydraulic retention time.

The control cells were fed with primary sludge from Yorkshire Water's Mitchell Laithes wastewater treatment works. The co-digestion cells were fed with a combination of supermarket organic wastes and primary sludge. Supermarket wastes were collected weekly from a local Asda supermarket and homogenised prior to feeding and blended with primary sludge to achieve the design organic loading rates.

Solids destruction rate doubled

The co-digestion cells were found to maintain considerably higher rates of organic matter destruction when compared to the control cells (Fig. 1).

Average total solids destruction rates were

27.7% for the control reactors and 53.7% for the co-digestion cells. This substantial increase is related to higher organic loading rates and a more degradable feed stock. Volatile solids destruction rates for the control reactors averaged 37% and 63% for the co-digestion cells.

Gas composition for the co-digestion reactors was typically 60-65% CH₄ and 35% CO₂. The average biogas generation and methane production rates from the control and co-digestion cells are presented in Fig. 2. The results show that the specific biogas generation rates (m³ biogas / kg volatile solids added) were 70% greater in the co-digestion cells than the control cells.

In terms of specific methane generation, the co-digestion cells produced 50% more methane per kg of volatile solids added than the control cells, which indicates the highly digestible nature of the supermarket produce wastes.

Full scale trial likely to show further benefits

The results from the experimental trials indicate the potential of co-digestion for increasing organic waste recycling and recovery of energy through biogas utilisation. A full-scale trial to treat supermarket produce waste and sewage sludge has now been developed with Waste Recycling Group, Yorkshire Water and Asda. These trials are expected to start Spring 2002 and will evaluate process performance at full-scale and investigate new waste handling techniques for organic waste.

At full-scale, it is anticipated that further improvements in digester performance will be achieved through higher feeding frequency (to reduce the peaks in biogas generation) and greater operational control and buffering capacity. The aim of the proposed full-scale trials is to evaluate

the effectiveness of this system for providing a more sustainable waste-treatment technology for the recycling and energy recovery from high-moisture-content organic wastes.

In the UK, the development of combined anaerobic digestion with sanitisation for organic wastes from commercial and industrial sources is an exciting opportunity to raise the level of organic waste recycling with energy recovery.

For further information please contact Ben Purcell on +44 (0)1572 726140 or beurcell@lineone.net

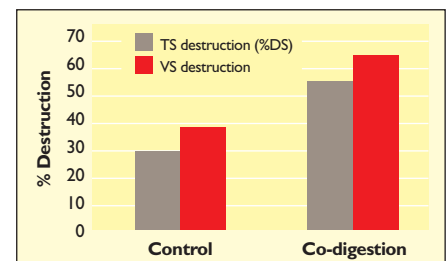


Fig. 1. Total solids (TS) and volatile solids (VS) destruction rates are more than doubled in the trial co-digestion reactors

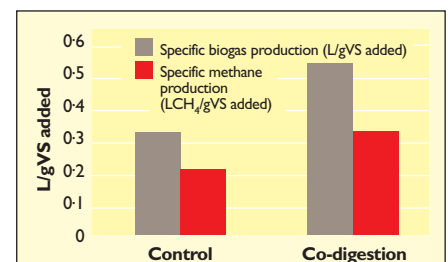


Fig. 2. Biogas and methane (CH₄) production is also nearly doubled in the trial co-digestion reactors



Supermarket waste can significantly improve the financial and environmental aspects of sewage treatment

PROFESSION

Civil engineering graduates are just the job

A new report on graduate employment reveals that civil engineering graduates ride high in employability stakes but the sector is losing ground to 'new' industries. Mike Hill of the Higher Education Careers Services Unit explains.

Civil engineering graduates are hot property and are achieving amongst the highest employability rates of all graduates. According to *What Do Graduates Do? 2002*,¹ which examined the final destinations of the 2000 UK graduate cohort, nine out of ten employed civil engineering graduates secured professional jobs within six months of graduation.

The report reveals that 80.9% of civil engineering graduates found work within six months of graduation, second only to the employment rates achieved by accountancy graduates at this stage. And of these employed civil engineering graduates, 89.8% achieved jobs of professional status, that is a job requiring a degree or equivalent academic qualification.

Nearly two thirds remain in engineering

Further, 63.9% found employment as engineering professionals – comprising structural, municipal, mining and quarrying engineers (54.7%); design and development engineers (3.7%) and mechanical engineers (1.4%).

A further 9.8% were employed as commercial, industrial and public sector managers while 7.9% used their degree to work in other professional, associate professional and technical occupations and 2.5% secured jobs in IT.

A small proportion, around one in ten civil engineering graduates, embarked on further

education or training. This includes graduates who are now studying for an MBA; a PhD in coastal engineering; or an MSc in a variety of subjects including civil and environmental engineering, structural engineering, transport, civil & earthquake engineering, computing, advanced concrete studies, concrete structures and business & management.

Just 3% of civil engineering graduates are believed to be unemployed – compared to the overall graduate average of 5.5%.

Number of graduates down by a third

Clearly civil engineering offers attractive and immediate career opportunities for graduates; not only are the vast majority finding professional employment in their chosen profession but they are doing it quickly following graduation.

However, although still a popular choice, the number of students graduating in civil engineering has dropped by a third over the past five years to 1,602. By comparison, electrical engineering is down 13% and building down 29%.

In addition the report includes details of average salaries offered to graduates. According to *Prospects Today*, which is published by the Careers Services Unit, in the year to May 2001 the average salary for graduates from 'any engineering' subject was £18,309,

above the £17,786 average for all subjects.

Overall the employment picture across all subjects showed that 68.4% of graduates found work within six months of graduation. Although the employment rate has stabilised, more graduates have secured professional jobs this year with 68% of employed graduates now in professional positions, a 2% increase on last year.

Employment levels now at a peak

Generally speaking, the graduate employment market has never looked healthier but it is hard to envisage unemployment rates falling any lower than the current 5.5%. Current predictions suggest that graduate employment has now peaked and students should beware of complacency. Even for subjects like civil engineering and building, where the unemployment rate is below average, it is likely that this time next year a graduate job will not be a foregone conclusion.

Overall, 56% of the graduating cohort were women. This has grown from 53% five years ago. As before, there are stark differences in the gender balance between subjects. IT, science and particularly engineering subjects were dominated by men – less than 8% of electrical and electronic engineering graduates, 9% of mechanical engineers and 15% of civil engineers were women. Women were more concentrated in arts and social sciences such as psychology, sociology, modern languages, and English.

Whatever the subject, vocational or traditional, a degree is still a worthwhile investment. Recent graduates aged between twenty and 24 earn on average 25% more than their age peers with A-level or equivalent qualifications and just 21% of graduates aged 25–29 are in non-professional occupations.

The report tracked the career destinations of first degree and HND graduates and examines the employment market by occupation and academic qualification. Data was gathered through the annual first destination survey comprising information compiled by careers advisers on 170,751 graduates, representing 81% of the total (UK domiciled) graduating force of 210,943 in 2000.

For further information please contact Mike Hill at the Higher Education Careers Services Unit c/o Pat Hindley, Twelve Consultancy, tel +44 (0)20 8879 1234 / 07770 500 194, email pat@twelvepr.co.uk

Reference

1. *What Do Graduates Do? 2002*, published by the Higher Education Careers Services Unit, the Association of Graduate Careers Advisory Services and the Universities and Colleges Admissions Service, 2002
see www.prospects.cc.uk/wdgd



Over 80% of civil engineering graduates got jobs within 6 months