

The first article in this series examined a number of current issues where engineers might consider direct action in response to perceived ethical duties to give warnings of preventable disaster. This article examines further the nature of the ethical principles with which engineers must be concerned. It then looks at circumstances in which ethical issues may arise. The instances considered involve generally acts or omissions by engineers which affect the public at large or individuals who do not have any clear legal remedy. The relationships between legal and ethical duties is discussed and questions identified which will need to be considered by bodies charged with establishing ethical standards.

Ethics defined

The first article noted that the subject lacks both definition and scope. It is now appropriate to consider both of these issues. As to definition, it may be noted that the concept of engineering ethics includes, on one view, broad considerations of 'social conscience'.¹ Proponents of such an interpretation would readily accept that it necessarily merges into the fields of sociology, philosophy and politics, which subjects form the background to much current writing.² The wide interpretation draws on general philosophy, particularly the works of Hume and Bentham, and forms a branch of what is currently termed 'applied ethics'.³ Without seeking to diminish the importance of the wider field of ethics, principles which depend on the judgment of philosophers are likely to be of limited use to engineers. It is suggested that the definition adopted must be of narrower compass and should be tied to the objectives set out in the published codes of conduct of the engineering institutions. These set out, in detailed and considered form, the actions which those institutions consider appropriate for their members in dealing

Engineering ethics

Principles and cases

with ethical questions which confront them in their professional practice. The subject might be called 'professional ethics' and may be seen as defining the principles that underlie the concept of good professional practice in engineering.

Engineering ethics in the United Kingdom has not developed to the extent seen in other countries⁴ and, while there is no clear model to be emulated, there are lessons to be learned from experience elsewhere. Developments in the United Kingdom, with its prominent but diverse institutional structure, may be expected to follow, to some extent, development which has already occurred in medical ethics,⁵ which has as its source decisions of the medical disciplinary bodies as well as the Courts. What seems clear, is that any expansion of engineering ethics here will be dependent on attitudes and actions of the engineering institutions. Given that the institutions are the source of professional ethics, there can be no

practical utility in an ethical duty unless it is one that the institution responsible would be prepared to recognise and enforce by appropriate action. The consequences of this will be considered in the third article in this series, but it

This is the second of a series of three articles in *Ingenia*.

The first article (in issue 13) looked at the issues involved when individual engineers seek to warn the public about potential and often preventable disasters. Other means of securing disclosure, such as confidential reporting systems and *amicus curae* action by institutions were examined.

The third article will consider the position of the institutions who promulgate, and are assumed to review and enforce, codes of professional conduct intended to regulate the actions of their members.

needs to be emphasised that the ethical standards of any profession are for the members of that profession to establish, preferably without intervention of the Courts or other outside influence.

It should be clear that the definition suggested does not encompass, for example, the 'ethics' of nuclear power compared to renewable energy sources. Those emotive subjects do, of course, raise moral ethical issues for engineers as informed members of the public. In the terms of this article, ethical duties in such a situation would oblige engineers who become involved in the debate to present the full and unadorned technical facts, and to refrain from presenting biased technical data to support a point of view. The same should apply to the engineering institutions: it is not their function to pursue any 'policy' on moral or political issues, but to ensure that information given to the public is accurate and balanced. Such is the clear duty of any expert in any profession. This issue is considered later in this article.

Scope of ethics

The scope covers the questions of where duties are owed and in what circumstances they arise. A survey of the institutional codes of conduct indicates that, in addition to the primary obligation owed to the client, they cover ethical issues in terms of wider duties primarily concerned with the public interest. The codes speak of a duty to 'safeguard'⁶ or to 'have full regard for'⁷ the public interest. Many of the specific duties set out in the codes concern matters of health and safety and the environment, although other specific duties are mentioned.⁸ An important consideration is the relationship between ethical duties and recognised legal duties. This involves both areas in which ethical and legal duties may be seen as overlapping; and other areas in which legal duties are clearly of limited extent, as compared to wider ethical duties. It seems clear that the existence of a legal duty, *a fortiori*, one created by

there would seem ... no reason to limit ethical duties to areas covered by the law

statute, does not affect the existence of a related ethical duty, although the question of parallel remedies may arise.

