



The Royal Academy
of Engineering

 Inter-Disciplinary
Ethics Applied
A Centre for Excellence in Teaching and Learning

Engineering ethics in practice: a guide for engineers





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Foreword and introduction

This guide is addressed to the professional engineering community. The United Kingdom Standard for Professional Engineering Competence¹, published by the Engineering Council, defines three types of engineering professional – Chartered Engineer (CEng), Incorporated Engineer (IEng) and Engineering Technician (EngTech). While their roles and responsibilities differ, each has to demonstrate a commitment to professional and ethical standards. This guide aims to support members of this community in addressing the ethical issues they face in their daily professional lives, helping them to identify, analyse and respond effectively to the challenges these issues raise.

The Royal Academy of Engineering and Engineering Council's Statement of Ethical Principles (SEP) was developed to identify the common ethical standards which all engineers are committed to – and is included as appendix 1 in this document. This guide is designed to complement the SEP by illustrating these principles with concrete cases and helping readers to explore their widespread application. The publication of both of these documents is part of the ongoing process of providing support to professional engineers in the development of their ethical skills, such as their ability to recognise the ethical aspects of engineering decisions, and to fulfil the ethical expectations of the general public. The primary elements in these skills are the abilities:

- to *identify* the different, and sometimes competing ethical concerns they face
- to *analyse* the issues that might underlie those concerns and
- to *respond effectively* to those concerns.

These are key elements of good professional judgement, which complement other technical skills that form an engineer's professional competency. In describing the key principles that bear on an engineer's ethical responsibilities, the SEP has provided the initial stage in the process. This guide constitutes the next step.

The case studies and discussions below are intended as a resource for engineers who are working in demanding roles, and making important decisions based on a very wide range of different kinds of information. The intention is not to present ethics as an additional demand that also needs to be taken into account, adding to what is already a very complex and demanding working environment. Instead, the aim of the guide is to show that ethical considerations are already built into the decisions made by engineers, yet that these issues can be navigated with confidence, clarity, and above all with the same high standards of rigour, evidence and rationality that engineers already apply to other aspects of their roles. Indeed, engineering can be enriched by paying more attention to ethics.

This guide uses cases drawn from real engineering situations, in order to allow engineers to practice ethical reasoning as it applies to these situations. However, in terms of developing better ethical awareness and reasoning skills, there is no substitute for dealing with the dilemmas and decisions that each of us faces daily. The first step is recognising these when they arise. Analysing them and responding effectively goes to the heart of personal and professional identity.

This guide is available as an abridged published document, and a full set of case studies available online. It is our intention to update and add to the case studies over time, reflecting the changes in technology and society that affect engineering ethics. Ethics, like engineering, is a practical subject, and its exercise is in debate and discussion. We hope that these case studies are used to stimulate discussion between engineers, to help individuals, and the profession as a whole, to advance their understanding of the ethical issues in engineering.

How to use this guide

The purpose of this guide is to supplement the SEP with discussions, clarifications and illustrative personal experiences that will bring the ethical issues in engineering to life. The guide is also intended to encourage reflection on the complex nature of the ethical demands described in the SEP. For instance, the SEP describes the requirement for professional engineers to act with "integrity", but this is a difficult concept to pin down. By highlighting subtleties in some of the words and concepts, and challenges and obstacles that might get in the way of adhering to the SEP in a simple and straightforward manner, the descriptions and discussions contained in this guide will illuminate the SEP and provide the tools to make concrete ethical judgements in an effective way. The chapters will also describe the principles in more detail, and provide examples of ways in which they might become relevant in different areas of engineering.

This guide is designed so that it can either be read from start to finish, or used as a reference resource for help with a particular issue or area of concern. We have included frequent references to the SEP and cross-references between different principles and cases. Ethical issues rarely occur in isolation, and it is very likely, for example, that a case that is ostensibly concerned with Responsible Leadership will also raise issues to do with Respect for Life, Law and the Public Good. One way to use this guide, therefore, would be to start with a case you find interesting, and then trace the links between that case and others in different sections of the guide.

Chapters two to five are devoted to the four fundamental principles from the SEP as described above. Each chapter begins with a short discussion of the principle and how it applies to engineers. These introductions also include some very short descriptions of cases where the principle might come into play in different areas of professional engineering. After the introduction, each chapter is comprised of a number of sub-sections relating to different aspects of the general principle. These sub-sections can be thought of as different ways in which the top-level principle makes ethical demands on the professional engineer. For example, *Accuracy and rigour* involves being objective in professional judgments, but it also involves keeping knowledge up to date and not going beyond the boundaries of one's competence.

Each of these sub-sections is built around a case study. These have been drawn from real life situations, though details have been changed in some, either to maintain confidentiality or to make the case clearer in the way it highlights a particular issue (individual and company names have been changed in all cases). Following a detailed description of the case, the central dilemma is stated simply and clearly, followed by a number of possible courses of action. Some of these might be ruled out altogether, either because they are against the law, or because they clearly contravene one or more of the fundamental principles as set out in the SEP. However, they are included because circumstances may arise where there would be pressure to take these unacceptable options. Other possible courses of action may be more difficult to choose between, and it may be necessary to exercise fine judgment in deciding what to do. The discussion section in each sub-section shows how this can be done, and progress made on the ethical issues involved. The last two parts of each section summarise the discussion, and then show how different principles referred to in other parts of the guide may have a bearing on the case in question.

Although the guide discusses cases based on real life the actual choices made in the original situations are not set out here. This is partly because those choices may sometimes have been mistaken, or might even be illegal. But it is also

because the primary aim of this guide is not to present supposedly authoritative answers to specific cases but to stimulate reflection.

The final chapter of the guide provides advice on how to take an interest in engineering ethics further, including useful resources and places to go for further information. It also lists some further sources of practical guidance, for example, websites, ethical helplines, and specialist advisory organisations.

1 Ethics and the engineer

Ethics and the professions

Why is ethics an integral part of professional life, and in particular the life of an engineering professional? The importance of ethics in the professions can be understood through thinking about what a professional is. The word 'professional' is hard to define, even for traditional professions such as medicine, law, accountancy and engineering. However broadly speaking there is agreement on common characteristics shared by all professions. Thus a professional:

- has specialised skills and knowledge
- has acquired such knowledge and skills through a long period of training and study, and continues to maintain and update them through professional life
- has, as a result of this specialised expertise, significant power to affect individual clients and wider society
- belongs to a professional body which regulates their practice
- and as part of that self regulation adheres to ethical principles which the professional body oversees.

The expertise of professionals, and the domains over which they exercise that expertise, give them power to improve people's wellbeing, or to cause significant harm. This is perhaps most obvious in the case of doctors, whose actions can save lives or cause death, and affect quality of life in many more subtle ways. A patient needs to know that a medical professional is not just technically competent, but will exercise ethically informed judgement in treating them, acting only with consent, maintaining confidentiality, pursuing their best interests, and so on. While the actions of a medical professional typically affect individual patients directly, the decisions of engineering professionals have the potential to impact on the wellbeing of many hundreds or thousands of people.

As a result of the power their skills bring, society places great trust in professionals to exercise those skills wisely. Thus common to all professions is a commitment to use expertise in pursuit of the public good. This creates a critical role for ethics, as the professional's adherence to ethical principles is a central part of the exercise of good professional judgement. Through this the professional both earns the trust of the public, and provides good reason for such trust to be continued.

In short, being a professional brings with it significant privileges in terms of affects on others, whether that be access to information about them, or capacity to affect their needs and interests. Those privileges bring with them important responsibilities, so professions and professional bodies need continually to earn the right to be entrusted with such responsibilities by showing that they exercise them in an ethical way.

Ethics and engineering

Engineers invent the future and their work affects the lives of millions of people, for better or worse. That raises enormous ethical issues in every branch of engineering, from computing through biotechnology and energy to civil and aeronautical.

Engineering ethics in practice survey

Engineers work in many disciplines but all of them have the ability to affect societal wellbeing to a very significant extent. At one extreme, as Richard Bowen² has noted, engineers play major roles in two enormously important aspects of human life. On the one hand engineers can provide solutions for the more effective management and treatment of water resources. In a world in which a significant proportion of the global population do not have safe drinking water (estimated at 1.1 billion by the World Health Organisation in 2004), such engineers have the power to do great good. On the other hand engineers are significant actors in the defence industry. In serving to defend people from aggressors this activity too has considerable potential to do great good, but equally weapons can be used to cause considerable harm. The privilege of having the skills and knowledge to contribute so much to such important areas of life clearly brings with it the need for wise ethical judgement when exercising that privilege.

But engineers also impact on individual and communal welfare in many direct and indirect ways. When a person steps on a bridge they need to know that engineers have wisely balanced the paramount importance of safety against demands for building within cost and achieving a pleasing aesthetic result. The location of a mining project requires good judgement; taking into account environmental and other impacts as well as adequately meeting technical and commercial requirements. Material and energy resources are used in the production, packaging and distribution of products that engineers design and make, and so the engineer must consider the sustainability of their methods. Responsible engineers have to be aware of all these implications and act appropriately in light of them.

Clearly, then, engineering professionals need to be trusted across a vast range of human activity. Wise ethical judgement is as important for engineers as for any other profession. How, though, does ethics differ from basic common sense?

There are many concrete examples which show that intelligent people with good common sense can disagree where ethics is concerned. Modern electronic devices that allow surveillance are often claimed to be valuable in countering terrorism, but people disagree as to whether the consequent invasion of privacy is warranted. Some see the production of wind-power as an environmentally sustainable way of meeting needs for electricity, but others claim the impact of the large turbines on the landscape to be environmentally damaging. The case studies in this guide provide further evidence of the limits of common sense for dealing with engineering ethics.

Do such difficult cases show that ethical issues are merely subjective, with no right or wrong responses? They show only that it may not always be obvious what the right answer is, as even the most difficult dilemmas have 'wrong' answers. Keeping all citizens in their homes twenty four hours a day is not a warranted method for achieving security. Completely unregulated extraction of minerals should not be permitted. Identifying these wrong courses of action is not a mere matter of opinion – the aim of this guide and the Statement of Ethical Principles is to show that it is possible to identify key considerations for reaching ethical judgements and to use reason in deploying those considerations.

Professional engineers and the engineering profession

**The problem these days is often knowing when you have done enough.
Guidance from a respected professional body would be helpful and
allow more defensible decisions.**

Engineering ethics in practice survey

The Royal Academy of Engineering, in conjunction with the Engineering Council and a number of the leading professional engineering Institutions developed the Statement of Ethical Principles (SEP) to describe, in general terms, the kinds of ethical considerations that a professional engineer will need to attend to, and how a principled engineer should seek to respond to the ethical issues they face. The SEP is intended not only to provide guidance and support to individual engineers, it also serves to reassure the public that engineers take their ethical obligations seriously. By categorising the different kinds of ethical concerns that exist in engineering, the SEP represents the scope of ethics in engineering activities.

The four principles set out in the SEP are:

- Accuracy and rigour
- Honesty and integrity
- Respect for life, law and the public good, and
- Responsible leadership: listening and informing

These four fundamental principles, in the words of the SEP, "should guide an engineer in achieving the high ideals of professional life".

Some of these principles apply to all professions equally; other principles have a stronger role to play in engineering. Much of the role of an engineer is taken up with making judgments, working with new technologies, and giving advice. So the need for accuracy and rigour, for maintaining up to date knowledge, and for care in representing the evidence accurately and not making claims that go beyond the evidence, is particularly crucial in engineering. Any inaccuracies may lead to accidents, failures, or even death.

A key reason behind producing a Statement of Ethical Principles for the engineering profession was that many professional engineers may face organisational challenges in thinking through ethical issues. Engineers almost always work for and with others – clients, employers and contractors – and may face conflict between their professional values and the demands made on them by others. Famously in the Challenger Shuttle disaster the engineer concerned with safety critical matters was exhorted by his manager to think like a manager not like an engineer. There may often be similar external pressures to stray from professional obligations, so it is helpful to have clarity on what those obligations are.

Of course, no engineer exists in a vacuum unconnected with the broader profession of which they are a part, and the society in which they live and work. While many of the case studies presented in this guide focus on the choices made by individuals it is important to recognise the limits on what an individual acting alone can achieve. We might imagine cases in which the option that appears best from an ethical perspective is simply not available for the individual to choose – for example, it may be best for all businesses in an industry to employ the latest low emission technology, but if just one business were to take such action the increased costs (relative to competitors) could lead to bankruptcy.

In such cases it may be possible to take steps that change the situation so that the best choice becomes available. Such changes could include, for example, government legislation that set limits on acceptable emissions. It is in situations such as these that we could identify not just a role for engineers individually, but also for engineering as a profession; where collective influence opens up a course of action that was closed to the individual. These issues are touched on further at various points in this guide, particularly in the introduction to chapter 5.

Ethics and the law

This guide seeks to provide engineers with guidance in identifying ethical issues in their professional lives and responding to them. It does not provide legal advice and should not be taken to do so. While there is clearly a close relation between ethics and the law – many laws are implemented to enforce the ethical judgments of our society – the two are not identical. A course of action might be legal, but it may still strike the engineer as unethical. Equally, it is clear that thinking through the ethical contours of a situation tells you nothing directly about the laws that apply to that situation in a particular jurisdiction.

The issues raised in some of the case studies presented in the guide touch very closely on particular legal issues, and in some cases detail of these legal issues has been noted. However, it is important to reiterate that nothing in this guide will provide you with the knowledge necessary to incorporate legal considerations into the decisions you make as an engineer. Some further thoughts on this relation between ethics and the law are presented in Appendix 2 of this guide.

Engineering ethics in practice

This guide was influenced in part by the results of a survey on the ethical issues that engineers face in the course of their work, and the support that they receive (or not) from their employers in dealing with them. The small survey was carried out in 2009 and 77 engineers responded. Although this was too limited a sample to draw broad conclusions, some insightful responses were given. A selection of anonymous comments are quoted or paraphrased in section introductions.

2 Chapter introduction: Accuracy and rigour

Accuracy and rigour is the first principle listed in the Statement of Ethical Principles. This states that “professional engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others”.

Probably the most obvious reason why accuracy and rigour is important to professional engineers is that accuracy and attention to detail ensures better engineering solutions, just as inaccuracies and carelessness in engineering can mean failure of engineering projects, which can in many cases mean financial failures, accidents, injuries and deaths.

Professionalism also involves being honest about level and areas of competence, and never agreeing to work in areas in which you are not competent or not able to easily achieve competency. The temptation to do this can be generated by commercial considerations, for example a company bidding for a lucrative contract despite not having the correct skills and technical knowledge within its teams. The risk here is that engineers working on the project will make mistakes, as they may not be aware of the key mistakes to avoid, and mistakes in engineering projects have the potential to be catastrophic. Conversely an engineer employing their specialist skills within their area of expertise can make a significant and positive contribution to society. However, it is important to note that many engineering projects are novel, and will require previously untested skills and methods. In these cases it is an engineer’s duty to ensure that risks are managed and steps taken to allow teams to acquire the appropriate skills – but above all to be honest about unknowns and skills gaps.

“Q: Are there different pressures in your company which make it hard to always work in a way that you feel is ethical? A: Inability of management to get to grips with the idea that everyone can't do everything, and that available competency is a constraint in some cases which needs to be considered.”

“Safety in construction requires continuous training and emphasising.”
Engineering ethics in practice survey

Engineers also have a specific duty to maintain up to date knowledge in their fields of expertise because of they have the trust of their clients and the wider public. Engineers should be aware of the value that is given to their ‘professional opinion’, and never give it lightly or on the basis of insufficient evidence. If an engineer’s opinion turns out to be mistaken, they may be held accountable for any negative consequences of actions taken on the basis of it. Although they may have used inaccurate information unwittingly, given their position as a supposed expert they will still be responsible for those actions.

Conflicts of interest can influence the accuracy of an engineer’s opinion. Engineers should consider whether the opinion they have given is objective, correct to the best of their (up-to-date) knowledge, and based on the available evidence; or whether there might be other considerations influencing their judgment. These might include, for example, commercial considerations, or loyalty to an employer.

The boxes below give some brief engineering examples relating to accuracy and rigour:

Anne is an engineer working for a company that has an opportunity to tender for some work on the construction of a new building. However, neither Anne nor anyone else at the company is familiar with one of the materials that the client wants to use in the project. Anne's boss suggests that they submit a tender for the work without saying anything about their lack of experience with the material, and in the meantime Anne can take the opportunity to learn what she can. Should Anne go along with this?

Bill is a software engineer who is asked to give an opinion in court as to the level of security offered by a company's data protection procedures. Bill suspects that the system may not be completely secure, though he has not had the opportunity to inspect it as thoroughly as he would like. Should Bill accept the request to appear as an expert witness? If so, how should he phrase his testimony?

Claire is a mechanical engineer working on the design of a new make of car. The car has passed all of the legally required safety checks, nevertheless Claire believes that there may be a problem with the transmission, that will only manifest itself after a few years' use. Claire has informed her manager, who has informed her that he does not believe the issue is severe enough to delay production until it is fixed. What should Claire do?

In the following chapters more detailed cases based on real scenarios are used to illustrate different aspects of accuracy and rigour. These cases are designed to be challenging and to allow reflection on what the principle means in practice.

2.1 Acting with care and competence

Professional engineers should "always act with care and competence"

Scenario

David's job title is 'examining engineer' and it is his responsibility to review and sign off the reports of inspectors who make visual examinations of rail bridges. These reports are intended to identify any defects and to monitor the rate of deterioration of any previously identified defects. All reports should be accompanied by photographs that support the written information.

David is one of a number of examining engineers who work together in a team, and he has become concerned that one of his colleagues, Kevin, may not be conducting his work to a standard that David thinks is appropriate. The engineers have worked together for over 10 years, and consider each other to be friends, but David has noticed what seems to be an increasing lack of interest from Kevin in his job. To back this up, Kevin has made light hearted remarks about the lack of detail in the reports that he is given and the poor quality of the photographs he receives and has given the impression that he signs them off anyway.

