Civil Engineering Procedure

Eighth edition

Institution of Civil Engineers

Foreword

In the canon of classic civil engineering textbooks, there are few that enjoy the privilege of multiple editions. That this textbook has now reached its eighth is a huge tribute to the successive drafting committees since that first edition in 1963. Granted, there were 26 editions of Rankine's *Manual of Civil Engineering* to humble that claim, but that began its journey in 1862, not 1963.

I have kept the second edition of *Civil Engineering Procedure* since my undergraduate years at Edinburgh – a (large) pocket-sized handbook that was a welcome relief from theory and gave a glimpse of real-world practice to naive aspiring engineers. Its full value was to be realised later when it helped navigate the early encounters with contract documents and construction management.

The eighth edition would be scarcely recognisable to the engineers of the 1960s and 1970s. In upholding the principles of that first edition – 'to describe the established organisation and methods of working in the industry' – the successive editions of this guide have reflected the evolving status of what is considered to be 'established' civil engineering procedure.

Intervals between successive editions have steadily reduced since 1996 and the pace of changing practice is unlikely to slow down, the natural consequence of a vibrant profession. This latest edition brings the series firmly up to date.

The need for clear, straightforward explanations of project and contract management principles and practice is all the more important as options for commercial and project delivery models become increasingly sophisticated. But underneath what may appear to be a highly complex set of contractual conditions and incentives lie the fundamental principles described in this book. The engineer of today can rely on these principles for the knowledge and understanding to nurture deeper and stronger professional expertise, just as engineers benefitted from the earlier editions in, arguably, a simpler landscape.

The need for skilled professionals in this field will not diminish. When I returned to the University of Edinburgh (Rankine's alma mater) after a career in major programmes, I was pleased to seed the idea of a new MSc course in Leading Major Programmes. This developed in far more capable hands into a suite of multidisciplinary modules covering the very broad range of skills and personal qualities required for the successful delivery of the most complex megaprojects in any sector – engineering, IT, healthcare, government enterprises, etc. This book will be required reading to introduce civil engineering procedures to students of all backgrounds.

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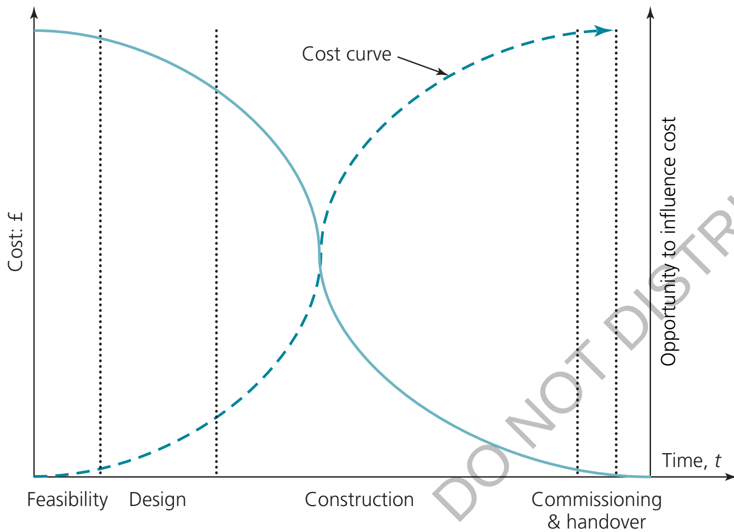
Figure 1.2 Project cost versus opportunity to influence cost



behaviour. A range of financial, socio-economic, environmental and other evaluation methods are used at this stage to assist the decision-making process. Discounted cash flow or social cost–benefit techniques are often used, usually expressed in terms of net present value (NPV), as these enable comparison of various options, taking into account costs and benefits, using discount rates to reflect the timing during a project's economic life when particular costs and benefits arise.

Quantifying the benefits is particularly difficult in cases where a capital project will not generate a revenue stream; for instance, a project to reduce accidents at a junction on a road. In the UK, rules set out to guide the appraisal of such projects are described in *The Green Book* (HM Treasury, 2018). Nevertheless, a specification, budget and programme are normally decided, together with contingency, schedule and sources of funding. As the decisions made at this stage define the scope and standards of the project, they form the basis of all that is to follow.

