Proceedings of the Institution of Civil Engineers
Engineering Sustainability 160
June 2007 Issue ES2
Pages 55–56
doi: 10.1680/ensu.2007.160.2.55

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Editorial

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ICE journals: what are they for? Reporting on best practice, showcasing recent projects and providing a forum for vibrant discussion of research of subjects still in development, where we still have much to know and learn. *Géotechnique* is probably the exemplar of the latter. In some engineering areas there is little research left to be done – linear control theory is an example – as the problem is solved.

Civil engineering is very much a practice-based activity – operating uniquely at the interface between engineering science, society and the global environment. Civil engineering is essentially about delivering sustainable urban and natural environments, for the worldwide common good. Knowledge transfer, sharing best practice, is vital to advancing this goal. ICE's journals (13 titles in the Proceedings suite with three more publishing from 2008, plus *Géotechnique*) fulfil this role admirably. *Engineering Sustainability* has a special role to play in this sphere.

Sustainable development is a curious beast – is it a discipline or a philosophy? Or just an application of systems science and theory? Or is it more than this: an amalgam of theory, practice and ethics informed by its crucial dimension of context?

The fact that we are still asking these questions, and still struggling to apply tentative answers, puts *Engineering Sustainability* firmly in the category providing that crucial forum of providing an outlet for research in a subject not yet fully defined; and application – seeking to put tentative approaches into practice.

The set of papers in this issue is the first part of a set of papers which in their various ways look at project assessment. They are very different but are a valuable contribution to seeking a convergent solution to sustainable development in the context of civil engineering. It might be a chimera – maybe there is not a unique solution. For sure, sustainable development is not like elasticity theory!

Sustainable development is essentially about making decisions. On the one hand, decision making is very simple, and on the other very complex. A simple example? 'I prefer this to that.' In these situations we don't need a cardinal scale, an ordinal one will do. Unfortunately it gets trickier when uncertainty is involved – uncertainty to do with natural risk, the actions of others, or uncertainties of outcome. It is even trickier when there are several stakeholders involved in arriving at a decision, and where the decision to be made needs to take into account several (conflicting) criteria. It is a complex problem.

Complexity? This involves 'richness of structure' – which is not the same as richness of detail. Complication? Finite elements are complicated. Sustainable development is complex! It is difficult . . .

If sustainable development is about making decisions, and if civil engineering is to contribute to that process, engineers have to demonstrate not only their practical application to this activity but also to base it on sound principles. Decision making is not a theory free zone. It has its roots in the classical Greco-Roman empires and in the Enlightenment. It was the subject of a classical paper by Bernoulli, on 'the St Petersburg paradox', and it was the subject of some definitive work by von Neumann and Morgernstern, *Theory of Games and Economic Behavior*,[1] which set down the basis of rational decision making. (John von Neumann was not only the originator of game theory, but also a key player in the development of the atomic bomb.)

But what von Neumann and Morgenstern failed to do was address how one dealt with decision problems in which there were several decision making criteria (synergistic or antagonistic) or where there were several decision makers/stakeholders. The simplistic solution is to weight – by some arbitrary process – the various criteria, and then score each decision option under each criterion, add them up and announce a decision. Such an approach has limited theoretical foundation. There is a danger in this – and engineers are susceptible to it – we like numbers! But important decisions are not always made this way. They require judgement. Based on numbers, yes, but also based on the ability to synthesise them into values, judgement and a decision.

So, it is opportune for *Engineering Sustainability* to provide a set of papers – this issue is the first of two - which addresses the problems associated with project assessment in which the decision criteria are complex, the outcomes multi-attributed, and where the decision involves diverse stakeholders.

We need to develop decision-making frameworks for sustainable development, and it is a natural starting point to base these on summative methods as the foundation for a holistic decision. The four papers in this issue explore these issues.

The first paper by Jefferson *et al*. explores a set of sustainability indicators for environmental geotechnics. As alluded to earlier, geotechnics is a technical discipline still very much in development but its role in helping to deliver sustainable outcomes is vital. As a first step, the authors outline a set of 76 generic and 32 technology-specific indicators to assess the sustainability of specific techniques for treating contaminated land. With time, and after application in practice, the indicators will no doubt be refined (and probably reduced in number!). But this is a very useful starting point.

The paper by Rogers *et al*. outlines the issues of strategic environmental assessment (SEA) for wind farms, drawing upon experience in the Republic of Ireland and comparisons with Germany and Spain. The paper explores the dilemma of resolving site-specific criteria within a more generic SEA process.

The third paper by Kain *et al*. looks at multi-criteria decision-making aids for sustainable water management, evaluating three multi-criteria decision aid models from a process facilitation perspective. The paper looks at the degree to which these models include, encourage and make explicit, stakeholder engagement without the need to rank on the basis of complex mathematical calculations.

The final paper by Braithwaite is based on a case study, describing how company performance — and year-on-year improvement — can be assessed though a sustainability assessment. The methodology uses a 4-dimensional assessment framework.

These papers show precisely why engineering for sustainable development is still very much about work in progress, and why it is vital to continue the dialogue through this journal. The papers range from exploratory enquiry and reflective practice to practical application.

I hope they inform and stimulate your thinking as they have mine.

REFERENCE

1. VON NEUMANN J. and MORGENSTERN O. *Theory of Games and Economic Behavior*. Princeton University Press, Princeton, NJ, 1944.