Given the possible impact of this behaviour on the critical safety of rail bridges, David is contemplating taking his suspicions to the regional manager at the company. However, David is in a dilemma since even if Kevin is signing off reports

in the way that he suspects, he is not sure that this constitutes a breach of Kevin's duty of care. After all, David has in the past come across bridge inspectors who only submit detailed reports and comprehensive photographs when there is something significant to record. He can also remember times in the past where he has assumed that a lack of detail simply meant that no defects had been found.

As Kevin is a friend, David decides to discuss his concerns with him before doing anything else. Kevin is unrepentant and sullen, and denies that he has let his standards slip. David now finds himself in a difficult position. He is aware that he and Kevin are in positions of trust and have a duty to act with care and competence, but he must decide what this duty requires in the context of their job. He must also decide whether any failure in this duty is the result of personal failings in an individual (Kevin), or rather a result of a system that has come to accept unacceptably low standards as the norm. His conclusion in this matter will determine what action, if any, is appropriate.

Dilemma

Imagine that you are in David's position. You have reason to believe that a colleague, and friend, is not taking sufficient care in the execution of his role of examining engineer, and that this breach of duty may be impacting the safety of rail bridges. You know that you and he both have a duty to ensure that work is conducted with care and competence, but you must decide firstly what such a duty requires in this case, and secondly whether any breach is the fault of your colleague or the system in which you are both working. On top of this, you must also contend with conflicts that might arise between your professional duties and your loyalty to your friend.

What should you do?

1. You could attribute Kevin's behaviour simply to a bad few days at the office, and decide that the care he is taking with his reports is no less than anyone else's – after all, a lack of detail in reports is quite widespread. Moreover he is your friend. You could therefore decide to take no action.
2. You could decide that the evidence you have gathered is sufficient to show that Kevin is particularly negligent in his duty of care and that you should report his behaviour to your superiors.

Discussion

Decisions like this raise a number of issues. The first is the conflict that you could face between your professional duties and the loyalty you feel towards colleagues or others who are close to you. Particularly in cases where it is not obvious that a professional duty has been breached it is difficult to decide whether the evidence that you have justifies putting a colleague's reputation at risk.

In this case it is clear that not only does Kevin have a duty of care in executing his role, but that you also have a duty of care as an engineer – not only for your own work, but also in other engineering matters that you can affect. If you decide that there is reason to think that Kevin's behaviour breaches his duty of care, then it would seem that your duty of care obliges you to act.

Having decided that you must act, you need to decide what action is appropriate. This will in large part depend on why you think the duty of care has been breached. If it is a result solely of Kevin losing interest in his job and not taking his responsibilities seriously, then it may well be that you should report his actions to your superiors. If, on the other hand, Kevin's actions are simply an example of a general culture of lax standards that has developed, then perhaps bringing this fact to the attention of your superiors will be better – it will address the real cause of the problem, and not result in bad consequences for this particular colleague.

If you decided that this latter course of action (option 3 above) was most appropriate, you could always keep an eye on Kevin and check that his standard of work improves as general improvements to practice are implemented.

Summary

In this case you have had to balance your responsibilities to your friend and colleague against the risk of a violation of the duty of care that you both have to do your jobs to the appropriate standard. In doing this you have had to consider what would constitute a breach of this duty in the particular context of your job.

In addition, you have had to decide on the appropriate action to take once you have determined that a breach of duty has occurred. This in turn has depended on whether the breach was due to the personal misconduct of an individual, or rather was more directly traceable to a culture of lax standards that had developed within the organisation.

Other ethical considerations involved in this case

As well as *accuracy and rigour* this case study involves important questions of *honesty and integrity*, both in the requirement to respect the reputation of your friend, and in the need to respect the rights of those that might be affected by his actions. It might also invoke your duty to prevent professional misconduct. In balancing these concerns the requirement to *respect life, law and the public good* will come into play, especially the requirement to hold paramount the health and safety of others.

Wider applications

In many ways, the obligation to act with care and competence sums up the role of a professional. Whether it be an orthopaedic surgeon passing on negative news to a patient, a family lawyer dealing with divorcing parents, or a chemical engineer developing strategies for waste water management, there is a need for a professional both to utilise their expertise and to be aware of the impact of their decisions.

This case study has examined some of the obstacles to acting in this professional manner, focusing on issues around personal relationships and confidentiality. Obstacles can also arise from concern for your career and personal prospects, commercial conflicts of interest and many other sources. Dealing with these obstacles can require reflection and external support, but the primary remedy is an awareness of your responsibilities, and of the ways in which fulfilling those responsibilities can become difficult through workplace pressures.

2.2 Staying within your limits

Professional engineers should “perform services only in areas of current competence”

Scenario

An engineer who is trading as a consultant specialises in performing Environmental Impact Assessments (EIAs) for industrial developments. The engineer is approached by Pellar Paper Ltd, a company that is planning to build a paper and board production plant, and is offered the job of performing an EIA for the development, which he accepts. As the facility will produce over 200 tonnes of paper and board per day, legislation necessitates that an EIA is included as part of the submission to the local planning authority. Pellar Paper has already received a “scoping opinion” from the local planning authority, indicating the areas in which they have concerns. The engineer’s job is to describe the likely effects of the plant on various aspects of the environment and local community, and the mitigation efforts that will be made.

There are many kinds of environmental impact that have to be considered for this project. They include (but are not limited to) treatment and disposal of waste water, the visual impact of the development, noise pollution from the machinery and effect on air quality of emissions from the on-site incinerator. As an EIA specialist the engineer is expected to have a sufficiently broad understanding of engineering to be able to make informed judgements about these effects. However, one of the areas of concern highlighted by the local planning authority and the highways authority is the effect of the increase in the road traffic caused by the development.

Unlike the other key elements of this EIA, the engineer does not feel competent to undertake the traffic impact assessment required in this case. He does not feel able to gauge the precise increase in traffic, nor its effect on the nearby village and the local road network, which includes many narrow country lanes. In the past, he has handled traffic assessments in one of two ways: if they have been simple or straightforward he has conducted them himself. If they have been more complex he has recommended the employment of a specialist in this area to provide the necessary input.

The engineer discusses the issue with Pellar Paper. He states that in his judgment the traffic will not cause significant problems, and such problems as there are could be mitigated in various ways. Nonetheless, given the importance of this issue and the fact that it has already been raised by the local planning authority, he is not sufficiently confident in his judgment and recommends that a traffic impact expert is employed to undertake this aspect of the EIA. Pellar Paper is not keen on this idea, highlighting concerns about the extra time and expense of hiring a consultant. More than this, however, the engineer is left with the impression that Pellar Paper are worried that detailed scrutiny might uncover the kind of negative impact that will worry the local planning authority or the highways authority. Pellar Paper urges the engineer to make the traffic impact assessment himself, and to state that in his judgement that there will be no negative effects due to the increase in traffic.

Dilemma

Imagine you are the engineer in question. Whilst completing an Environmental Impact Assessment (EIA) for a paper manufacturing company, you have been urged to include your judgement that the increase in traffic caused by the development will not have a negative effect. However, you do not feel sufficiently competent in this area to be confident in your judgement and think that the company should engage a specialist consultant, which they are reluctant to do.

What should you do?

1. You could explain that since you do not believe that you are competent to complete the traffic assessment in this case you will be unable to continue to work for Pollard Paper unless they engage an independent expert traffic impact consultant.
2. You could agree to complete the EIA, but restrict yourself to matters other than traffic, so leaving it incomplete.
3. You could accept the view of Pollard Paper and include your own view, of which they approve, in the EIA, as they are your clients and you do feel capable of making a traffic assessment with some level of accuracy.

Discussion

In this case study, you are being pressurised to make a judgement that you feel is outside your areas of competence. The client is less interested in you making a thorough and accurate assessment than in you making an assessment that will favour their plans. This places you under an obligation to consider the best way of producing a satisfactory EIA, whilst bearing in mind the interests of the client.

One of the key elements in this case study is not only the need to be aware of your limitations, but the need to be confident in your communication of those limitations. Circumstances can make it tempting to claim competence which you do not have, or to acquiesce to other people's expectations of certain knowledge and skills. It may make their life easier if you perform a certain task, but that does not make it the right thing in the long run for you to do.

This can be particularly relevant at the beginning of a project, where it may be easy to overlook unrealistic expectations of your competence. Or you may notice, but it might not seem like a significant issue. Projects develop their own momentum however, and it in most situations it will be easier to be clear at the outset about your range of expertise, even if that may disappoint clients.

Given the options presented, 1 and 2 may well amount to the same thing – Pellar Paper are unlikely to want to receive a report that omits a key element that has been requested by the planning and highways authorities. In this case you may be faced with a simple choice between doing the whole report and getting paid and not doing any work at all. It is in tough practical situations such as this that doing the right thing is the hardest. However, the earlier comments about setting expectations early are particularly relevant here – if you had set out clearly the services that you were able to supply at the beginning, you may not have found yourself in this difficult position in the first place.

Summary

In this case you have made your judgement about your competencies clear to the client, but for apparently commercial reasons they are keen for you to include your assessment (of which they approve) even if you are not confident of its thoroughness and accuracy. In this situation it is your responsibility to ensure that any work you sign off has been conducted competently. If you are not confident that this is the case with the traffic assessment then you should not put your name to it. Unfortunately this may mean that you will have to withdraw from the project, unless you can persuade your client to employ an expert in traffic impact assessment.

Other ethical considerations involved in this case

This case study raises issues of *honesty and integrity*, particularly if you think the report risks deceiving readers, or has been the subject of improper influence. The potential adverse effect on society of a poorly completed EIA also brings in considerations of the *respect for life, law and the public good*. Finally, you will need to consider whether your actions in this situation would violate your duty to show *responsible leadership* by ensuring all statements you make in your professional capacity are objective and truthful.

This case study dealt with the issues that can arise when you are pressurised to offer a judgement that you feel to be outside your area of competence. But there are other ethical issues that can arise in the realm of professional competence. One is that it can sometimes be difficult to decide what is, and what is not, included in your area of competence. One factor that can make this difficult is that what counts as knowledge sufficient to back up a professional judgement can vary greatly depending on the situation. Depending on various complex factors, an engineer may have to have decades of specialised experience in order to provide an assessment, or may only require a passing familiarity. For instance, compare the situation of the chief engineer on the launch of a space shuttle with the same engineer discussing rocket propulsion with A-level students. The levels of expertise required in order to offer a "competent" judgement will differ radically in these two situations. Awareness of the nature of the situation, and the expectations of the people affected by the decision, is a key part of being aware of your limitations.

Another issue is what precisely counts as a standard area of engineering competence. Engineering is very multi-disciplinary, and a typical engineer may be expected to make decisions about a vast array of different issues, ranging from molecular and atomic factors to ways in which people and communities behave. There are various ways in which these areas of competence are codified, including the standard range of modules in undergraduate degrees. But there are still areas where individual reflection is required. Should an engineer be expected to make judgements about issues that are more "social" in nature? For instance, should an engineer developing a home surveillance system for the elderly be expected to make a judgement about the impact of the system on personal privacy? Is that rightly considered an engineering issue? There may well be engineering decisions that are closely and inextricably linked with social, political and ethical issues. Furthermore, engineering is a dynamic discipline, with many engineers working with emerging technologies with unknown impacts, or on one-off major projects. In such cases engineers have to manage the risks of using novel methods rather than relying on tried and tested knowledge.

2.3 Keeping up to date

Professional engineers should “keep their knowledge and skills up to date and assist the development of engineering knowledge and skills in others.”

Scenario

Alexander Boyd is the Managing Director of Icarus Aeronautics, a medium size aeronautical engineering company. For the last year or so work in the sector has been hard to come by, but Icarus has been fortunate to have an excellent relationship with a particular airline. This airline has engaged Icarus in a large, ongoing project to redesign multiple elements of the interior of its planes, for example, seats, overhead lockers, hostess trolleys. With very little other work coming in, it is only this project that is sustaining Icarus, and even then the financial situation is perilous.

In order to manage this situation, Alexander has taken a number of measures. Despite having teams with varying specialities, virtually all the engineers employed by Icarus are now working on the airline project. In addition, all non-essential expenditure has been cut back, and this includes training that is not required by existing projects.

One of the teams within Icarus specialises in developing and designing safety critical composite airframe structures, although they too have been working on designing cabin fixtures for the best part of a year. The head of this team, Sarah McKay, requests a meeting with Alexander and voices a number of concerns. She says that her team are not very happy with their current work although, in general, they understand the need to arrange things this way. Part of their concern, however, is that their skills in composite airframe structures are becoming outdated. The best way to keep these skills up to date would be by working on a relevant project and undertaking training, but in the absence of any such projects she asks if the team can at least be allowed to continue training in this area.

Alexander tells Sarah that he understands her concerns and that he will consider her request. He does not want to lose the capability to do this specialist work and he does not want the team to be unhappy, but at the same time he does not know how he can afford to take them off their current work and pay for additional training. In addition, he also knows that there are other teams in a similar position who could also make a request for training if he agrees in this case.

Dilemma

Imagine that you are Alexander Boyd, Managing Director of Icarus Aeronautics. You have a responsibility to assist the development of engineering knowledge in others, particularly those who work for you. However, by agreeing to the request of your team leader and sending her team on training to update their specialist skills you will have to take them off the project that is sustaining the company and spend money that will generate no immediate return. Moreover, even if you did allow the training you would certainly be unable to fund similar requests from other teams. On the other hand, if Icarus loses all its specialist skills, it will be harder to acquire new work and complete it competently. Should you allow this team to undertake the requested training?

What should you do?

1. You could agree to the request in this instance, believing that you can bear the cost once, while making it clear to the team and the rest of the company that this is an exception.
2. You could refuse the training, citing the current market conditions and the particular financial pressures on Icarus.
3. You could agree to the request in principle, but make it clear that any training will only be approved if accompanied by a business case showing how the team intend to use the training to generate income for Icarus.

Discussion

Assisting in the development of engineering knowledge and skills in others is a central responsibility for engineers, particularly when the people concerned are employees for whom engineering is a core skill. Indeed, as a member of a professional Institution it may be a requirement to carry on with professional development. However, in this case it is clear that approving all relevant training across the company is not a viable option – Icarus Aeronautics would go out of business to the detriment of all employees. Given that this is the case, perhaps a balance can be struck by approving the training just in this instance; you could argue that you are discharging your responsibility as best you can given the constraints that exist.

The problem with this approach is that you need to decide how to respond when other teams in the same position complain that they have not been given the same opportunity to maintain their skills. Such preferential treatment based only on the fact that one team complained first does not seem to be fair. This being the case, it may be better, in the interests of fairness, to deny all teams training, while making clear that it will be permitted again once conditions have improved and resources are available to fund training for all.

Such a solution may be fairer, but it again risks failing to satisfy the requirement to ensure that engineering skills are kept up to date. This is particularly the case if Icarus Aeronautics maintains ambitions to undertake specialist work, such as designing composite airframe structures, in the future. One central reason that maintaining up to date knowledge is important is to ensure that work is always conducted to the highest possible standards. By denying your teams the opportunity to maintain their skills you may either have to reduce the range of work that you bid for, or risk undertaking work that you are not competent to perform.

A possible solution to this dilemma could be to consider the third option. By requiring business cases to accompany training requests you could ration training according to your budget, and could make the rationing criteria fairer than 'first come, first served'. By making as much money available as possible given your constraints, you would also be fulfilling your duty to maintain knowledge.

This may indeed be the best solution available given the significant financial pressure that the business is under, and the disastrous consequences for all involved should it fold. However, it may be that you should still exercise caution – some training may not obviously lead to incremental revenues for the business, but instead may be necessary to ensure the quality and safety of work currently being undertaken. What attitude would you take to training of this kind? Perhaps

by offering all employees time for professional development as long as it did not incur any costs such considerations could be taken into account.

Finally, if the financial situation became so difficult that it was impossible to fund any training or allow staff to take time off for professional development, is there a point at which the survival of the business becomes less important than ensuring that its employees have up to date skills (for example, if skill levels were no longer sufficiently up to date to be able to ensure the safety of projects undertaken)? How would you decide when this point was reached?

Summary

It is a reality of business that financial pressures constrain the opportunities for engineers to engage in training to enhance and update their skills. In this case the constraints are very tight and so training will have to be tightly rationed. By allocating available training based on business requirements and by exploring other ways to pursue professional development you might fulfil your responsibilities to keeping skills up to date to the best of your ability, while being as fair as possible. This should also ensure that all employees are competent to undertake the tasks required of them. Nonetheless, how would you respond if faced with a number of equally valid requests that cannot all be met? Or if it proved impossible to finance all training necessary to maintain basic skills to an acceptable level? What trade-offs is it acceptable to make in order to keep your business running?

Other ethical considerations involved in this case

Keeping engineering skills up to date will also affect an engineer's ability to maintain *accuracy and rigour* in other respects, such as their ability to act with care and competence, and to evaluate risks. Equally, *honesty and integrity* would not be served by leading others to think that you were expert in a particular area when you did not possess the latest knowledge. This in turn could cause damage to your reputation and that of the profession, and would be at odds with the requirement to *respect life, law and the public good*. This case study also raised questions of fairness relating to the allocation of training within a company.

2.4 Ensuring others are not misled

Professional engineers should "not knowingly mislead or allow others to be misled about engineering matters"

Scenario

Bradlet Structural, a firm that provides consultancy services regarding structural integrity and subsidence evaluation for heritage sites, has been hired by STZ, a contracting company that has been building a complex of luxury flats in the centre of a market town. Work has been halted as concerns have been raised about the effect of the building work on some nearby historic buildings, including a Medieval church and a street of Grade 1 listed buildings.