As regards overlapping duties, taking health and safety as one important example, there exists a very extensive network of legislation which places heavy duties on those in a position of control. The duties are owed by statute and apply generally in relation to any members of the public who may be affected.⁹ Ethical duties in relation to health and safety are not necessarily co-extensive with legal duties, nor is any breach necessarily to be judged by the same standard. There will be cases where legal liability is found to exist but which should not be regarded as involving breach of any ethical standard. This is plainly so given the absolute nature of many of the duties under health and safety law. The converse must also apply, in that the absence of legal liability (or allegation of liability) will not absolve the individual from consideration of his conduct against professional ethical standards. The same points could be made in relation to environmental issues. The important point that emerges is that ethical or professional standards bodies must not take the comfortable position of allowing the Courts to determine questions of professional ethics, which will rarely coincide with legal duties. The question of what action is appropriate by the institutions where legal proceedings are brought, or where civil or criminal liability is found, will be considered in the third article.

What is the scope of ethical duties in areas that are not covered by existing legislation or legal duties? Where there is a known lacuna in health and safety or environment law, is it to be expected that engineers must continue to have regard to the interests of persons

affected? An example of such a lacuna under earlier law would be the need to ensure that a design could be safely constructed without endangering the workforce or the general public. The former at least is now specifically covered by the Construction (Design & Management) Regulations 1994 and the scope of such an ethical duty may therefore be reduced. It would be for the profession to form its judgment, but there would seem, in the example, no reason to limit ethical duties to areas covered by the law.

A different aspect of the gap between legal and ethical duties concerns the engineer's duty to act with reasonable skill and care. Such a duty is axiomatic in relation to the immediate client, but how is the duty to be extended to cover the public at large? It is easy to envisage circumstances in which engineering projects and the actions of engineers may be seen as adversely affecting the public interest. Indeed, the bulk of engineering activities involves on one hand detriment to the existing order, in the cause of creating new works or services ultimately intended to benefit the public, via the interests of the immediate promoter. The engineer cannot be unaware of the balances that must be drawn between short-term and long-term interests, between the interests of promoters and the wider community, and between the interests of potentially opposed groups. Is there a point at which the engineer, in such circumstances, is to be regarded as having breached his ethical duty in regard to the public interest? It is not my purpose to suggest an answer, which is ultimately for the profession itself to resolve, but it seems clear that such questions should arise in the course of determining the scope of engineering ethics. To illustrate these and other

questions, this article now proceeds to discuss more specific circumstances in which ethical issues may arise, and to suggest the nature of some of the issues that will need to be considered.

Engineering in practice

Ethical principles should influence much of the day-to-day functions and activities of engineers, as is the case in many professions. Much of the engineer's work in practice involves devising and implementing solutions to technical or managerial problems where ethical considerations may dictate, at least, the maintenance of proper standards of design and performance generally.¹⁰ Such duties are likely to align closely with legal duties owed to an employer or client, and the enforcement of ethical standards may become appropriate only in serious cases, for example, where legal sanctions are considered to be inadequate. Most professions operate procedures for striking off or lesser sanctions in cases of gross professional misconduct.

More controversial is the application of ethical principles which create potential conflict between the commercial interests of the employer or client and the interest of others. Particular circumstances in which 'others' may be identified bodies or individuals are considered below. Of even greater interest are situations in which an ethical duty may be owed to the community at large. Such a duty must encompass, for example, the actions of engineers responsible for technical aspects of safety which have been found wanting as a result of an accident or disaster, where inquiries

have revealed prior knowledge of serious shortcomings. Rail accidents and chemical and oil industry disasters probably represent the most thoroughly researched instances, where criminal proceedings may be brought against those alleged to be legally culpable. The complexity of the factual issues involved should not preclude further investigation as to whether individual engineers, irrespective of any criminal proceedings, have failed to comply with their ethical duties to the public.