Project selection

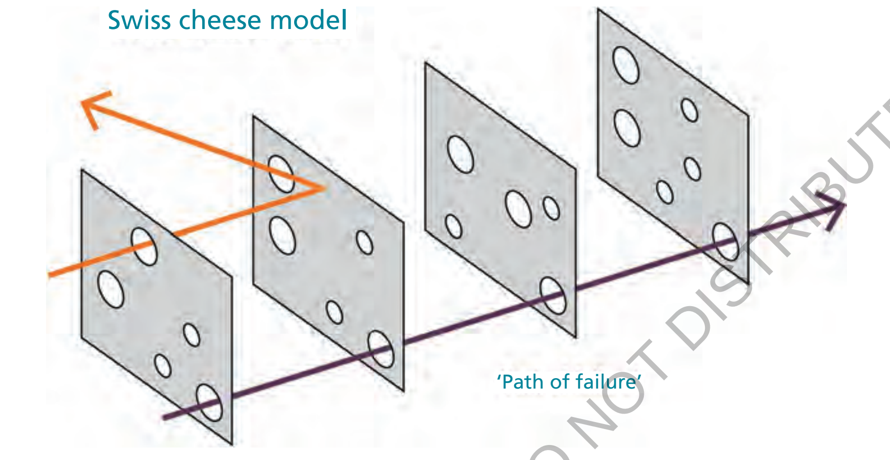
The investigations and feasibility studies of a proposed project may take some considerable time. This may be for engineering complexity or planning and legal issues, as well as environmental impact concerns. The conclusion will either be selection or rejection of the proposed project. This decision effectively determines the project's future. Sufficient time and resources should therefore be used to ensure that the decision is sound and

Figure 2.1 The asymmetrical network arch bridge over the River Irwell, Ordsall, Salford

> *The new viaduct's landmark structure, the River Irwell Crossing, is the first network arch bridge in the UK and the first asymmetric network arch bridge in the world. All structures were designed completely in 3D. For the River Irwell Footbridge, which runs below the Ordsall Chord's network arch bridge, the design was delivered as a 3D computer model without conventional design drawings. This saved 15% off the cost, and 20% on the programme.*
>
> (Mott MacDonald, 2020)

To deliver the Ordsall Chord project, an alliance was formed (known as The Northern Hub Alliance), consisting of the infrastructure owner Network Rail, Siemens, AmeySersa Joint Venture (JV), Skanska BAM JV and steel fabricator Severfield. This alliance enabled early contractor involvement (ECI), which was deemed essential during the design stage, given the challenges of civil engineering works taking place on an operational railway and over watercourses. The ECI approach was particularly critical in ensuring greater certainty of programme delivery.

Figure 4.2 The 'Swiss cheese' model



system is perfect, after all – but if no holes align after that, the risk of failure falls to zero. A clear pathway needs to open through aligned holes in every line of defence for a catastrophic failure to occur.

Following the Grenfell Tower fire, Professor Peter Hansford, University College London, led a review to consider whether we fully understand the potential vulnerabilities in our economic infrastructure. The ICE panel used the Swiss cheese model to consider the systemic nature of risk to infrastructure, with individual lines of defence grouped under the headings of 'knowing', 'applying' and 'ensuring'.

'Knowing' covers three lines of defence: knowledge of the asset's condition, including the availability of high-quality data; knowledge gleaned via learning from previous failures; and the rigour of the regime used by professional engineers for their continuous learning – that is, their continuing professional development (CPD).

'Applying' concerns the processes used. These consist of five lines of defence: standards and regulations; attention to quality in both the design and construction phases; the deployment of suitably qualified and experienced persons (SQEP); adherence of individuals and corporate bodies to professional institutions' codes of professional conduct; and the accountability and responsibilities of asset-owning organisations.

'Ensuring' focuses on the processes put in place to guarantee application of knowledge. This covers five lines of defence: governance processes and corporate decision-making;