The development was controversial from the outset, being situated so centrally, but the Local Authority was persuaded that the design would be in keeping with the surrounding buildings, and would regenerate the centre of the town.

In an effort to satisfy the planning officers as well as the local media and the community of the town, STZ engages Bradlet Structural to undertake an

evaluation to demonstrate that their building work is not having a negative effect on the structural integrity of the church. Specifically, Bradlet Structural has been charged with investigating the possibility that construction of the foundations of the development is causing ground settlement and subsidence underneath the church building. STZ is hoping to use Bradlet's report to allay local worries, and to allow building work to continue. A team is sent to perform the evaluation.

In the course of the team's investigation, it discovers evidence that points to significant recent subsidence in the vicinity of the church. The foundation work on the flat development is the clear cause of this subsidence, which is likely to exacerbate the increasing natural problems with the structural integrity of the medieval church.

Before compiling a report, the team leader verbally advises STZ of the team's findings, and their conclusion that there is a high risk of further development causing structural damage to the church building if the working methods are not changed.

On receipt of this information, STZ informs Bradlet Structural that the consultancy contract will be terminated, with full outstanding fees paid. Bradlet Structural is no longer required to compile a written report.

Some weeks later, when the controversial issue of the development work is being covered in an influential local paper, a member of the Bradlet Structural team notices that representatives from STZ have claimed that the development work is having no effect on local subsidence, and that the church is under no threat from the building work. The representative further claims that STZ have evidence (by implication from Bradlet Structural) to support that view.

Dilemma

Imagine you are the team leader from Bradlet Structural. It is your responsibility as a consultant to give advice on whether you think a building project is a threat to the structural integrity of a local church. By ignoring your advice and claiming that the church is under no threat, the company who engaged your services, STZ, has given information to the public that you feel to be false, about a topic that has the potential to cause harm to people and property. Furthermore, you have substantial evidence that this is the case, gathered by your team in a professional capacity. How should your team act?

What should you do?

1. You could decide to say nothing, given that the information in your possession was gathered whilst your company was employed by STZ, and there is an obligation to be loyal to those who pay for your services.
2. You could inform STZ that you do not agree with their public statements on the matter of the subsidence around the church, and that they should reconsider their position in the light of the information that your team gathered whilst in their employment.

Discussion

The information at your disposal was gathered during consultancy work for STZ; they have therefore paid for that information. Their ownership of the information is not absolute, but you may feel that its future use is their prerogative, and not that of Bradlet Structural or the consultancy team. In which case, STZ should have a role in the decision as to whether to publicly release the information.

There are also commercial reasons for Bradlet Structural to withhold the information. It may damage the reputation of the company if potential clients receive the impression that they may unilaterally release findings generated through client work. Any organisation in a situation with a risk of negative publicity from Bradlet's investigations will be reluctant to engage their services.

However, the consultancy team do have information that strongly indicates that the public statements of STZ are false. Moreover, those misleading statements concern development work that has the potential to lead to serious structural damage to a local heritage site, and possible injury or death to visitors and residents. Given that STZ are misleading the public on such a serious matter, and probably acting illegally given their duty of care to the public, it is clear that the company, the team, and the Team Leader as an individual have a responsibility to counter their claims. Not to do so would be a particularly serious case of allowing "others to be misled about engineering matters" and would therefore be contrary to the Statement of Ethical Principles. Moreover, people may hold Bradlet Structural responsible if serious structural damage did occur. The first option above, doing nothing, is therefore not an ethically acceptable option in this case.

These considerations may persuade you that the best course of action is to urge STZ to disseminate the information themselves, or at least to modify their public statements. This course of action has the advantage of giving STZ the opportunity to do the right thing. However, the position of STZ is such that they are probably unlikely to accede to the demand. Their actions have clearly demonstrated that the accuracy of their pronouncements is not their primary concern. To urge them to reconsider their position may be a collaborative solution to the problem, or it may just be a way of assuaging your conscience.

If you decide to go public with the information, Bradlet Structural will probably be brought into direct conflict with STZ, perhaps damaging their reputation with other engineering firms. You may feel that your duty to the public overrides these concerns, but going through the official channels looks like a way of discharging this duty more discreetly, without damaging Bradlet Structural's reputation by appearing unprofessional.

Summary

In this case, advising the Building Regulations department of the Local Authority looks like the best option. This department has the powers to stop any work that they deem to be dangerous and ask for modifications to ensure public safety. Going through the official channels means that, as Team Leader for Bradlet Structural, you can discharge your duty of care to the public, while staying mindful of your responsibilities to your employers.

However, if you take this route you may have to decide whether your responsibility ends there. What if the Local Authority does not act on the information? Should you then go public?

Other ethical considerations involved in this case

As well as *honesty*, this case also highlights issues of *accuracy and rigour*. The company in the case were disseminating inaccurate information, but when does 'mere' inaccuracy become outright dishonesty? It also involved considerations of *respect for life, law and the public good*, and particularly the injunction to '*hold paramount the health and safety of others*', particularly the members of the public who would potentially be affected by the new development. Finally, as a Team Leader, the protagonist in this case was asked to show *responsible leadership*.

2.5 Being objective

Professional engineers should "present and review engineering evidence, theory and interpretation honestly, accurately and without bias"

Scenario

Sudocom is a small company that provides communications consultancy to local businesses. They are hired by Sealion Finance, a financial services company with 40 staff, to develop an internal communications network for the sharing of non-sensitive information. There is already an intranet for storing and sharing the details of clients and staff, but the CEO of the company wants an easy and less formal way for staff to communicate, along the lines of social networking sites such as Facebook and Twitter. The aim is to foster team spirit as well as streamline discussion of non-confidential information.

When Sudocom discuss the work with the CEO of Sealion Finance, Jane Foster, it emerges that she wants minimal security on the new network, limited to a simple password access system. Sudocom inform her that for a system like this, their communication engineers would normally include various other security measures that would make it far more difficult for intruders to access the system. Jane Foster feels that because the system is only designed for non-confidential information, the supplementary measures will not be required. Moreover, the CEO wishes to avoid the effects of the extra security on the performance of the system.

To allay Sudocom's professional concerns, Jane Foster assures Sudocom and their engineers that staff will be instructed to only use the new system for non-sensitive information. All confidential data will be shared using the old intranet, which incorporates much more substantial security measures.

These discussions have left one of the communication engineers very concerned about Jane Foster's specification. The CEO appears to have placed a great deal of weight on the ability of her employees to refrain from discussing confidential information on the new communications network. In the communication engineer's experience of developing such systems it is hard to predict precisely how staff will use the network. The engineer feels that the CEO is taking greater risks than she might otherwise, because she is in a position of control. The engineer thinks that she is overestimating her ability to influence the communications of her staff, and that the new system should incorporate extra security measures to guard against the accidental discussion of confidential data. The engineer believes that if she were not the CEO of the company she would probably not judge the risks to be acceptable.

Dilemma

You have been hired by the CEO of a company to develop an internal communications system for non-confidential information. You feel that it is important to include substantial safety features, but the CEO is confident – over-confident, in your opinion – in her ability to ensure that staff members restrict their communications to non-sensitive information.

What should you do?

1. You could insist that external advice is sought on the issue, and include a security assessment in consultancy. This will ensure that the security ramifications of the new system are fully explored.
2. You could forcefully offer your professional judgement that extra caution be taken, and convey your feeling that Jane Foster is overestimating her control over the situation. By committing your opinion to paper, you may persuade Jane Foster that further security measures are worthwhile.
3. You could proceed as Jane Foster has asked, without any more discussion of the security of the system. You have expressed your opinion that extra security would be standard practice, and the final say should lie with the client.

Discussion

This situation requires you to make a judgement about the objectivity of a client, and to act on your judgement in a professional manner. To what extent are you responsible for the opinions and judgements of clients, colleagues and superiors, if those opinions and judgements are in your sphere of expertise?

The case study presents the CEO of Sealion Finance as overestimating her ability to affect the communication habits of her staff. Often, a person who has a high level of control over a process may estimate the risk level differently from someone who does not have that control. In everyday life this is familiar from the risk level you feel when driving a fast car compared to riding as a passenger. Jane Foster is presented as accepting a certain risk level because of her position of authority, a risk level that you feel to be too great.

If you do not accept that Jane Foster's objectivity is compromised, you may wish to take the third option and leave it up to her. Similarly, if you do not accept that your judgement is superior to hers then you will make the same decision. However, if you do think that her objectivity has been compromised then you must make a decision about what action to take.

You may feel that your professional obligation is limited to passing on your belief that her judgement is flawed, in which case you might choose the second option. You believe that her position of control is adversely affecting her assessment of the acceptable level of risk, and by explaining your view you may feel your professional obligation to be fulfilled.

However, the danger associated with insufficient security measures on the communications system could be severe, for both clients and the company, and you may feel that it would be unprofessional to omit the security features. This would be a strong and potentially unpopular route to take, but you may think that your experience and expert knowledge places you in a position which makes this course of action necessary.

Summary

This situation demonstrates a conflict of opinion between the client and the supplier. You may not want to force your opinion too strongly, in case the relationship between yourself and the client is damaged, but likewise, it is important that you do not let your professional knowledge and opinion be sidelined. However, suggesting that the CEO of a company does not know her staff is unlikely to build the relationship.

It is also important to consider the cost of this activity. If additional security measures would cost more to build and then implement for this system, your opinion that they are required could be viewed as you trying to maximise profit for Sudocom. If you decide to push for greater security, what steps could you take to avoid having your objectivity called into question?

2.6 Evaluating risks

Professional engineers should “identify and evaluate and, where possible, quantify risks”

Scenario

SW Power is an energy company that has been given responsibility for the overhaul of a substation. The substation is old, and is long overdue for some serious maintenance and repair work. As is standard, another substation will take up the slack whilst the substation is taken off-line for the repair work, but an unexpected event – such as an abnormal surge in power demand – could cause a power-cut.

The government regulator imposes fines on energy providers for any disruption to the power supply. An energy company undertaking work that significantly raises the risk of disruption will take out insurance against the possibility of the fine. The cost of the insurance (which is fixed by the level of the possible fine) will dictate the intensity of the maintenance work, e.g. whether weekend and night-time work is undertaken to reduce the time-period during which the power supply is at risk.

As the work will involve a significant increase in the risk of a power-cut, the project manager for SW Power is required to go through this process. SW Power requires insurance to be taken out against any fines that they may incur, before the substation can be taken off-line and the overhaul completed.

In assessing the disruption risk-level, the project manager realises that although the area serviced by the target substation is small, one of the key features is a medium-sized hospital, with 350 in-patient beds. According to the regulator's fining structure, no significance is given to the fact that this building is a hospital, and the fine incurred for a disruption in power supply to this institution is the same as for any residential building of its size. Furthermore, there are no regulations requiring a hospital to be treated any differently. On investigating, the project manager ascertains that the emergency generator for the hospital cannot be guaranteed to maintain power for more than 12 hours which is the period deemed by the hospital to be the probable maximum outage time of the mains supply.

The level of the fine, and thus the cost of the insurance, is within acceptable limits to proceed with the overhaul of the substation. The cost of the insurance is also low enough to mitigate the need for intensive working practices.

However, the project manager is concerned. Without intensive working, the substation will be offline for well over the 12 hours during which the hospital's emergency generators can be expected to function. This will leave the hospital vulnerable to a black-out. Without an electricity supply, many of the crucial pieces of medical equipment in the hospital will be unable to function, leaving patients extremely vulnerable. Although this does not increase the financial risk to SW Electric, the project manager feels that the danger to the patients in the hospital is severe enough to necessitate intensive working, to complete the overhaul of the substation within 12 hours. The project manager would like to recommend to their manager that they agree to over-time payments, to allow overnight working to take place, but the project manager is unsure precisely how to proceed.

Dilemma

A usually standard engineering decision has unexpectedly thrown up a difficult question. You feel that there is a powerful reason to perform intensive working on the overhaul of the substation, to protect the hospital from the risk of a damaging powercut. However, this decision is not motivated from a financial point of view. How are you going to communicate your judgement to your manager?

What should you do?

1. You feel that the best thing is to frame your decision in terms of the responsibilities of the company to the local community. Whilst there is a financial cost to undertaking the intensive work, an obligation exists to protect the patients in the hospital.
2. Although you are motivated by an ethical concern, you feel that the best way to present your decision is in direct commercial terms. You will seek to justify your decision by citing longer-term financial benefits of protecting the hospital.
3. You worry that the ethical considerations involved in this decision place it outside your area of responsibility, and you will pass the decision on to your manager. You will state your opinion that the intensive working is justified, but you will refrain from making a definite judgement.

Discussion

You feel strongly that your company has a responsibility to safeguard the hospital, even with the increased costs and the lack of legal requirement. However, the company usually relies upon legislation, standards and regulations to ensure that it meets its obligations. The problem in this case is that there is an important concern – the special requirements of a hospital – that is not reflected in those regulations.

You want to emphasise the significance of the ethical responsibilities of the company in this case, but you are concerned how this may be received. There are two possible effects of this that might concern you: a) your recommendation may not be accepted, b) it might affect your reputation within the company. You certainly do not want to be seen as someone who will waste the company's money on spurious ethical concerns.

These kinds of considerations might persuade you to frame your decision in terms of standard commercial considerations. You might cite the longer-term financial costs associated with negative publicity, or with increased governmental oversight and intervention, caused by any dangerous power-cut to the hospital. There is a chance that this kind of message will meet with more success with your manager.

The downside of using a financial message is that it does not accurately reflect your judgement. You might consider it reasonably dishonest, perhaps even manipulative, to disguise the essentially ethical nature of your concerns. It might also be uncharitable to assume that senior managers in the company would not share your feeling that the hospital deserves protection. Just as you have felt a certain obligation, so those managers steering the company might easily be aware of the same kind of obligation.

Even if the senior managers of the company are not receptive to a message based on corporate responsibility, you may feel a duty to help in changing that atmosphere from within. By concealing a legitimate ethical concern, you could be promoting the kind of corporate ethos that excludes the kinds of wider social obligations that the public are increasingly expecting of large companies.

Of course, as a member of a large organisation you only have a limited effect upon, and limited responsibility for, the values and reputation of that organisation. You might feel that your personal responsibility does not extend to making the kind of ethical judgement that this situation involves. This might lead you to pass the decision on to your manager.

The downside of passing the decision along is that you may be seen as avoiding your responsibilities. In any normal circumstance it is your job to make this decision, and the presence of wider social obligations is usual in an engineering context. Professional codes of conduct, including the Engineering Profession's Statement of Ethical Principles, make it clear that you are expected to make competent decisions regarding the impact of engineering activities on society. If you feel strongly about the intensive working, maybe you should have confidence in your judgement.

Summary

Within this situation, it is clear that you need to make SW Power aware of the risks to the hospital. Ignoring the situation could result in causing harm to people within the hospital, as well as harm to SW Power's reputation. As part of your considerations, you must decide if the organisation will be driven by ethical or commercial arguments, or a combination of the both. It may be useful to get support from your manager in making this decision, but passing the responsibility for the decision solely onto them would appear to demonstrate a lack of judgement and responsibility on your part.

You may also wish to try and liaise with the hospital, to make them aware of the potential risk, in case there are other contingency plans they can put in place.

Other ethical considerations involved in this case

Significant elements of this case are relevant to your duty to **respect life, law and the public good**: both the requirement to hold paramount the health and safety of others, and the requirement to uphold reputation of engineering (which could be damaged if it appeared that you had neglected the risk to the hospital). The way in which you present your concerns to your manager also raises issues of **responsible leadership**. If your worry is an ethical one, would it be responsible to present it in a different light, or even pass the decision on to someone else to take?

Wider applications

imagine you are hired to provide your professional judgement about the design of a cutting-edge electronic automotive component, but in doing so you may be in danger of disclosing confidential information from a previous client in the same industry.

As a professional engineer, you have an obligation to provide the most accurate, unbiased and objective information at your disposal. In the normal course of events this is straightforward, but what if you have information that is relevant to the client, but is confidential? In such a situation it is harder to determine what your obligation to objectivity requires. You will have to judge how best to balance the needs of the current and the previous clients, without either compromising your ability to provide professional advice or releasing confidential information.

Imagine you are asked by your employer whether they should invest in software produced by a company that you personally dislike, because of the unpleasant way they treated you as a employee earlier in your career.

One factor that can make it hard to remain objective can be the emotions and feelings that are present in working life, just as much as in your personal life. Professional relationships can cause feelings that affect your judgement, and whilst many of these will improve your ability to provide accurate engineering information, they can sometimes be an obstacle. If you have personal feelings, whether positive or negative, that are not directly related to the engineering qualities of a product, process, individual or organisation, you will have to think carefully to ensure that the professional advice you provide is not biased or prejudiced.

3 Chapter introduction: Honesty and integrity

Honesty and integrity is the second principle listed in the Engineering Profession's Statement of Ethical Principles. This states that "Professional Engineers should adopt the highest standards of professional conduct, openness, fairness and honesty".

"If I know that a competitor is bidding unethically, but will win the business, should I a) match his unethical behaviour in order to win the business which was rightly ours, or b) expose the unethical nature of the rival bid, therefore jeopardising the confidentiality of the unattributable source, or c) walk away from the business and retain the moral high ground?"

"Competitors are often less ethical... How does one compete with people that lie?"

Engineering ethics in practice survey

Honesty and integrity are in fact two separate but closely related concepts. While they have different meanings, it is hard to imagine anyone exhibiting one without the other. At least, someone who is dishonest is unlikely to be described as having integrity.