The appointed engineer

In many forms of engineering construction contract, a named engineer is appointed with extensive powers as to acceptance of the contractor's work, giving directions to the contractor and determining issues which arise under the contract.¹¹ The engineer so appointed will be required to quantify sums due to the contractor and to decide upon claims for extensions of time, which will determine payments due to or from the contractor. In some matters the engineer is the agent of the employer and must act in his best interest. In deciding matters arising under the contract, including disputes, the engineer has a duty recognised by the law to 'act in a fair and unbiased manner ... holding the balance between his client and the contractor'.¹²

Cases in which engineers have abused or misinterpreted their role provide precedents for legal remedy.¹³ Ethical issues arise wherever the role is abused, and particularly where there is no available legal remedy. A recurrent problem arises where a decision by the

engineer in favour of the contractor would imply fault on the engineer's part, for example, for having failed to discover unforeseen ground conditions. How should the engineer act in such circumstances, and can he continue to discharge other functions under the contract?

While engineers have, over many decades, performed this difficult role honourably, there has been an increasing note of discontent expressed by contractors who have considered that engineers and certifiers generally lacked the necessary independence. In England and Wales, now followed by Scotland and Northern Ireland, the Construction Act¹⁴ has now effectively removed the engineer's power to bind, substituting a right to statutory adjudication in relation to 'any dispute' at any time. However, there remain many categories of engineering work that are excluded from the Act¹⁵ and contracts performed abroad are not affected. There is still, therefore, a substantial range of work in respect to which engineers continue to be empowered to bind contractors by their decisions. The perceived failure by an engineer to act in an unbiased manner raises clear ethical issues on which the institutions ought to take a position that they are prepared to enforce.

The design commission

Since the general demise of scale fees in the engineering profession, fee competition has become the norm. Fees have been 'opened up' to the commercial practices of the market place, if not the bazaar. The pursuit of ever lower professional fees by clients, strongly encouraged by a new attitude in government during the 1980s, has reportedly given rise to engineering commissions which could not be performed economically on the basis of what were once regarded as normal professional standards. While the evidence for this is largely anecdotal, there can be little doubt that many engineers have been faced with the

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choice between developing new and progressive designs at enhanced cost to themselves or adopting or adapting an existing design at a more economic cost. The Government itself has become well aware of the 'innovation trap' and has sought to adapt its guidelines, now favouring adoption of the 'best value' tender. In some cases, elaborate grading systems have been devised to select between competitive design tenders, necessarily including the price.

The impact of fee competition on professional standards raises clear ethical issues. How far can engineers, in seeking to win commissions by low fee bidding, reduce the quality of their design work? There is a clear public interest in the quality of engineering artefacts and structures. While there is a wide range within which the design service provided may be regarded as adequate, there must be a minimum standard below which an engineer should be answerable to his profession on behalf of the public.

Duty to warn of perceived danger

The first article addressed the question of the practical means of warning of preventable disaster. It is appropriate here to consider the circumstances in which there might exist an ethical duty so to act. The concept of a duty to warn of perceived danger, where it is not part of the primary duty of the engineer, has been considered by the Courts in a number of cases¹⁶. For this purpose it makes no practical difference whether the wider duties are regarded as based on the law of contract or tortious negligence. Limitations on the duty imposed by the law may arise on the basis that the engineer has other duties which might be seen as conflicting, and particularly where the client has other professional advisers. In a recent Court of Appeal judgment¹⁷ May LJ referred to contractors, who had become aware of a risk in the design for which they had no primary

responsibility, as 'not mere bystanders'. They were held to owe a duty to warn of the danger which they should have perceived, as part of the ordinary duty of skill and care. The same principle will apply to another engineer involved in the project. The result in other cases has not always been the same, however. In an even more recent case, Dyson J declined to hold specialist contractors liable for failing to advise of a potential danger on another part of the project, on the ground that other contractors then engaged in the work could have performed it safely. He considered it relevant to the question whether there was a duty to warn that the client was being advised by another professional person.¹⁸

Given that the Courts have applied such limits to the legal duty it becomes relevant for the institutions to consider whether an engineer is entitled to rely on such considerations when deciding whether he should give warning or otherwise take action in relation to a potential failure or other disaster. The fact that a legal duty might not be imposed, were the matter to come to court, can hardly be relied on as a moral defence in all circumstances. Of considerable relevance will be the magnitude of the impending disaster, and whether its consequences will be largely economic or will involve health and safety issues. Problems of confidentiality have already been discussed. The engineer must also consider the consequences of his perception proving to be mistaken. Does his professional indemnity cover extend to protect him in these circumstances? These are matters in which individual engineers are entitled to look to their institutions for guidance, but there can be no doubt that awareness of a preventable disaster raises ethical issues.