Engineers are likely to work for the benefit of a number of different groups of people, and in many cases will have a duty to keep these people informed of relevant facts. The public trusts professionals to provide information that is as complete and accurate as possible. Honesty is not simply a matter of not lying: an engineer may at times need to disclose information which has not been requested directly, and which in some cases people may not want to hear. In other cases, such as where there is a duty to maintain confidentiality, for example to a client, it may be unethical to disclose information which would jeopardise that confidentiality. In these cases, failure to disclose would not necessarily be dishonest.

Integrity is a more difficult concept to define. It has to do with acting ethically, even when there is no personal advantage to doing so. A person of integrity will resist pressure to compromise their ethical values and principles, whether that pressure comes from employers, clients, or anywhere else. They will take steps to avoid conflicts of interest or, where this is not possible, declare these conflicts clearly and do their utmost to avoid improper influence. People with integrity are consistent and reliable, and their actions match up to their words.

For some, integrity may also mean 'standing for something', trying to change practices and attitudes that seem less than ethical; it might mean trying to influence for the better the practices of an employer, the engineering profession, or even society at large. According to the Statement of Ethical Principles, an engineer should "take steps to prevent corrupt practices or professional misconduct" in others, and not simply avoid falling into such practices individually.

The boxes below give some brief engineering examples relating to honesty and integrity:

Dave is employed by a radio broadcast equipment manufacturer as a sales representative. In addition, Dave works as an independent consultant for organisations in the radio broadcast field. This work can include analysing their technical problems and, when required, recommending any radio broadcast equipment that they might need. In some cases, Dave recommends the use of broadcast equipment manufactured by his employer. Is it enough for Dave to declare his conflict of interest, or should he resign one of his positions?

Esther works on military contracts for a company manufacturing sensors which can detect and warn of the presence of chemical and biological agents. Esther is proud that her work contributes to equipment that saves lives. One day, she is asked to begin working on a new lightweight radar which can sense and display the movement and location of soldiers and vehicles on the battlefield. With this information soldiers can quickly call in mortars and artillery fire to destroy enemy positions. Can Esther work on the new project and keep her integrity?

Faisal is a technician working on the central heating system for a building which is occupied by a large financial services company. One day, while carrying out maintenance work in one of the building's corridors, he overhears two executives talking about a debt crisis at the company, something which has not yet been communicated to the public. Later, Faisal's friend, who owns shares in the company, asks him if he knows anything about the company's financial health. Should Faisal warn his friend about what he has heard?

In the following chapters, more detailed cases, based on real scenarios, are used to illustrate different aspects of honesty and integrity. These cases are designed to be challenging, and to allow reflection on what the principle means in practice.

3.1 Affecting others

Professional engineers should "be alert to the ways in which their work might affect others and duly respect the rights and reputations of other parties"

Scenario

ALN Monitoring have contacted a consultant electronics engineer to develop an internal surveillance system for residential buildings. The system is required to sense human activity in a very refined way, in terms of "normal" and "abnormal" bodily movements, and the engineer has been hired to develop the hardware for the system, including the user interface. It is an interesting project as there are considerable technical difficulties involved in co-ordinating the various different kinds of cameras and sensors that will be required, and in processing the large amount of information.

As the engineer begins to work on the project, she holds a meeting with ALN monitoring to discuss the layout of the residential buildings in which the system will be placed. The engineer discovers that the system will in fact be used as a

monitoring system for elderly people in their own homes. The team from ALN Monitoring inform the engineer that the system is wanted by relatives of infirm elderly people, who wish to have peace of mind about the welfare of their elderly relatives. The aim of the monitoring system will be to pick up abnormal movements - such as falls and trips, and the staff that will be monitoring the system will be able to summon help quickly.

On further investigation, the engineer learns that some people have concerns about the system. ALN Monitoring have been contacted by a local charity representing elderly people who are worried about the issue of consent. Many of the elderly people for whom the system is designed will be mentally as well as physically frail, and therefore may not be able to fully comprehend the nature of the system. This raises the worry that the implementation of the system will constitute an invasion of their privacy.

Learning about the planned application of the monitoring system has given the engineer something to think about. If the system is going to involve cameras and sensors monitoring the activities of individuals who have not fully consented, due to not being sufficiently mentally competent to understand, then she has reservations about continuing to work on the project. The impact of her work on the end user is something she wishes to take seriously.

Dilemma

You have started consultancy work on a project to develop a sophisticated monitoring system for residential buildings, and you learn that the proposed use is as a surveillance system for elderly and infirm individuals. There is a concern that as some of those individuals will not have the mental capacity to understand the system, and so will not be able to fully consent to the system, your work might lead to an invasion of individuals' privacy.

What should you do?

1. You could refuse to continue working on the project, on the grounds that you are unhappy with the proposed use of the technology.
2. You could continue work on the project, as you feel that there are relatively simple measures that could ensure that there is no invasion of privacy.
3. You could continue work on the project on the condition that the system allows the person being monitored to turn it off, which is not part of the current specification.

Discussion

This situation places you in the position of a designer having to think about the future use of the technology they are developing. In this situation, the system you are designing may end up infringing the right of elderly people to privacy in their own homes. By monitoring their actions with cameras and sensors, the surveillance system that ALN Monitoring wish to produce could be considered intrusive in a way that should not be inflicted on people without their consent. The mental frailty of some of those for whom the system is designed opens up the possibility of someone being monitored without their full co-operation, as they may not be competent to understand the process.

As a designer, you are being asked to consider how your obligations extend to the end-user. You may think that your job is merely to provide the client with a product that fits their specification, and that may be true in the standard situation. Most people would feel, however, that it would not be acceptable to design a lethal device knowing it would be intentionally used on innocent people, or to design an addictive and potentially dangerous drug that would be supplied to children. So the welfare of the end user is certainly relevant, if the end user is under sufficient threat. If you feel that the threat to the users of the monitoring system is high enough, you may choose the first option and refuse to work on the project.

You may feel that any threat to privacy that does exist can be mitigated in some way, and the third option offers one route to this by providing a method of switching off the mechanism. Even this may not be suitable for those users lacking comprehension of the system, and you may wish to find other ways of limiting the possibility of harming the welfare of the vulnerable people for whom the product is designed.

Summary

This situation reflects on the importance of considering the use of products you have helped to engineer. There is clearly a potential benefit to the systems, but the effect of the product on privacy and the problem of consent should not be ignored. Whichever route you choose it is important to be confident in the decision you choose, and to be able to defend that decision to others.

Other ethical considerations involved in this case

This case also touches on questions of *respect for life, law and the public good* since it introduces consideration of the public interest into an engineering context. Following from this, important questions of *responsible leadership* are also raised – society entrusts engineers with the management and exploitation of technologies, and as such it is important to take full account of the wider good of society and issues of public concern when making engineering decisions.

3.2 Preventing corruption

Professional engineers should “avoid deceptive acts, take steps to prevent corrupt practices or professional misconduct, and declare conflicts of interest”

Scenario

Sudobuild is an international civil engineering consultancy that undertakes work all over the world. They have been assigned to direct a project in a developing country involving the development of a large hydroelectric installation that will in due course provide power for a town of several hundred thousand inhabitants. In conjunction with a business manager, the project manager negotiates the terms of the deal with the client, who is the construction company that will be building the facility.

The client agrees the contract with Sudobuild, and they inform the project manager that the funding for the consultancy work will be coming from a donor-backed central government fund dedicated to the development of energy production facilities. A small team from Sudobuild, including the project manager, flies out to provide guidance on the plans that have been developed, to give specific direction on ensuring that the facility can cope with a wide range of flow variation.

After the work is complete and the project manager is submitting an invoice, the client asks the project manager to invoice for twice the original amount. The client explains how this specific government fund operates; the fund is supposed to pay for 50% of the fee, and the client company is supposed to pay the other 50%. However, key individuals involved in the administration of the fund have developed a practice whereby consultants bill for double the amount, thus ensuring that the government covers the whole cost of the work.

The fee for Sudobuild's services in this situation is £370,000, of which only £185,000 was supposed to come from the government fund. The client is proposing that Sudobuild invoices for £740,000, and Sudobuild will then receive the full £370,000 that the government pays. The client points out the benefit of this from Sudobuild's perspective: they are paid in full, and on time. This is rare in consultancy work of this kind, and will save both time and money for the accounts department. The benefit for the client company is clear, as they receive the services without having to pay for anything. The government is none the wiser, as the administrators of the fund conceal the procedure from senior government officials.

On being informed of this unilateral change of procedure by the client, the project manager expresses surprise, and some anger. The project manager does not wish to participate in the theft of state funds however "normal" it is, and the manager explains Sudobuild's position to the client company. The client company then breaks some disappointing news; they say that they do not have the money to pay the consultancy fee. They claim to have available only a quarter of the 50% that they were scheduled to pay Sudobuild, and they urge the company once more to follow the process they have outlined so that Sudobuild can receive their full payment.

Dilemma

You have undertaken some consultancy work with a foreign company, under a scheme whereby half of your fee comes from the central government. However, the client company informs you after the work has been done that they are in financial difficulties, and that the only way you will be paid in full is if you falsify the invoice document so that the government pays 100% of your fee. You are also told that this is standard practice, and happens with the cooperation of the administrators of the government fund.

What should you do?

1. You could agree to the process as described by the client company. It is important that Sudobuild get fair remittance for the work they have undertaken, and administrators of the government fund have approved the practice of doubling the invoice.
2. You could refuse to participate in the practice, and accept whatever funds that the client company have available. You do not want to engage in corruption, but you do not want to sever your relationship with this company and others in the region.
3. You could refuse to double your invoice, and take the client company to court to recover your fee. It is important to take a stand against corruption, and to ensure that companies face up to their financial obligations.

Discussion

This situation places you in a scenario where perhaps the simplest course of action, refusing to get involved in the situation at all, is not possible. You are already embroiled in the situation, and you have been placed in an uncomfortable position. Your job in this case would be to manage the problems as best as possible for everyone concerned.

Perhaps the main point to consider is that doubling your invoice is likely to constitute fraud. It is clearly against the explicit rules of the fund, and also against the spirit in which the fund was established. Doubling your invoice is equally clearly an act of falsification of an official document. The consequences of this type of fraud are very serious. Both the company and responsible managers could be liable both for a criminal conviction, and for damages. In addition, you may be committing consequent accounting, tax and money laundering offences. The fact that it is standard practice, and that it has been endorsed by the administrators of the fund, does not provide a defence.

Sensitivity to differing working practices and business procedures is a key part of undertaking work in foreign countries. This sensitivity entails not rushing to ethical judgements about the way things are done, but it equally does not mean giving blanket acceptance either. Just because something is normal, does not make it acceptable from your point of view as an employee of a company with its own values and standards. Nor does it make it legal; you must never issue a false invoice.

You must avoid endorsing and participating in that process. If short-term benefits are the main issue, then taking the company to court may be the most attractive option. This may constitute the best way of getting your money, but may have a negative impact on your reputation in the area. Not only have you refused to play by the normal rules, you have also launched legal proceedings against a local company. Accepting a smaller amount of money in return for maintaining positive relationships with the local companies could be the better long-term option, but not if they are likely to repeat this conduct.

Summary

Several issues need to be balanced in this situation: the reputation of your company, the need to be paid for your work and how to deal with corrupt practices. Going along with the practice may appear to be the easiest option, but it is illegal and would constitute "a deceptive act" and a "corrupt practice", both of which are explicitly prohibited by the code of conduct.

Agreeing to take a smaller amount of money, on the other hand, may result in your company being seen as lacking business acumen, and you may risk other clients trying to do the same with you, resulting in your company not being paid for their work. Equally, while court proceedings may expose the corrupt practice of your client and offer a way of recovering your money, you run the risk of alienating many potential clients in the area.

Other ethical considerations involved in this case

This case raises questions of *accuracy and rigour* since it touches on an engineer's duty not to mislead about engineering matters. It is also particularly relevant to issues of *respect for life, law and the public good*: work must be undertaken lawfully, and the reputation of the profession must be upheld. This reputational element is important since, even in cases where you think the suggestion of your client does not constitute corruption, you must also consider whether it will look as though you have acted corruptly. Finally, you also have a duty to be truthful and not to take advantage of the trust placed in you by society. These considerations are part of your obligation to show *responsible leadership*.

Wider applications

Imagine you find out that senior local government managers in your civil engineering section are giving preferential treatment to their friends, equivalent to significant overpayments in consultancy payments.

One issue that can arise regarding corrupt practices is what to do when you discover that they are happening. If this involves senior members of your organisation then the problem becomes acute, as there are fewer options to report the activities within the normal channels. You will have to consider disclosing information either to regulators or to other relevant parties. The effect on your own career and reputation, at least in the short term, may be severe and you will have to consider the effects on your family and personal situation before deciding how to balance your professional responsibilities.

Imagine you are an experienced engineer moving into a new industry sector in which corruption in procurement and contracting procedures is rife. You want to put measures in place to prevent the prevalence of corrupt practices.

You may have advance knowledge that a role may involve dealing with corrupt practices. There are certain engineering sectors, and certain areas in the world, where corruption is a significant issue. In this kind of situation, you will be faced with putting systems in place, at an individual and organisational level, to deal with those pressures. These measures may include rigorous oversight of financial decisions and increased disclosure both inside and outside the organisation. A crucial step may also be to inform new and experienced staff about the legal, ethical and social situation regarding corruption and bribery.

You come to realise that a public procurement official, who happens to be a good friend of yours, has overpaid you for some stock. You did not realise this at the time, and you are uncomfortable that you received preferential treatment.

If you find yourself in the position of having received unwarranted benefits, on the basis of friendship, family ties or other factors, you will be faced with a difficult decision about disclosure. It may be tempting to remain silent on the grounds that there was no corrupt intention on your part, but you will have to be aware of how things may appear. It may be necessary to be open about the situation, although the effect of this on the friend (family member, etc.) that was involved will have to be considered. In particular, once you have discovered that there has been an overpayment, you should immediately repay the overpayment, otherwise you could be committing a criminal offence.

3.3 Rejecting bribery

Professional engineers should: "reject bribery and improper influence."

Scenario

Corsey Mining, a large multi-national mining company, is currently setting up new gold mining projects overseas. The company is particularly concerned that it should act responsibly and is looking for opportunities to invest in the local communities which might be affected by its operations. An employee of the company involved in this project becomes aware of some land which they have good reason to believe is very rich in gold. The land is situated in the centre of a country in an area which is currently wilderness. The company begins looking into the possibility of setting up a mining operation there.

Under the law of the country, all companies need to be granted a special license before they can perform any investigative mining activity. Due to the complex local bureaucracy, it proves very difficult to get a clear idea of how to apply for this license, and what criteria the project would have to fulfil in order to be granted it.

After a series of unproductive meetings with local officials, the company are able to arrange a meeting with the Mayor of the local town. Although the Mayor does not make the official application process any clearer, he does make it clear that Corsey Mining would be granted a license if the company agrees to fund the construction of a new hospital for the town. It initially appears that there will be no other way of getting the license. The company express their concerns to the Mayor: they want to be sure that the project is authorised through the proper channels. The Mayor assures Corsey Mining that everything is perfectly above board. In this country, he says, this is the way things are done.

Dilemma

You are presented with what looks like an excellent opportunity to set up a prosperous mining operation and also to provide some benefit to a local population. However, in order to get this operation off the ground, it looks like you may have to bypass certain legal channels, and to perform a quid pro quo service for the Mayor which could be interpreted as a bribe.

What should you do?

1. You could go along with the Mayor's suggestion, setting up the mine and building the hospital.
2. You could refuse to go along with the Mayor's suggestion, and look for new opportunities elsewhere.
3. You could continue investigating how to obtain a license for the land.

Discussion

The legal situation is important here. Will the Mayor be using his influence improperly to bypass the legal process? Does he in fact have the legal authority to grant you a license? You will need to consider whether the company should make more effort to investigate what the proper channels are, rather than accept the Mayor's reassurance. 'In this country, this is the way things are done' would not be an effective legal defence.

Your company has a duty to its shareholders to return a profit, so financial considerations will be important. It looks as though your company stands to benefit from a potentially fruitful project. However, can you really trust the Mayor to follow through on his part of the bargain? With little formal paperwork in place, what recompense, legal or otherwise, would you have if he should fail to do so?

PR and reputational concerns will need to be considered. The opportunity to secure a lucrative mining project while investing in a local community looks superficially like a reputational win-win situation. However, if the legal and ethical status of the Mayor's offer is in question, might you be gambling with the reputation of your company by accepting it? Alternatively, might your company's, and your, reputation be damaged by missing out on a lucrative opportunity?

If the Mayor is acting legally, and if the proper procedures are followed, then building a hospital for the benefit of the community is unlikely to be seen as a bribe. However, if the Mayor is acting illegally, and is by-passing or wrongly influencing the procedures, or is requiring the hospital for his personal benefit, then the building of the hospital may constitute a bribe, and the mining contract may as a result be deemed illegal and be terminated. Both the company and responsible managers could be liable both for a criminal conviction, and for damages. In addition, you may be committing consequent accounting, tax and money laundering offences.

You may consider that agreeing to build the hospital would effectively be a bribe to the Mayor. Generally, a bribe is a benefit to the person receiving the bribe that induces them to use official powers in an improper way. In this case, both aspects of this definition can be questioned. Firstly, can the building of a hospital be seen as a personal benefit to the Mayor? Not obviously, although if the Mayor is democratically elected, his securing of a new hospital may well work in his favour in getting re-elected. Secondly, is what the Mayor is suggesting an improper use of his official powers?

It is important to consider the negative effects of bribery, even though these may not be immediately obvious from the case. In this case, for example, bypassing proper legal channels (if this is what is happening), may result in the bypassing of legal checks and balances designed to minimise impact on the environment, or to ensure that the local people are properly compensated for the loss of land and environmental impact. There is also the possibility that the local people might stand to be exploited. Although they will benefit from the project, perhaps they would have benefited more if the proper legal process had been followed, especially if this had involved a competitive tender between your and another company. So they may be losing out on something to which they are morally entitled

Summary

It is important to ensure that your actions are legal, and that no criminal offence is being committed, and no breach of procedures is occurring. It is also important to consider the wider impact of your decisions – if you decide to build a hospital, who will staff it, who will provide the resources for it? If it isn't formally supported through legal structures, will the hospital actually do any good for the community? Would the building of the hospital end up being a white elephant – nice but useless, and if so, what will this do for your company's reputation? It seems in this situation that it's important at least to try to find another route to carry the mining, possibly through direct engagement with the local communities affected by the project.

Other ethical considerations involved in this case

This case covers a number of considerations that are relevant to ***respect for life, law and the public good***: requirements to ensure that work is lawful and justified; that it takes account of the limited availability of natural resources; and that it does not risk the reputation of the engineering profession. In addition, it raises questions of ***responsible leadership*** since, given the trust placed in engineers by society, they have a duty to take the wider societal good into consideration in deciding on an appropriate course of action.

3.4 Gaining trust

Professional engineers should “act for each employer or client in a reliable and trustworthy manner”

Scenario

Sudoparts are a multinational company with a reputation for developing innovative and cutting-edge parts for the European automobile market. One of the senior engineers is leading a team working on new designs for transmission systems, and a need has emerged for a new design of constant-velocity (CV) joint. CV joints allow a rotating shaft to transmit power through a variable angle without an increase in friction or play. They are used on the drive shafts that connect the transmission to steered wheels, and have to accommodate both the rotation of the wheels and the vertical motion of the suspension.

The team is keen to set up an R&D project based around some new design ideas, which will hopefully increase the efficiency of the energy transfer, the senior engineer puts together a proposal to take to the board of Sudoparts. The engineer is aware that it is a difficult time for the company, and that expenditure is being very closely managed. The project will have to be very carefully presented to the board if it is to obtain any funding. The board has made it clear that it will only grant funds for activities that are clearly structured and managed.

The project is estimated to cost £5m: for staff time, tooling of new machinery, and production and testing of the prototypes. However, often with this kind of project there is a significant risk of further funds being needed. In this kind of R&D work, promising avenues can very quickly become dead-ends, and the team would have to go back to the drawing board. If this kind of thing happens, it is estimated that the project would need up to £1m on top of the original £5m.

The senior engineer could include the possibility of a further £1m in the presentation to the board, but the prospect of further necessary investment, as well as the appearance of a level of uncertainty, might give the board a reason to block the project. The whole team is very keen to work on this exciting project, and it is necessary that the best possible case is presented to the board.

If the senior engineer does not mention the possible need for supplementary investment, the board will look much more kindly on the bid although they recognise that development projects tend to be overspent. Nonetheless, in the current circumstances the board would be very unhappy if further funds did turn out to be necessary.

Dilemma

As a team leader presenting a bid for R&D funding, you naturally want to present the best possible case for the project that you wish to work on. However, this may mean omitting details about the risk of further funding being needed. Should you disclose this possibility in your presentation?

What should you do?

1. You could lay out every foreseeable cost of the project to the board, including the significant possibility of the need for supplementary funds further down the road.
2. You could omit the risk of further expenditure from the presentation, and express confidence that the project will be completed on budget.

Discussion

In a situation in which corporate expenditure is being severely rationed, it might make sense to alter the way in which you present requests for funding. You might want to emphasise certain benefits of the project, and to downplay certain drawbacks that will be particularly worrying to those paying the bills. From this perspective, avoiding mention of the possibility of further expenditure might seem like a viable option.

You may even feel that the board does not want to be bothered with possible future issues, and that they are looking to you to provide a level of certainty. There may be pressure to deliver results, which might invite a short-term way of thinking. You will have to work within the constraints of your company's way of thinking.

On the other hand, withholding information about risks associated with the project might conflict with your obligation to present your best engineering judgement. The board will undoubtedly expect you to present the best case you can, but it is probable that this will not include omitting key risks.

The board will expect you to take a level of personal responsibility for the project. By omitting the risk of extra expenditure you are acting in such a way as to "trick" the board into agreeing to your request. A more honest way of taking responsibility would be to be upfront about the risks associated with the project, and leave it up to the board to make the final decision. This seems the more appropriate division of labour.

By presenting all of the information, you would be doing a better job of taking responsibility for all aspects of the proposed project. By limiting your proposal to the positive elements you may not be displaying the sense of responsibility that would be expected given the trust placed in you by your superiors and your colleagues.

Summary

You will have to decide in this case what it would mean in practice to act in a reliable and trustworthy manner towards your employer. It is quite clear that telling outright lies would not be acceptable, but equally it seems likely that the board will expect you to put a positive 'spin' on the project and so in doing so you are unlikely to breach your responsibilities. Deciding where 'spin' ends and outright lies begin is a difficult judgment that you will have to make in the light of your knowledge of the organisation, its procedures and the standard expectations of employees. At any rate, it seems improbable that complete failure to mention the possible £1m overrun will be compatible with acting in a trustworthy manner.

Other ethical considerations involved in this case

As well as *honesty and integrity*, this case raises important issues of *accuracy and rigour*. These issues include the requirements not to mislead others; to present evidence accurately and without bias; and to identify, evaluate and quantify risks. The requirement to be truthful in a professional capacity is also relevant, bringing with it considerations of *responsible leadership*.

4 Chapter introduction: Respect for life, law and public good

"The debate concerning the use of ATP [advanced train protection] on Britain's railways is an ethical dilemma - the system saves lives but the cost is disproportionate compared to using the funds for health or road safety."

Engineering ethics in practice survey

This set of principles is probably the broadest of the four that make up the Statement of Ethical Principles, and arguably the one that encompasses the ethical issues most commonly associated with engineering ethics. Obviously, all of us have general responsibilities for the life, law and the public good, but the engineer also has particular professional responsibilities to protect and uphold these. Many discussions of engineering ethics focus on major accidents where people were killed and injured, and particularly cases in which there seems to have been some level of negligence involved; for example, the Bhopal chemical leak, the Challenger space shuttle disaster and the Piper Alpha offshore rig fire.

Indeed, when Michael Davis, a leading ethicist,³ considers the question "What does it mean to think like an engineer?" his conclusion is that the principle of ensuring the safety of others is so central to engineering that following it constitutes a large part of what is involved in thinking like an engineer. His analysis was based on an investigation of the Challenger disaster, in the course of which the head engineer was apparently asked to think like a manager, and not like an engineer.

This set of principles is not limited to health and safety, but also covers respect for the law, respect for (and the protection of) the natural environment, and the reputation and dignity of the engineering profession. It encompasses all aspects of engineers' responsibilities for the people affected by their work and the social and environmental context in which they function. This aspect of an engineer's responsibility is very sensitive to changing social and political standards and expectations, and the steps engineers are expected to take to protect others have changed over time, and vary across the world. The risk that labourers on Victorian engineering projects would have been exposed to, such as the building of Brunel's Great Western Railway, where 100 people died blasting one tunnel alone, would not be tolerated now. Similarly, there is increasing awareness of the impact of engineering projects on the local landscape and the global environment, and the need to mitigate any negative impacts.

These principles overlap significantly with the previous principles because, for example, failures of accuracy and rigour can put the public at risk, and failures of honesty and integrity can damage the reputation of the profession. Furthermore, as the example below illustrates, this principle doesn't only apply to the most senior engineers making decisions at the highest level, but on all engineers, from technicians to managers.

James is replacing the window of a commercial passenger aircraft, but realises that he doesn't quite have enough new bolts with the screen—he has just over half of the number he needs. The standard practice is usually to throw away old bolts and to refit windows with new bolts provided with the screen. However, time is short, he's due to finish for the day, and he suspects that if he goes to find more bolts there will be delays and he won't be able to finish on time. In addition he'll be late for his date, and he wants to make a good impression. He knows that other members of staff sometimes re-use old bolts when they're short of parts. Is using the old bolts compatible with showing due respect to life, law and the public good?

In the following sections, more detailed cases, based on real scenarios, are used to illustrate different aspects of the respect for life, law and the public good. These cases are designed to be challenging, and to allow reflection on what the principle means in practice

4.1 Justifying the work

"Ensure that all work is lawful and justified"

Scenario

Logic Learning is a small software engineering company specialising in designing and developing e-learning functionality. Having only ten employees, the company relies on a steady flow of public sector contracts to ensure its continued viability. Logic Learning has an excellent reputation in the industry, but its revenue has been hit by cuts in public spending, and as a consequence it has recently posted an annual loss for the first time in ten years of trading.

A government department has recently set up a new agency whose purpose will be to provide online training for unemployed people. The idea is that this training will help people to develop a range of skills with the overall aim of helping them get back into work. Courses will be developed in all aspects of the job-hunting process, including designing an effective CV, looking for job adverts, filling in job applications, interview technique, and so on. There may also be courses in basic numeracy, literacy and IT skills. Learning Logic has a good pedigree in designing and developing courses of this general kind, and creating a good relationship with the new agency could lead to an excellent ongoing source of income for the company.

The Managing Director of Logic Learning has a background in software engineering and learning design. She looks over the first Invitation to Tender (ITT) that has been released by the new agency – for a course in CV design – with a view to developing a bid. The course has eight definite learning outcomes, and the person who has written the ITT has stipulated that each of these learning outcomes should be assessed using a different method of assessment in order to provide variety for the user. In the MD's opinion, however, this amount of variety in assessment is far too complex for a course of this length. Not only will it make assessment less effective overall, it is also likely to result in a learner experience that is annoying and confusing. On the other hand, these are the project requirements as laid out in the ITT, and the increased complexity in the work would mean a larger project that would bring in more money to Logic Learning if they were to be successful in their bid.

Dilemma

Imagine you are the Managing Director of Logic Learning. You are planning to tender for some work from a public sector agency – an e-learning course aimed at job-seekers. The work as specified in the Invitation to Tender is, in your opinion, unnecessarily complex. On the one hand, your business needs to take on work, and if you do not bid for the work as described it may be less likely that you will win this contract. Moreover, even if you do win it, a less complex project will bring in less revenue.

What should you do?

1. You could bid for the work as described, arguing that it is the responsibility of the customer to set out the project's requirements, and that your responsibility is to generate revenue for your company by fulfilling these requirements.
2. You could develop a bid that contradicted the customer's stated requirements, but that met what you see as their real needs both more effectively and more cheaply.

Discussion

The company described in the case study, Logic Learning, has been struggling financially. However, this new ITT is for work that matches Logic Learning's skills and experience, and their generally good reputation as a supplier of e-learning functionality to public sector organisations, Logic Learning would presumably be in a strong position to win the work. The requirements are problematic, but are not so bad that the project cannot be salvaged. For this reason, ignoring the work seems like a poor option. Realistically, the choice is between options 1 to 3 above.

Aside from any concern for the client, each of these options can be evaluated in terms of the commercial interest of Logic Learning. If Logic Learning decides to bid for the work as described, it may be that they increase their chances of winning the contract, and the value of that contract is likely to be higher. Furthermore, building a good relationship with this government agency now could lead to more work in the future. However, if the badly thought-out requirements result in a bad piece of software and a poor learning experience, Logic Learning's reputation may be tarnished as a result. It may be that a better relationship can be built by being honest about the perceived shortcomings of the ITT. On the other hand, while the customer might appreciate the honesty of stating concerns, they may resent being told that their requirements are badly thought out, and may choose instead to go with a supplier that sees no problem with the work as it is described.

So far we have only considered what would be in the commercial interests of Logic Learning. While it is legitimate for the Managing Director of Logic Learning to take these interests into account, they are not the only factors which will impact the decision. The Statement of Ethical Principles states that engineers should 'ensure that all work is justified'. Would the design of eight different assessment methods be justified? In terms of the customer's stated requirements, the answer might be 'yes', but an engineer may consider that a higher standard of justification is needed here, which could be thought of in terms of respect for the public good. It is perhaps not compatible with respect for the public good to use an unnecessarily large amount of public money to design a piece of software that is frustrating for the people using it.

However, it may not be Logic Learning's place to make this judgment. There is an important question of responsibility in this case. The customer has a responsibility to set out requirements carefully, but if they appear to have failed in this responsibility to an extent, is it the supplier's responsibility to point this out, especially when this course of action may harm their commercial interests? If it is, the third option looks like a way to discharge this responsibility while minimising the risk to the business.

Summary

In this case, tendering for the work as described, but including in the tender a section detailing what you see as the cheaper, more effective option, allows you to discharge any responsibility generated by the need to respect the public interest, while giving you a good chance of winning the contract. However, it will require skilful communication to do this in a way that strikes the customer as a helpful, constructive suggestion rather than an intrusion on or criticism of their work.

Furthermore, this may not be the end of the ethical issue. What if the customer accepts your bid, but declines the suggestion regarding simpler functionality? Assuming you still thought the complex version was not justified, would you be ethically required to turn down the work?

Other ethical considerations involved in this case

As well as *justifying the work*, this case also highlights issues of *honesty and integrity*. Stating your concerns about the way the project is described may be a requirement of honesty, and it may be seen as an act of integrity to do this even though it might not be in your own interests. The case also requires you to consider how your work *affects others*, taking account of the effect of your work on the users of the course, and on the public in general, as well as on your own company and your prospective client. There is also a question of *gaining trust*. Would you be better placed to gain the trust of your client by serving their needs as described, or by stating your reservations about their ITT?

4.2 Minimising and justifying adverse effects

Professional engineers should "minimise and justify any adverse effect on society or on the natural environment for their own and succeeding generations"

Scenario

Jean Smith is a self-employed engineering consultant. Jean has recently acquired a contract from Construction Towers to produce an environmental impact statement for a project that they have developed. The project is to construct a tunnel beneath a river which divides two halves of a major city. Construction Towers has sold the idea to the city authorities on the basis that a tunnel will relieve significant traffic congestion currently being experienced on one of the main road bridges across the river. Final approval for the project, however, will depend on the results of the environmental impact statement.

Jean is aware that she is being employed by Construction Towers, and as such has a responsibility to provide a satisfactory service to her client. Having had a number of informal conversations with members of the client's management team she knows that their expectation is that the report will find no significantly

negative environmental impacts associated with the project. She takes this to be a tacit instruction to ensure that the report meets this expectation; furthermore, she knows that such tailoring of reports is common practice amongst her competitors.

One way that Jean could ensure the results of the report meet Construction Towers's expectation is to be selective about the date which is used. She knows that there are a number of different ways to construct such a report and a number of different methodologies that could be followed. Unless there are large and obvious environmental issues with the project she believes that she could make the report supportive of the project without committing outright deception. Such results could be achieved, for example, by careful selection of the impacts that will be considered significant, the methods of collecting data, the way the data is analysed, and methods of forecasting future effects.

While she does not yet know the outcome of the investigations, Jean has some reasons for thinking that the environmental impact of the project will not be negligible: the proposed entrance to the tunnel is close to a rare grassland habitat, and she has seen evidence from similar projects that suggests the overall effect is likely to be an increase in total traffic and hence an increase in both localised and more widespread pollution.

As a further consideration, if Jean report is not supportive of the project she thinks it unlikely that she will get any more work from Construction Towers and also that other clients that she works with will be less likely to employ her in the future.

Dilemma

You are Jean Smith, a self-employed engineering consultant. You have been employed to produce an environmental impact statement for a new road tunnel on behalf of the construction company proposing the tunnel. It has been made clear to you that the expectation of your client is that the statement will not find significant environmental problems with the project. However, you are concerned that if you produce a report that meets these expectations, it will not fully represent the adverse effects of the project and could lead to the project proceeding even though its benefits do not outweigh the environmental damage it will cause. How should you go about completing the environmental impact statement?

What should you do?

1. You could proceed with the intention of satisfying your client's request – if at first the report is too critical of the project you will adapt the methodology used to make it more favourable. If this does not work you will alter the data you have collected to fit the conclusions.
2. You could conduct the report, adapting the methodology within limits in order to meet the expectations of Construction Towers, but not going so far as using false data or deliberately misleading techniques.

Discussion

If you decide before you start that the environmental impact statement will be favourable to the proposed tunnel it is likely that you will have to ignore some of the adverse environmental effects that you could report. The approval process, which is meant to weigh proposed benefits against expected costs, will then not be able to take these effects into account. If the tunnel is approved, it may well be that some of these negative effects are not compensated for by the benefits it provides; at the very least we will not know whether they are outweighed or not.

Your actions will have prevented the minimisation or justification of any effects on the natural environment, in contravention of the statement of ethical principles. Therefore, option 1 is not an ethically acceptable course of action. Perhaps, then, the second option would be a good compromise. By adapting the methodology of the report to the situation that you find you could do your best to satisfy your client's expectations while at the same time not using false data or any approach that falls outside the bounds of acceptable methodology.

However, you would perhaps still be left asking yourself questions. How can you determine what these bounds of acceptable methodology are? It is true that such reports are typically constructed in different ways, but at what point does an acceptable difference in methodology become manipulation of the data and the process of the report? You may conclude that any change in methodology that is introduced *with the express purpose of delivering a particular result* may constitute unacceptable manipulation.

If this is your conclusion, then perhaps you will decide to set out your methodology before you start collecting data, and then report your findings whether or not they are favourable to the project or not. By trying to construct your report based on accepted best practice, you would be able to fulfil your responsibility to "minimise and justify any adverse effect on society or on the natural environment". But how do you determine what best practice would require?

Furthermore, you know that if your report is unfavourable to the project there is a strong possibility that you will both lose a valuable client and also acquire a reputation in the industry which makes it harder for you to get future work. Construction Towers might even get another consultant to produce a report that is more favourable to the tunnel. At the very least, your actions are unlikely to have a long term effect on the way that environmental impacts are taken into account in such cases, since you are aware that many of your competitors are at least willing to tailor the way they produce such reports to the requirements of their clients.