Duty to warn of retrospective danger

This represents a potential extension of the duty to warn of preventable disaster.

In the much publicised and difficult case of *Eckersley v Binnie & Partners*, engineers were held liable for the consequences of a methane explosion in a pumping station some years after its completion, where the design had failed to take into account the possibility of methane build-up in a transfer tunnel. In this case, a party of 38 local people were taken on a tour of the Abbeystead Pumping Works. While they were in the valve house an explosion occurred in which 16 died. At the trial, Rose J held the consulting engineers (Binnie), the contractor (Nuttall) and the operator (North West Water) respectively 55%, 15% and 30% to blame. On appeal to the Court of Appeal,¹⁹ Nuttall and the water authority were held not to be liable. A majority held that Binnie was liable on the basis that the trial judge had been entitled to find on the evidence that there was a risk of methane being present which should have been taken into account in the design. In a strong dissenting Judgment, Bingham LJ (now Lord Bingham) held that the evidence did not support any finding of negligence against Binnie. Of particular interest is that the trial judge had suggested that the designer might be under a continuing duty, after completion of the project, to advise on new information that might indicate a danger. While not being prepared to rule out such a possibility, Bingham LJ said:

'What is plain is that if any such duty at all is to be imposed, the nature, scope and limits of such a duty require to be very carefully and cautiously defined. The development of the law on this point, if it ever occurs, will be gradual and analogical. But this is not a suitable case in which to launch or embark on the process of development, because no facts have been found to support a conclusion that ordinarily competent engineers in the position of the first defendants would, by May 1984, have been alerted to any risk of which they

were reasonably unaware at the time of handover. There was, in my view, no evidence to support such a conclusion. That being so, I prefer to express no opinion on this potentially important legal question.'

The case has not yet been followed, and the development of this particular principle remains uncertain. This, however, emphasises the need for the institutions to consider what ethical duties might exist. Apparent sources of danger are likely to be publicised by the institutions and research bodies, but the question then arises whether individual engineers should be regarded as having an ethical (if not legal) duty to warn former clients or others whom they should appreciate as being subjected to unforeseen risk.

Ethics and the expert witness

The need for engineers to present technical facts in a full and unadorned manner has already been mentioned in the context of public debate. The same applies, with the added force of judicial opinion, in the context of litigation and other legal proceedings. The current problems involved in placing scientific and technical evidence before Courts and tribunals has been recently and thoroughly aired in a seminar at the Royal Society whose proceedings are now available in published form.²⁰ The ethical problem is that expert witnesses, whether engineers or from other technical disciplines, while purporting to act 'independently', invariably support the case of the party by whom they are instructed. The problem has been the subject of many judicial observations including, notably, a detailed list of duties to be followed by expert witnesses laid down in *The Ikarian Reefer*.²¹ The essence of these rules is that the expert is said to owe a duty to the Court or tribunal, rather than to the parties. There are various difficulties about this, including the obvious fact that the expert in question is vulnerable

to negligence proceedings at the suit of the original client, while breach of any duty to the Court is unlikely to lead to more than rejection of the evidence. Despite all attempts to improve the situation, expert witnesses instructed by individual parties continue to support the case advanced by that party, often in the form of thinly disguised technical advocacy. The situation in other jurisdictions, notably in the USA, is undoubtedly even worse than that in the UK, but the problem is universal.