Ideally, you could change the way that such reports are typically produced so that it would be accepted by all parties that the results were entirely independent. Perhaps this could be done by introducing a methodology that was certified as an industry standard. But how would you do this, particularly when so many vested interests are at stake? And how should you act in the meantime given that your business depends on keeping your clients happy?

Legally, you must be very careful that your report does not use false data or parameters or produce a false or misleading result; otherwise you could be committing fraud. It can be fraud not only if you knowingly or recklessly include false data or parameters, but also if you knowingly or recklessly exclude data or parameters which could lead to a different conclusion. You need to bear in mind that in many cases reports are not only being received by your clients, but also by other interested parties, such as the government, the public, or the court. They

will often be expecting you to be acting impartially and as an expert. Fraud can result in criminal conviction and fines.

Summary

In this case, the best outcome would be for the environmental impact statement to be completed according to a single methodology that has been agreed by all interested parties. This would seem to be the best way of discovering adverse effects of the project and investigating if they were justified. Given that no such a methodology exists, it seems hard for you to bring this result about. If you try to use what you believe to be the best candidate for an industry standard methodology you risk losing your business if the results are not favourable to your client. You could attempt to get such a methodology universally recognised, but how would you do this given the vested interests involved?

Other ethical considerations involved in this case

As well as *respect for life, law and the public good* this case involves considerations of *accuracy and rigour*, although it might be unclear how to distinguish picking an appropriate methodology for a client from acting with unacceptable bias. *Honesty and integrity* will come into play with a requirement to reject improper influence, and so will *responsible leadership*, especially in its requirement for *objectivity and truthfulness* [link to 5.3].

4.3 Respecting limited resources

Professional engineers should “take due account of the limited availability of natural and human resources”

Scenario

BFG Ltd have been contracted by a local authority to undertake restoration work on Russell House, a listed building in England. Russell House is an attractive specialist children's home well-loved by staff and children who, for the duration of the restoration work, have had to be relocated to rather unsatisfactory temporary accommodation. As it is a listed building, materials that need to be replaced must be replaced like-with-like. Most of the timber in the house is sapele hardwood sourced from a single country. Of course, where possible, BFG will retain as much of the original timber as possible. But, as part of the refurbishment the timber will have to be taken out, to get to cables for example, and then put back. As a result of this, some of the timber is likely to break and will need to be replaced like-with-like.

At the same time, however, there are a number of requirements to use sustainable timber. As the restoration is government-funded, BFG are required to comply with the government's timber procurement policy which states that contractors should actively seek to buy timber from legal and sustainable sources. Government contracts are not awarded if contractors cannot guarantee that their timber is legal and, wherever possible, contracts are awarded to those companies who provide timber which is sustainable also. However, many environmental groups argue that these requirements are too lax, and should be more stringent. In particular, the reliability of some of the regulating bodies has been questioned, and the Forest Stewardship Council (FSC) is generally considered to be the most reliable.

Whilst BFG was awarded the contract for Russell House based on their tender to use sustainable timber, there are no further regulations concerning any particular requirements. The government policy does not stipulate, for example, that FSC

timber must be used. The local authority has stated, however, that one of the reasons for choosing BFG over other companies was their reputation for having commendable environmental policies. BFG themselves have a policy of only using timber certified as sustainable by the Forest Stewardship Council (FSC).

The company have tried to find a supplier of sapele hardwood sourced from the same country as the original, that was certified as sustainable by the FSC. Unfortunately, this has not been possible and they have found instead a supplier elsewhere in the EU who could provide such wood that was certified as sustainable by the Sustainable Forestry Initiative (SFI). There is also a UK supplier who could provide sapele certified by the FSC, but sourced from a different country.

The staff and management of the children's home have been bringing pressure to bear to complete the project quickly. This is because of the detriment to the welfare of the children from the less suitable temporary accommodation.

Dilemma

You need to decide whether to go with the supplier who is able to provide SFI-certified wood from the same country as the original wood, or the UK supplier, who is able to provide FSC-certified wood sourced elsewhere. This dilemma involves deciding between two important considerations: taking account of limited natural resources and carefully preserving our collective heritage.

What should you do?

1. You could go with the supplier who is able to provide SFI-certified wood from the same country as the original wood.
2. You could go with the UK supplier, who is able to provide FSC-certified wood sourced from a different country.

Discussion

You may think the supplier of wood from the original country presents the most ethically attractive option. Their wood is certified as sustainable, and BFG are not to blame if it turns out not to be. As long as the certificate is there, BFG have done their duty. Although not using FSC timber goes against BFG's usual policy, this is justified in this instance to fulfil the like-with-like condition. The wood is like-with-like and this is important to preserve the heritage of the building - more important than having to consider the mere possibility that the wood might not be sustainable.

However, there are good reasons for thinking that the UK supplier presents a better option. There is strong reason to suspect that the wood supplied by the other supplier may not come from sustainable sources - the SFI is said not to be as reliable as the FSC and this is probably why BFG have a policy of only using FSC certified timber. The like-with-like condition may not be so stringent and replacing any broken timber with wood of the same species is probably sufficient. Furthermore, the woods are very similar in appearance and properties, and so it is unlikely anyone will notice. Even if the colour of the new timber is slightly different, this may improve with age, and having wood panelling that does not match is not as important as saving endangered habitats.

Summary

There are two core considerations in this case: the need to preserve the heritage of the building and the need to be sensitive to the natural resources that you use, in particular ensuring that they come from sustainable sources. In order to balance these two considerations you need to use your judgment to determine exactly what each requires in this case. For example, you may decide that SFI certification is not sufficient to make it acceptable to use that wood, and that wood sourced from a different country, but of the appropriate kind is sufficient to preserve the building's heritage. If this were the case, then using wood from the UK supplier is clearly the best option.

Other ethical considerations involved in this case

Other considerations that relate to *respect for life, law and the public good* will also be relevant here, in particular the need to act honourably, responsibly and lawfully and uphold the reputation, standing and dignity of the profession. In addition, this case also calls for *responsible leadership* in being aware of the issues your actions raise for society and the how these bear on the aspirations and concerns of others.

4.4 Health and safety

Professional engineers should "hold paramount the health and safety of others"

Scenario

Kudochem is a multinational chemical company producing chemicals for the agricultural industry. Responsibility for engineering issues at the 11 Kudochem chemical plants in Europe, primarily in the UK, Germany and the Czech Republic lies with Kudochem's European Regional Engineering Director, Sally Proctor.

In the early hours of one morning, Sally receives a telephone call informing her that there has been a serious explosion at one of the plants. There have been some injuries, and damage has been done to property several hundred metres from the plant, but there have been no fatalities. The scale of the damage is huge, and the main site of the chemical plant is almost completely destroyed.

In accordance with company policy, an inquiry team is set up, involving company employees as well as independent consultants. After several weeks, the team discovers two possible causes, both relating to a new ammonia production technique for fertiliser, which has recently been introduced in all of Kudochem's plants. They are unable to determine which of these two possible causes are responsible. Given the presence of the flawed procedure in all of Kudochem's plants, it is imperative that the ultimate cause of the explosion is identified, so that urgent steps can be taken to safeguard against similar accidents at other sites.

The inquiry team is very concerned at their inability to determine the cause of the accident. Without this knowledge, it will be impossible to satisfactorily modify the plants in order to prevent future explosions of this kind. They make a radical recommendation: to call a meeting with several competitor companies who are also using the new procedure in their fertilizer plants, in order to share experiences and research findings.

This would be a significant departure from standard practice, and some senior colleagues with commercial responsibilities have reservations. To call the meeting would entail releasing information about the safety lapse, as well as discussing sensitive commercial information with business rivals. However, it may be the case that other engineers in other companies have encountered problems with

the new method for producing ammonia, and could offer help in isolating the problem. Whilst such a course of action may be unusual in this case there are industries where safety critical information is routinely shared amongst competitors.

Dilemma

You are the European Regional Engineering Director for a multinational chemical company. After an explosion at a chemical plant, you have responsibility for preventing similar accidents at 10 other sites. The inquiry team has been unable to identify the cause with complete accuracy, and they have recommended that you initiate discussions with competitor companies to pool knowledge. This would be unconventional, and would entail significant commercial risk.

What should you do?

1. You could take the advice of the inquiry team, and invite engineers from other chemical companies who are using a similar process to produce ammonia, to come and discuss the accident.
2. You could persevere with the safety inquiry in-house, hire more consultants and attempt to ascertain the precise cause of the accident without involving other companies.
3. You could consider the entire process as too risky, and reconfigure your chemical plants to utilise a different method of ammonia production, perhaps reverting to the older established method.

Discussion

In this scenario, the situation could be seen as one in which there is a conflict of interests and duties, such that you are required to balance these conflicting concerns. On the one hand you need to ensure the safety of employees and local residents, and on the other hand you need to maintain the security of commercially sensitive material. In addition, you need to balance the risks with the financial costs of possible remedies, and you need to judge what is appropriate in an abnormal situation.

The Statement of Ethical Principles states that you must "hold paramount the health and safety of others." At the same time, though, you need to take into consideration any other obligations you may have – including the duty to keep sensitive material secure, and to protect people's jobs by protecting the commercial interests of the company.

Of course, if a company is acting illegally or irresponsibly, you may have a duty to 'blow the whistle', and this may defeat any obligation to keep sensitive information secret. However, in this case, there is no indication that the company was acting irresponsibly. As a result, while it may be the case that you have an obligation to protect the safety of others, you have other duties too.

As such, you could consider the commercial risks of sharing information with your competitors to be too significant. Even if this is not your first response, you could be persuaded by commercial managers of the company that this is true. However, it is not clear that these considerations can outweigh the safety concerns. The principle states that you should hold paramount the health and safety of others. The same procedures are being used in all of Kudochem's plants and, given that the cause hasn't been identified, you need to take seriously the possibility that there could be another explosion.

Therefore, whichever option you choose, you will need to ensure that you take steps to ensure that there isn't a similar accident in one of the other plants. Therefore, if you decide to keep the enquiry in house and just hire more consultants, whether or not this is acceptable may depend on what other steps you take to prevent accidents at the other plants. If no steps are taken, this option would appear to be ruled out by the principle we are considering.

Alternatively, you may decide that a remedy will not be found in-house, and that it is not suitable to share information with competitors, and that it is preferable to take the drastic step of replacing the entire process rather than run the risks associated with the other options. This solution at least has the benefit of being associated with predictable costs, timescales and safety levels.

Finally, it may seem like pooling safety information with other companies is the best way of ensuring the safety of the chemical plants, and of holding "paramount the health and safety of others". Not only will you be able to ascertain the cause of the accident and modify your own plants, but your competitors may be able to avoid similar accidents.

This last point should not be understated. The principle is not just to avoid being the direct cause of harm, but to hold paramount the health and safety of others. As such, if you are able to act in a way that helps other companies to make their plants safer, you should do so. Of course, it is not your main responsibility, and of course your competitors have the primary responsibility of ensuring that their plants are safe. But if there might be problems with their plants, of which they are not aware and about which you could warn them, this does seem to be a further reason in favour of sharing information.

Furthermore, the practice of sharing information in this manner has precedents in other commercial areas. For example, following the Piper Alpha disaster in the North Sea, offshore oil and gas companies now routinely share safety related information. This may be true, but it is important that in extreme situations such as this you make a thoughtful decision, and reflect on a range of considerations. The safety of employees and residents should take priority, but how this is achieved and how other considerations are compromised will require reflection and careful consideration.

Summary

In this case, there does seem to be good reason to share safety information, if at all possible. Of course, where possible this should be done in a way that gives appropriate weight to one's other duties, regarding sensitive information, for example. Ultimately, however, it should be recognised that holding health and safety paramount doesn't just mean ensuring that you are not directly responsible for harms to the public, but that you also have some responsibility to help others improve their health and safety, for example by warning them of dangers they may not be aware of.

Other ethical considerations involved in this case

Another consideration that is central to this case is the principle of *upholding the reputation of engineering*. If engineers were perceived to be taking unacceptable risks because they were putting economic considerations and competition before health and safety, this could be very damaging to the engineering profession. On the contrary, the sort of co-operation considered in this case might well enhance the profession's reputation.

Wider applications

One of the characteristics of engineering decisions is that they can affect the health and safety of very large number of people. This means that the general public expects engineers to consider the ways in which their activities might put people in danger, and to remove or mitigate those dangers.

It is easy to say that the health and safety of employees and the public should take priority, but issues arise in identifying an appropriate level of safety.

Engineering activities are rarely 100% safe, and what matters is whether an activity is "safe enough", where this is down to the judgement of individuals, society, politicians, scientists or lawyers.

This issue crops up most often in engineering in the form of managing a balance between safety and financial cost. How much should you spend in order to avoid death or injury to a member of the public? This decision can depend on many factors, and different answers are given in different areas; rail transport and car transport, for instance. Many aspects of this kind of question are settled by legislation and industry standards, but engineers can easily find themselves having to make decisions at the boundaries. In these situations it is important to be able to think about health, safety and risk in a rational manner, without either feeling totally constrained by financial pressures, or disregarding the practical implications of implementing safety measures.

4.5 The reputation of engineering

"Act honourably, responsibly and lawfully and uphold the reputation, standing and dignity of the profession"

Scenario

You are the member of a team is responsible for the regular maintenance of a fleet of 10 aircraft for a small, airline. Recently, a jet has caught fire and crashed over the North Sea and your team is charged with examining the wreckage to see if any malfunction occurred. They quickly identify that the crash was due to the failure of a pump casing; in particular, studs that attach the pump casing have failed. You put these findings into a report which you pass on to your superior.

Three days later a memo is circulated by Head Office instructing all maintenance teams to replace all pump casing studs on every jet of this kind in the fleet. Replacement studs are delivered to the workshops with instructions that this job is to be undertaken as a matter of urgency, with crews working over the weekend to ensure its swift completion.

You examine the new studs that are to be put in all aircraft. You come to the conclusion that they are of poor quality: the studs have cut threads where the old studs had rolled threads (rolled threads have a better fatigue resistance). You are not convinced that the replacement studs have the physical capacity to keep the pump casings on securely and believes that this may lead to further accidents.

However, the order to replace the studs has come from 'on high', and under normal circumstances you would be under an obligation to obey such an order. You are hoping for promotion in the next 6 months and do not want to be marked out as a troublemaker.

Dilemma

Imagine you are an engineer working for an overseas airline, given orders to replace the studs attaching the pump casings on all the jets under your control, but you believe the replacement studs to be of poor quality. As a relatively junior member of staff you are expected to follow orders and you are worried that raising your concerns in this case could be detrimental to your career. However, as an engineer your primary responsibility is to ensure the safety of the jets under your control, their pilots, crew and passengers. You believe that if you simply follow the orders that you have been given to replace the studs, you will not be acting responsibly and the safety of the jets will be compromised. What course of action should you take given your competing responsibilities to obey orders and to maintain the safety of the jets, and considering your concerns for your career?

What should you do?

1. You could decide simply to follow your orders. A decision has been taken at a high level that this course of action is the best for the safety of the jets, and so you could argue that it is possible both to obey orders and fulfil your responsibility for safety by replacing the studs.
2. You could inform your superior of your concerns and recommend that work not proceed until evidence has been provided to demonstrate that the studs are not of poor quality, or new high quality studs have been delivered.
3. You could refuse to carry out your orders and raise your concerns that this is a 'rush job' that threatens safety directly with senior company executives.
4. You could pass your concerns to the media. There has been substantial interest in air safety since the original jet crash, and you will be able to prevent what looks like the prioritisation of public relations over the safety of pilots and passengers.

Discussion

You have been given an order to replace the studs on the jets under your control with the new studs that have been provided. Moreover, this order has been issued as a response to a report that you yourself submitted stating that the cause of the recent jet crash can be traced to a failure in the studs on that aircraft. You are worried about taking actions that look like they are going against your orders. In particular, you don't want to risk the promotion that you hope to receive in the near future.

Looked at in this way, it seems that the best ethical course of action would be option 1. Replacing the studs fulfils your responsibility to maintain the safety of the jets, meets your obligation to follow orders and also recognises the responsibilities you have to yourself and any dependents for keeping your job and furthering your career. However, this analysis does not take into account the further information you have from examining the replacement studs. This information provides strong evidence that, despite the order being issued in response to your report, replacing the studs will actually be detrimental to the safety of the jets.

It is hard to see how simply ignoring this information is compatible with acting responsibly. Furthermore, were others to become aware that you had ignored it your reputation as an engineer, and by association the reputation of engineers in general would be damaged. Option 1 therefore seems contrary to the principle to 'uphold the reputation, standing and dignity of the profession'.

The other three options all present ways in which you could act on your concerns. You might think, then, that passing your concerns to the media would be for the best: it would be the course of action most likely to bring about a review of the order to replace the studs, and hence fulfil your responsibility to maintain safety. However, this is also the option that is most at odds with both your obligation to obey orders and protect your career interests. It could also harm your reputation as an engineer if it was thought that you were passing on confidential information without good reason.

With regard to these considerations, informing your direct superior of your concerns appears the most appropriate option, followed by bypassing the chain of command and going directly to senior officers. Simply going on the information available, you have no evidence that either of these options would be ineffective in addressing your safety fears.

If informing your superior of your concerns is effective in ensuring the safety of the aircraft then it would appear to be the best compromise between your competing obligations; if this option proves to be ineffective, it does not rule out going directly to senior officers or passing your concerns to the media. These other options would also be more obviously justifiable if you had already tried to go through the appropriate channels. Failing to do so would leave you open to criticism, which might even prevent your intervention from being effective.

Summary

In the first instance, informing your superior of your concerns and recommending that work not proceed seems like a good option, balancing your obligations to your employer with your responsibility to the safety of the aircraft. However, you are mindful that your primary responsibility is to the safety of the aircrew and the safe operation of the aircraft. Meeting this responsibility and upholding your reputation as an engineer may require you to take further actions if this one proves ineffective.

How could further information change this assessment? What if it would take time to go through your superior, resulting in many jets receiving the new studs? What if you believed that this was just one example of systemic problems in aircraft maintenance?

Other ethical considerations involved in this case

As well as *the reputation of engineering*, this case also highlights the requirement to *hold paramount the health and safety of others* as part of a general duty to have *respect for life, law and the public good*. In addition, this case also involves questions of *honesty and integrity*. Although the flight engineer's primary concern must be with safety, he also has a duty to act in a trustworthy way and respect the rights and reputation of his employer. In fact, upholding the 'reputation, standing and dignity' of engineering will involve being seen to uphold all relevant ethical principles. In this case *accuracy and rigour* in evaluating the order that was issued, and exercising *responsible leadership* of the team of engineers.

5 Chapter introduction - Responsible leadership: Listening and informing

"Give ethics a prominent place in all that the institutions do. Communicate this widely and frequently through the media. Work closely with other professional groups e.g. medicine to learn from their approach. Hold discussions with others from non engineering/scientific backgrounds e.g. philosophers to gain a broader insight into how they view and handle ethical issues."

Engineering ethics in practice survey, in response to the question: Do you feel that the engineering profession could be doing more to promote engineering ethics and to support engineers?

Under the heading, 'Responsible Leadership: Listening and Informing', the Statement of Ethical Principles states that professional engineers "should aspire to high standards of leadership in the exploitation and management of technology. They hold a privileged and trusted position in society, and are expected to demonstrate that they are seeking to serve wider society and to be sensitive to public concerns." This guide focuses largely on cases in which an engineer has to make a decision, often at a particular time. In presenting a report, for example, the engineer is required to be honest and objective. Or, if offered a bribe, an engineer is required to reject the bribe. We can think of these as requirements for an individual engineer, at a particular time. If the engineer fails to be honest, or if he accepts a bribe, the engineer does something wrong.

Not all ethical considerations are like this. If we think about the engineering profession as a whole, there might be responsibilities that apply to the profession, without being the responsibility of any specific individual professional. Professional bodies can engage with politics, campaigning for changes in the law and so on. For example, the medical profession gets involved with debates on the safety of sports such as boxing, or on public health policies relating to issues such as childhood obesity. It is plausible to think that this is a part of the profession's responsibilities but, typically, we would not claim that any particular doctor had done something wrong if they were not involved in any particular campaign. It may be perfectly permissible for any given individual not to be involved in any of these wider activities but something would be lost if the medical profession as a whole was not involved in public debate and had no part to play in forming public policy. Indeed it may be thought that the medical profession fails if it does not engage in this way.

Similarly, while it may be acceptable for any individual engineer to choose not to be involved in political debate, there may be an obligation for the engineering profession as a whole to engage in these wider activities. Issues such as climate change, energy security, the protection of personal data and so on are high profile policy issues to which the engineering profession can make an important contribution.

Hence, there is a specific interpretation of 'leadership' in this guide. This principle above could refer to the duty that engineers have to be responsible leaders when managing other engineers. As such, "listening and informing" would be a reference to the duty of a senior engineer to listen to the other engineers he is working with, and to keep them informed. Although this is important, this principle refers to the responsibility not of individual engineers, but of the engineering profession as a whole, to provide responsible leadership, to listen to society and to engage with the public. However, it is individual engineers who must make the decision to follow

this principle. If there are no engineers who engage with the wider debates in society, then the profession as a whole cannot fulfil this responsibility. How these responsibilities of the profession translate into individual responsibilities will depend on how (and how well) the profession organises itself.

The boxes below give some brief engineering examples relating to responsible leadership.

Some have argued that a number of major engineering disasters – such as the Hatfield rail crash – occurred not because engineers made mistakes or made the wrong decisions, but because engineers were not sufficiently involved in the decision making. In a number of large companies, there has been a move towards reducing the number of engineers involved at the higher levels of management, so that engineers have less direct involvement in a number of crucial decisions.

This is a trend that the engineering profession could try to address, for example by inviting and promoting dialogue on measures to promote health and safety.

One concern that some people have about carbon capture technologies as a response to global warming is that the prospect of a technical solution to the problem may discourage people from using energy more responsibly. One way in which the engineering profession could respond to this concern would be to be active in explaining all the different implications of implementing the new technology, encouraging a wide and balanced debate that captures both the positive and negative aspects.

Frequently, whistleblowers suffer as a result of their effort to expose corrupt, fraudulent or unsafe practices. Arguably, professional bodies could do more to protect the engineers who risk their own careers to help protect others, and similarly engineers could do more to encourage their professional bodies to do more.

In the following sections, more detailed cases are used to illustrate different aspects of responsible leadership. These cases are designed to be challenging, and to allow reflection on what the principle means in practice.

5.1 Listening to society

Professional engineers should “be aware of the issues that engineering and technology raise for society, and listen to the aspirations and concerns of others.”

Scenario

Adrian Slattery is a leading researcher in nuclear technologies and also an active campaigner for nuclear power, arguing that it is without doubt the most important part of a sensible response to the problem of global warming. He frequently attends events debating the pros and cons of nuclear power, including those open to the public and debates with leading politicians. He has now been asked to write an article about the future of energy production, and nuclear power in particular, for a national newspaper.

Increasingly, Adrian finds himself becoming frustrated with what he considers to be irrational attitudes, arguing that most people willingly participate in activities that are statistically more likely to harm them than a nuclear power station. Furthermore, he also argues that the public seem to over-emphasise the risks involved with nuclear power while simultaneously under-estimating the impact that global warming will have if we don't radically change our use of energy and our energy sources.

As a result, he writes an article that is very critical of what he considers to be people's irrational fear of nuclear power. Furthermore, he argues that there is an element of selfishness in people's attitudes. Although the UK will of course be affected by global warming, it is other countries (and future generations) that will suffer the most severe consequences. As such, he considers the UK public to be selfish and irresponsible, willing to expose future generations and individuals from other countries to much greater risks as a result of our energy consumption, rather than accepting the (relatively) small risk that comes from nuclear power.

Finally, in his conclusion, Adrian argues that the politicians responsible for making the decisions should simply ignore any opposition to nuclear power, and must instead embrace it, regardless of public concerns.

Dilemma

Imagine that you are in Adrian's position, and share his beliefs. You passionately believe that nuclear power is the only real solution to the problem of global warming, but you are frustrated by the public's opposition to it. You want to work to promote a proper understanding of the benefits of nuclear power, and to highlight the dangers of not using it, but you don't know how to deal with the public's opposition. How should you approach the article?

What should you do?

1. Like Adrian, you could stress the importance of nuclear power, and argue that it must be embraced, regardless of public concerns.
2. Alternatively, although arguing that nuclear power is a necessary part of the solution to global warming, you could argue that the decisions made must be informed by the beliefs and concerns of those who will be affected by the decision. You could stress, however, that those affected by these decisions include individuals from other countries, as well as those from the UK.
3. You could argue that we live in a democracy, and therefore the decisions made regarding the UK's energy sources should be made by the UK's voters. After all, engineers are not the only experts to claim that the public do not understand the finer details. Economists, of course, will complain that the public do not have a proper understanding of economics. Nevertheless, we all expect to be able to vote for the party of our choice, and frequently do so, on the basis of the party's economic policies. Nevertheless, you could, of course, do what you can to engage people in a public debate and to persuade them that nuclear power is the right solution.

Discussion

The point of this case isn't to take a stance on nuclear power, whether to support the position taken by Adrian Slattery, or to criticise that view. That's why, in the summary of the dilemma, we stressed that, as well as being in his position, you also share his views. If you don't share his views, you can, of course, consider a different example with similar issues. The point of this case is simply to focus on the principle of listening to society, and one important point that has to be considered in relation to this principle is that you may not always like, or agree with, what society has to say. Furthermore, not only might you disagree, you might think that the public are ignorant of the relevant facts and lack the relevant expertise. As such, for some, it is tempting to ask, why should we listen to society?

In these cases, however, there are two points to consider before dismissing public opinion too quickly. First, something that appears to be irrational may not be on closer inspection. Consider, for example, the view that it is irrational to oppose nuclear power while participating in other activities that are statistically more dangerous. In this case, it is a mistake to compare the two risks without recognising the fact that people have very different attitudes to risks they voluntarily choose (e.g. crossing the road) and those that are imposed on them, without their voluntary consent (e.g. nuclear power, potentially). Second, even if you do think people are irrational or misinformed, there is still reason to think that people have some right to consent (or not) to decisions that will have a major impact on their lives.

Consider the doctor/patient relationship. In medical ethics, people often contrast the doctor-knows-best model with the informed consent model. According to the former, the patient is simply not qualified to make a decision for himself. He does not have a sufficient understanding of medicine, or of his illness, and therefore the doctor ought to simply prescribe the appropriate treatment, without any real dialogue with the patient. The doctor just prescribes the appropriate drugs, and the patient is expected to trust the doctor.

In contrast to this, the law requires the doctor to obtain consent from the patient. It is the doctor's duty to explain (in terms the patient can understand) the potential benefits of the available drugs (or other treatments), and the possible risks. It is then the patient's decision whether to consent to treatment or not. If the patient decides to act against his doctor's advice that is (usually) his right. The doctor may disagree with the patient's choice but (assuming the patient is competent) the doctor must respect the patient's wishes.

Of course, engineers working on large scale projects cannot usually get informed consent from every individual who could plausibly be affected. However, engineers should, at least, listen to society, and give some weight to society's views – even if they do not share them.

Summary

In this case, Adrian Slattery is convinced that the public are failing to recognise the importance of nuclear power, and is inclined to think that the solution is simply to ignore public opinion. Although we may think there is reason to have some sympathy for that view, there is also good reason to engage with the public, not only to inform them, but also to listen to the views and concerns of the members of society, and to consider people's values.

Other ethical considerations involved in this case

Obviously, one other principle that is central in this case is *promoting public awareness*. Promoting public awareness and listening to society will go together, as part of a dialogue between engineers and society. Other principles that are relevant to this case (or similar cases) are *evaluating risks, affecting others*, and *upholding the reputation* of the engineering profession.

Wider applications

Clearly, the responsibility to listen to society is relevant in any area of engineering where society, or some members of society, has concerns. These concerns might be about safety or about the wider social impact of engineering developments. People may, for example, have concerns about the effect that certain technologies will have on people's way of life (eg, people's use of the internet and social networking); the impact on people's privacy (as with CCTV); or the impact on their ability to work for a living (if, for example, they are no longer needed to do their job because technological developments make manual processes redundant).

5.2 Promoting public awareness

Professional engineers should "actively promote public awareness and understanding of the impact and benefits of engineering achievements."

Scenario

SudoWatch specialise in surveillance technologies, and in CCTV and cameras in particular. Shanil is a senior engineer leading one of the main projects, which involves trying to develop a system that monitors live CCTV footage in order to detect unusual or suspicious activity, so that a human operator is not required to monitor each individual camera.

The system is designed primarily for train stations and airports, and the challenge is to develop a system that will detect people leaving bags unattended, or acting suspiciously, while limiting the number of people involved in innocent activities (such as trainspotting) being harassed.

Shanil is committed to his work, believing that it makes an important contribution, both because he believes that this technology will help to keep people safe, protecting them from terrorist attack, and also because he believes that it protects people's privacy interests – because the CCTV will not be watched by a human operator.

However, he also has concerns about the lack of regulations governing CCTV and other surveillance technology, and is concerned about the amount of CCTV, particularly owned by private individuals.

In addition, SudoWatch have recently started producing cheap hidden camera products, such as hidden cameras made to look like smoke alarms, clocks, mp3 players, pens and watches. These products typically sell for under £200 and can be bought by anyone who wants one.

Shanil doesn't believe that these products have a legitimate purpose, and is worried by the lack of regulation regarding the sale and use of such products. In particular, Shanil believes that the public are not aware of how easily these products are available, and of their potential impact. Shanil doesn't have any involvement with

the production of these products, but is not happy that the company he works for has decided to go in this direction.

Dilemma

You work for a surveillance technology company, developing behaviour recognition systems to protect people from the threat of terrorism – a project that you believe in. However, you have misgivings about the company's new venture into developing hidden cameras for individual use, although you recognise that your company are legally entitled to develop these monitoring products. What do you do?

What should you do?

1. You could tell yourself that you are working on a worthwhile job, and it is not your responsibility to address concerns about public policy and the misuse of products.
2. You could leave your job, stating that you have concerns about the work the company is doing.
3. You could continue working on the project, but at the same time speak out publicly about your concerns about the lack of regulation.
4. You could try to persuade your company to work with you to consider the ethical issues, to work with people in the community and with ethics committees. You could encourage them to work towards campaigning for better regulations while, at the same time, developing the new technologies.
5. You could work with professional bodies to explore the ethical issues, and to campaign for better regulations, informing politicians and the public of the technology that is already available and/or is likely to become available in the near future.

Discussion

In favour of the first option, it could be tempting for you to think of this in terms of a simple division of labour, with scientists and engineers developing the valuable technologies, and politicians dealing with the social policies to avoid the possible undesirable consequences of the technology. However, this option could be seen as an abdication of your responsibilities; at the very least, it is your responsibility to think about whether this is worthwhile work which ought to be done. If it isn't, perhaps you should refuse to work on something that isn't worthwhile, and could be harmful.

In this case, you do consider your own work to be worthwhile. Beyond this, however, there is another reason not to assume a sharp division of labour.

Arguably, you as the engineer could concentrate on the possible benefits of a new technology, and downplay any potential problems, especially when these could (potentially) be dealt with by a change in the law, or some other social change. This is especially true if you think about the issue in the way described above, with a clear division of labour, and if you assume that society will address the problems that need addressing in order to get the benefits without the harms.

Unfortunately, we live in an imperfect world, and you cannot assume that the appropriate laws will be passed or social changes will happen. You must consider what impact the technology will have, given that we live in an imperfect world, where there are many drivers governing what legislation gets passed. You should not focus only on the impact the technology would have if only we could eradicate various social problems and human vices.

In general, ignoring the complex social context in which decisions are made can lead to unrealistic calculations about the value of new technologies: if evaluating a technology involves weighing up the pros and the cons, this evaluation will be distorted if the cons are not given the appropriate weight.

This also illustrates why engineers have a duty to engage with society. A society cannot make the necessary changes if they are not made aware of the relevant developments by those with the right technical knowledge and expertise. If, as you fear in this situation, society isn't ready for the new technology, then the engineering profession has a responsibility to work to inform the public of the technologies that are being developed, and to offer advice about what changes are required, and to start a public debate.

You as an engineer – and the engineering profession as a whole - needn't accept the world as it is, and can legitimately encourage society to consider the possible consequences of new technologies and to take the steps that will be necessary to limit the unwanted side effects of a particular technology. The medical profession, for example, has been involved in debates about the ethics of abortion, or of stem cell research. This has typically gone beyond just giving medical advice, and has included ethical analysis, arguing for or against particular views. Engineers can involve themselves in similar ways in decisions relevant to their profession.

If you dismiss option one, and acknowledge that you have some responsibility to consider the social impact of your work, the question of what is a suitable option remains. Option two, leaving your job, doesn't seem appropriate in this case, but could be in other cases if you felt strongly enough about the issue. As a clarification of the third option, it should be noted that the suggestion is not that you speak out against your company (though, of course, whistleblowing is legitimate in some cases, especially in cases of serious wrongdoing). Rather, the suggestion is that you speak out publicly about the need for changes in the law, to stress the need for regulation. This could be done in a way that remains supportive of your company and your company's aims. The claim could be that these new regulations are required so that companies (like the one you work for) are able to continue to do valuable work without worrying that their products can be very easily used for less legitimate purposes.

Nevertheless, it would, of course, be preferable if you were able to persuade your company to work with you in this. Similarly, it will also be beneficial if you have the support of professional bodies.

Summary

In this case, you have a conflict between believing in the value of the project that you are working on and concerns about other products manufactured by the company. It may not be appropriate to quit your job over the issue in the first instance, as you could work towards the sorts of social changes that would be necessary to protect people from the misuse of surveillance technologies. Where possible, it would be best if you could work with the company and/or professional bodies in trying to achieve these aims.

Other ethical considerations involved in this case

As well as *responsible leadership* this case raises important questions regarding what an appropriate *respect for life, law and the public good* requires.

Wider applications

There will be many situations in which public awareness of an issue is important. Respecting the requirement to promote public awareness may just require publicising a new issue: to demonstrate, for example, that driverless vehicles are now a real possibility, and to consider the implications of this new technology.

In other cases, the promotion of public awareness may be important because the public have misconceptions about a particular technology – possibly due to lack of information. For example, individuals might have concerns about nanotechnology. Some of these concerns may be legitimate, and may be real issues that society needs to address. Other concerns, however, may be based on misconceptions, and the promotion of awareness and understanding may be sufficient to create informed opinion of important new technologies.

5.3 Truth and objectivity

"Be objective and truthful in any statement made in their professional capacity"

Scenario

Patricia Smith is employed by Spectrup, a radio broadcast equipment manufacturer as a sales rep. In addition, Patricia works as an independent consultant for organisations in the radio broadcast field. This work can include analysing their technical problems and, when required, recommending any radio broadcast equipment that they might need.

Whilst working as an independent consultant the kind of equipment about which Patricia makes recommendations is often the kind of equipment that could be supplied by Spectrup. Indeed, sometimes Patricia does recommend Spectrup products. There are two reasons why Patricia might recommend Spectrup products: firstly, that they are better or at least as good as any competing products at meeting the client's requirements; secondly, that Patricia is an employee of Spectrup, and both has loyalty to the company and will stand to benefit from the sale.