Solutions in the form of using a single joint expert, whether appointed by the parties or by the Court, are generally successful in the sense of ensuring that the evidence given is genuinely independent.²² The success of this approach indicates that the root of the problem lies in the expert being instructed by one party only, when it becomes almost impossible for him to act in a truly independent fashion. This exposes a number of ethical issues. First, should experts who accept instructions from one party only continue to hold themselves out as 'independent', knowing the inevitable result of accepting such an appointment? Secondly, is it appropriate for engineers to accept

instructions exclusively from one party, so as to become aware of the objectives and interests of that party in the matters in dispute. Ethical considerations would require the expert to ensure that he was not pre-disposed to support any particular conclusion or viewpoint. The public interest clearly requires that engineering evidence should be objectively independent. This will not be achieved without firmer action than has been seen hitherto.

Conclusions

This article has attempted to provide a firmer definition of engineering ethics in the wider context of what may be called professional ethics. Within this definition, the scope of engineering ethics may be seen as concerning primarily the duties owed by engineers to act in the public interest. This covers both areas in which a legal duty is recognised and, *a fortiori* areas in which it is not, either by reason of lacunae in the law or clear limitations on the extent of legal duties.

Areas of engineering practice are examined in which ethical issues arise. Questions are suggested, including particular areas which need to be addressed by ethical standards bodies.



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There is, however, a dearth of guidance from the engineering institutions in these and many other areas, so that little assistance is available to engineers who find themselves in such situations. The action that should be taken by institutions is the subject of the final article in this series.

A point for emphasis is the essential differences which must exist between legal and ethical duties. This dictates that bodies or committees charged with upholding ethical standards cannot simply defer to the Courts and take the view that legal liability should determine the matter. Institutions serving other professions, notably medical and financial services, are regularly reported as taking a robust and independent view of professional conduct or ethical issues. The engineering professions need to follow suit.

Notes

- 1 For example *The Engineer's Conscience*, by Prof. M.W. Thring, Brandish, Suffolk.
- 2 See generally proceedings of the Delft conference on Research in Ethics and Engineering at www.tbm.tudelft.nl/michielb/ethics/conference/programme.htm and articles published in the *Journal of Science and Engineering Ethics*.
- 3 See generally Peter Singer, *Ethics* OUP 1994 and *Applied Ethics* OUP 1987.
- 4 Particularly USA, Canada and Australia.
- 5 See Mason and McCall Smith, *Law and Medical Ethics*, 5th ed. 1999, Butterworths.
- 6 Institution of Mechanical Engineers, Rule 33.6
- 7 Institution of Civil Engineers, Rule 3.
- 8 Such as avoiding waste of natural resources and wasteful damage or destruction of products: Institution of Electrical Engineers, Rules 1 and 2.
- 9 For example, Health & Safety at Work Act 1974, s 3(1).
- 10 This is recognised symbolically in Canada by the wearing by engineering graduates of an iron ring reputedly made from the debris of the first Quebec Bridge, which collapsed owing to design errors in 1907.
- 11 See ICE Conditions of Contract and Model Forms MF/1, MF/2 and MF/3; also New Engineering and Construction Contract and the (former) Government form GC/Wks/1 Edition 3. In the latter two forms the engineer is re-titled project manager.
- 12 Sutcliffe v Thackrah [1974] AC 727.
- 13 Hickman v Roberts [1913] AC 229; Panamena Europa v. Leyland [1947] AC428.
- 14 Housing Grants, Construction & Regeneration Act 1996, Part II.
- 15 Excluded are contracts for oil or gas extraction, nuclear processing, power generation, water or effluent treatment or for chemicals, pharmaceuticals or steel; also contracts for provision only of building or engineering components, equipment, plant or machinery: Construction Act S.104(2). Other exceptions are contained in statutory instruments.
- 16 See EDAC v Moss (1984) 1 Const L J 131.
- 17 Plant Construction v Clive Adams Associates [2000] BLR 137.
- 18 Aurum Investments v Avonforce [2001] CILL 1729.
- 19 [1988] 18 Con LR 1.
- 20 Science and technology in the eye of the law: Conference 21 March 2000.
- 21 National Justice Compania Naviera SA v Prudential Assurance Co Ltd [1993] 2 Lloyd's Rep 68 per Creswell J.
- 22 Civil Procedure Rules 1998, Part 35.

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