Since they are employing Patricia as an independent consultant, her clients expect her to provide them with impartial advice, and feel that they are justified in this expectation. In other words, they expect Patricia only to recommend Spectrup products when they are the best available. Patricia is aware of this, but she is also a loyal employee of Spectrup and instinctively it feels wrong to her to recommend competitor products when Spectrup products would be adequate for the client's needs.

It seems, therefore, that by having both jobs Patricia is likely to face conflicting obligations. She is aware of this conflict of interests and wonders if she can overcome it by ensuring that she separates her two jobs completely, so leaving her free to think only of her clients' interests, and not those of Spectrup, when acting as a consultant.

However, even if Patricia manages to separate her two jobs effectively, giving entirely impartial advice when working independently, and being loyal and diligent when working for Spectrup, the fact that she has these two jobs may affect others' opinions of her; they may believe her to be biased when in fact she is not.

Dilemma

Imagine that you are Patricia Smith. You work as both an independent consultant and as a sales rep for Spectrup, a radio broadcast equipment manufacturer. Given that you are called upon to recommend appropriate equipment to clients in your role as a consultant, you recognise that you are faced with a conflict of interests between your two jobs. As a consultant you should be impartial, but as an employee of Spectrup you should promote their products where possible. Is it possible to separate your roles to avoid the conflict? And if it is, how do you convince people that you can maintain this separation?

What should you do?

1. You could make sure that your consulting clients do not know about your job with Spectrup to avoid them suspecting that your advice is biased.
2. You could decide either to stop offering independent consulting services, or you could resign from your job with Spectrup, so eliminating the conflict.
3. You could make sure that Spectrup is aware of your consulting activity, and that all your consulting clients are aware of your job with Spectrup and you could make it clear to all parties that you will act completely impartially when employed as a consultant.

Discussion

You are aware that part of the problem in carrying out your two roles stems from the feeling that you are somehow being disloyal to Spectrup if you do not recommend their products to your consulting clients. You know that your clients expect you to be impartial and would be unhappy if they thought that you were not; however, if they were unaware of your role with Spectrup then they would have no reason to question your impartiality. Perhaps by keeping your role with Spectrup concealed you can keep both parties happy.

This course of action would clearly be unacceptable in a number of respects. Firstly, as a professional engineer you have a responsibility to be truthful. Deliberate failure to mention materially relevant information is a breach of this obligation to truthfulness. In addition, you also have an obligation to be objective; objectivity requires that you only take into account relevant considerations, from the point of view of the problem at hand, when reaching professional conclusions. In this case the problem at hand is to decide on the most appropriate equipment for a client, and your role with Spectrup is not relevant to your conclusions. Not only does the client expect you to be impartial, but you have an ethical responsibility to be impartial.

It appears, therefore, that you must deal with the conflict of interests directly. One way of doing this would be to give up one or other of your jobs. Doing so would certainly eliminate the conflict of interests, but as you enjoy both roles you are keen to find a way to be truthful and objective in your consulting work while keeping your job with Spectrup.

At the very least, truthfulness would seem to require that you inform all interested parties of the different roles that you perform. As you also have an obligation to be objective as a consultant, you should also make this clear. It may be that

Spectrup fully accepts your dual roles and, having discussed this with them, you may feel that you no longer have a conflict of loyalty when making consulting recommendations.

If this is the case then option 3 may be sufficient. If your discussions with Spectrup are less clear cut than this, or if your consulting clients still harbour reservations, you could go further and actually have explicit terms written into your contract with Spectrup (and with your consulting clients). These terms would free you from any obligation to Spectrup when consulting, prevent you from receiving any commission for recommendations you make during such work, and commit you to impartiality.

Even going to these lengths, however, you may still feel uneasy – you have worked for Spectrup for so long that you are concerned that you may subconsciously still favour them. In addition, your consulting clients may still be worried that they have no way of verifying if you are keeping to your commitment to impartiality or not. If this is the case, perhaps you could go even further and offer to have any recommendations you make for Spectrup equipment independently verified to ensure they are appropriate?

Summary

Your obligation to act truthfully and objectively in your professional capacity when providing independent consulting services prevents you from favouring Spectrup products in your recommendations. In order to ensure you can meet this obligation, you must first ensure that neither your clients nor Spectrup think that you have made a promise to Spectre to the contrary, and that all are aware of your dual roles. The question is then, how far do you need to go to ensure that you are not biased in favour of Spectre, and that all parties can clearly see that you are not?

Other ethical considerations involved in this case

As well as *responsible leadership*, this case also touches on issues of *accuracy and rigour*, particularly ensuring that others are not misled about engineering matters. *Honesty and integrity* is also central due to the potential conflicts of interest present, and your obligation to act in a reliable and trustworthy way for each employer and client. Finally, the requirement to have *respect for life, law and the public good* is also touched upon, since your approach to the issues raised has the potential either to enhance, or damage, the reputation of engineering as a profession.

6 Conclusion

One of the intentions of this guide was to give some impression of the range and complexity of ethical issues faced by engineers. The eighteen cases in the full version of this guide attempt to reflect this range of issues, though there are countless other cases that could have been used, from all areas of engineering work. Another intention was to demonstrate the need for engineers to engage with ethical issues in their work, and to show that by untangling these issues it is possible to see clear paths ahead, and not just a thicket of conflicting opinions. This brief concluding section will suggest some general ways in which to take an interest in ethics further.

Firstly, there is a good deal of further information available relating to ethics, including more case studies, analysis of news events, and other resources connected to ethics in the engineering profession. The following resources section points to sources of such information.

Secondly, the insights from the cases in this guide can be applied to ethical issues faced in everyday practice. The following questions might help in applying the cases:

- Having thought about some ethical issues in engineering, can you now identify any issues from your own work of which you were previously unaware?
- Are any of the cases in the guide closely related to issues you or your colleagues have faced or are facing?
- If so, what were the important similarities and differences between your case and the case in this guide?
- Has the way the case was discussed in the guide changed the way you thought about your own case?
- Would you act differently, or do you feel you should have acted differently, in the light of the considerations outlined here?

Closely related to this last point, it is important to engage with the way that ethical questions are tackled at organisational as well as individual levels. One way of doing this would be to seek out and reflect upon material such as company codes of conduct and guides to ethics. As well as these explicit statements of ethical commitments, it is also important to reflect upon implicit ethical guidance – what kinds of behaviours are rewarded and praised by employers? What kinds are censured? In taking a reflective view of how an organisation approaches and deals with ethical issues it will be interesting, and important, to determine the extent to which explicit and implicit forms of guidance cohere or conflict with each other.

Engineering is a broad discipline and the case studies here cannot encompass all of the ethical issues that an engineer might face. However, ethical dilemmas quite different from those included in this guide can benefit from being approached in a similar way. This involves asking the following questions regarding a situation:

- What are the empirical facts relating to the case?
- What are the ethical values?
- How do these depend on and inform each other?
- How can the reasons for taking a particular course of action be articulated and

defended? Is the proposed course consistent with the Statement of Ethical Principles, and with the values, principles or rules of conduct of the relevant professional organisation or company?

Finally, engineers are invited to take a more active role in the ethical life of the profession. Traditionally, there has not been a clear demand for engineers to take a view on the ethical issues affecting their profession. In this respect, engineering is different from, for example, medicine. It would perhaps be surprising for a doctor not to have at least thought about the ethical issues surrounding, say, abortion, or euthanasia. Yet, as we have seen, the ethical issues in engineering are just as real, and they too can have very grave consequences. Moreover, it is no more possible for engineers to avoid ethical issues than it is for doctors to do so.

A good place to start engaging with professional ethics is through professional bodies. Some of these run training events or workshops in professional ethics, or provide web forums or other means of communicating with other members about these issues. The Royal Academy of Engineering has a series of publications on engineering ethics issues, links to which can be found in the ‘resources’ section at the end of this guide. Individual professional bodies can be encouraged to communicate the importance of ethics, and this can be stimulated by groups of engineers organising themselves to discuss ethical issues.

Regarding specific ethical issues, some engineers are concerned that decisions are increasingly taken out of the hands of engineers. One concern that people have about rail safety, for example, is that it seems to be the case that fewer engineers are being employed at the higher levels of management resulting in important decisions being made without appropriate input from engineers. If this concern is right, this is a trend that engineers should be active in trying to reverse.

Similarly, when engineers are involved in decisions regarding public safety there is a concern that they are often put under pressure to agree with the decisions that the managers want to make. The Challenger disaster is typically cited as an example of where this sort of pressure affected the decision of the engineers. In these cases, it can be very difficult for engineers to stick to what they consider to be the right decision. Likewise, where engineers are aware of unsafe or illegal practices, and feel that they ought to blow the whistle, it may still be very difficult for them to actually do what they feel they ought to because they may (legitimately, given past history) worry about the effect that being a whistleblower will have on their career.

However, industries are increasingly using confidential reporting techniques as a way of allowing engineers to report problems and enabling lessons learned by others to be passed on. Such systems are used in medicine, aviation, and structural engineering. These systems could be used across the engineering profession, and individual engineers will have a significant role in encouraging professional bodies to put them in place.

Ethics is not a set of rules that can be learned and taken for granted. Nor is it a simple ‘framework’ that can be applied to problems to make them disappear. Engaging with ethical questions is a difficult ongoing process that requires awareness, reasoning skills, imagination, and the ability to scrutinise and evaluate your opinions as well as those of others. In short, it is a set of skills, abilities and character traits that can only be developed with practice. This development is not only necessary, however; it is rewarding, enlightening and confidence-building. We hope that this guide will inspire engineers to take this approach in their working lives.

7 Resources

In this section we have suggested some resources that can help you further develop an interest in engineering ethics. This list is not exhaustive; there are likely to be many more resources than those of which we are aware. However, this is hopefully enough to get you started, and covers a reasonably wide range of subjects in engineering ethics, professional ethics, and ethics in general.

The Royal Academy of Engineering and the Engineering Council

The Academy and the Engineering Council jointly produced their Statement of Ethical Principles (<http://www.raeng.org.uk/societygov/engineeringethics/principles.htm>) in October 2005, and revised and updated it in June 2007. This guide is based on the principles in that statement. More information on the Academy's activities with regard to engineering ethics and practice and teaching engineering ethics can be found on their website.

The Academy also produces events and publications related to engineering ethics. These include a discussion document on the social, legal and ethical issues surrounding the development and use of autonomous systems, and some tips for teaching engineering ethics, as well as reports from a workshop on engineering ethics and accreditation, a conference on engineering ethics and practice and an earlier engineering ethics conference.

The Engineering Council provides guidelines for institutions' codes of conduct, and maintains the UK Standard for Professional Engineering Competence (UK-SPEC), which sets standards for levels of professional registration for engineers, including ethical and professional standards.

Professional engineering bodies

Approaches to ethics differ among the UK engineering professional bodies. The following are links to the sections of the public area of a selection of engineering institutions' websites that are relevant to ethics. Often, though not always, this is a code of conduct, royal charter or set of ethical principles or values. Usually, there are several areas on the site that are worth exploring, and in some cases, some information may be restricted to members.

Institute of Materials, Minerals and Mining
<http://www.iom3.org/content/code-conduct>

Institution of Chemical Engineers
http://www.icHEME.org/about_us/ethics.aspx

Institution of Civil Engineering Surveyors
<http://www.cices.org/bylaw.html>

Institution of Engineering and Technology
<http://www.theiet.org/about/ethics/index.cfm>

Institution of Mechanical Engineers
<http://www.imeche.org/membership/ethics>

Institution of Structural Engineers
http://www.istructe.org/knowledge/topic_areas/Pages/default.aspx

Other professional bodies

The following links are to the relevant public web pages of organisations from professions outside engineering. Some of these will relate to activity that is directly relevant to the work of many engineers – most obviously those that discuss ethics in the conduct of business activity. Others will not be directly relevant, but instead provide an interesting point of contrast, illustrating the extent to which common ethical considerations apply across various professional activities.

Chartered Institute of Building
<http://www.ciob.org.uk/about/royalcharter>

International Federation of Accountants
<http://www.ifac.org/Ethics/>

British Medical Association
<http://www.bma.org.uk/ethics/index.jsp>

Faculty and Institute of Actuaries
<http://www.actuaries.org.uk/regulation/pages/actuaries-code>

The Bar Standards Board
<http://www.barstandardsboard.org.uk/standardsandguidance/codeofconduct/tableofcontents/>

Royal Institution of Chartered Surveyors
<http://www.rics.org/ethics>

Support, advice and guidance

Many professional bodies will provide support, advice and guidance for engineers facing ethical issues. Often, employing organisations, whether public or private sector, will have their own ethics guides, statements of values, or codes of conduct to help staff tackle ethical issues in their professional lives. In addition, many offer helplines which offer advice and support to staff. There are also specialist organisations that provide support and advice for some specific kinds of ethical issues that arise for engineers.

Transparency International is an organisation that focuses on issues of corruption.

The Global Infrastructure Anti-Corruption Centre (GIACC) publishes extensive free information, advice and tools on preventing corruption in the infrastructure sector.

Public Concern at Work (PCAW) deals with issues of whistleblowing.

You may also be able to get legal and other relevant advice from **Citizens' Advice**.

Institute of Business Ethics is an organisation promoting best ethical practice in business.

Academic centres

Centres of expertise based at UK academic institutions.

Inter-Disciplinary Ethics Applied CETL

Producers of this guide. Based at the University of Leeds, the centre aims to help students and professionals to recognise, analyse and respond effectively to ethical issues as they arise. The IDEA CETL does extensive work in engineering ethics, both inside and outside HE.

Engineering CETL

Another Centre for Excellence in Teaching and Learning, the EngCETL seeks to impact on students and to develop and produce graduates who are employable, entrepreneurial, productive and innovative, through links with industry. It is located in the Faculty of Engineering at Loughborough University.

Higher Education Academy, Engineering Subject Centre

Also based at Loughborough University, the Engineering Subject Centre seeks to work in partnership with the UK engineering community to provide the best possible higher education learning experience for all students and contribute to the long term health of the engineering profession.

Blogs

Blogs are an excellent way of keeping up-to-speed with the ethical aspects of current events. The blogs below were active at the time of publication of this guide.

Engineering Ethics Blog

Mixes general reflections on ethical issues in engineering with in-depth discussion of news events.

Ethics in Public and Professional Life

By the Inter-Disciplinary Ethics Applied CETL. Analysis of public and professional ethics issues.

Crane and Matten Blog

Analysis of business ethics issues and news events.

Journals and magazines

Journals and magazines with engineering ethics content.

Science and Engineering Ethics

A multi-disciplinary academic journal that explores ethical issues of concern to scientists and engineers.

The Engineer

Engineering Magazine

Professional Engineering Magazine

Ingenia

General engineering publications covering all aspects of engineering, including ethical aspects. (Magazines in specific engineering disciplines will also often cover the ethical aspects of engineering stories).

Books

These are intended to be accessible to engineers with a general interest in ethics.

Benn, P., Ethics (Routledge, 1998).

A short, clear introduction to some central questions and ideas in ethics.

Bowen, W. R., Engineering Ethics: Outline of an aspirational approach (2009, Springer-Verlag, London)

Challenging analysis which takes a view of the overall ethical direction of the engineering profession rather than focusing on specific issues.

Davis, M., **Thinking Like an Engineer: Studies in the ethics of a profession (1998, Oxford University Press)**.

A good place to start if you want to explore further the ethical dimension of engineering as a profession. Davis offers an analysis of what is distinctive about the profession of engineering, drawing on real-life case studies to illustrate his points.

Kitcher, P., **Science, Truth and Democracy (2003, Oxford University Press)**.

An academic study of science as it is practised, including the ethical aspects of its relation to society. Also relevant to engineers.

Martin, M. & Schinzinger, R., **Ethics in Engineering, 4th edition, (2005, McGraw-Hill)**.

A text book which is aimed at academics and professionals alike. A comprehensive and far-reaching guide to ethical issues in engineering.

McCarthy, N., **Engineering: A beginner's guide (2009, Oneworld Publications)**
An introduction to the technical, philosophical and cultural history aspects of engineering, including ethics.

Training

Training courses are offered by some engineering professional bodies, see individual websites for details.

The Inter-Disciplinary Ethics Applied CETL offers training courses through its programme of activities, Professional Ethics for Professional Engineers. This project was initially supported by an *Ingenious* grant from the Royal Academy of Engineering. Often these training courses are provided in conjunction with Professional Bodies, but the Centre also offers bespoke courses tailored to the specific needs of individual organisations.

In addition, the Inter-Disciplinary Ethics Applied CETL offers an **Online MA in Applied and Professional Ethics** – a distance learning course in applied and professional ethics appropriate for engineers as well as other professionals.

Appendix 1: The statement of ethical principles

The Royal Academy of Engineering, in collaboration with Engineering Council (UK) and a number of the leading professional engineering institutions, has created a Statement of Ethical Principles to which it believes all professional engineers and related bodies should subscribe.

Professional engineers work to enhance the welfare, health and safety of all whilst paying due regard to the environment and the sustainability of resources. They have made personal and professional commitments to enhance the wellbeing of society through the exploitation of knowledge and the management of creative teams.

This Statement of Ethical Principles sets a standard to which members of the engineering profession should aspire in their working habits and relationships. The Statement is fully compatible with the principles in the UK Government Chief Scientific Adviser's Universal Ethical Code for Scientists, with an emphasis on matters of particular relevance to engineers. The values on which it is based should apply in every situation in which professional engineers exercise their judgement.

There are four fundamental principles that should guide an engineer in achieving the high ideals of professional life. These express the beliefs and values of the profession and are amplified below.

Accuracy and rigour

Professional engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others. They should:

- always act with care and competence
- perform services only in areas of current competence
- keep their knowledge and skills up to date and assist the development of engineering knowledge and skills in others
- not knowingly mislead or allow others to be misled about engineering matters
- present and review engineering evidence, theory and interpretation honestly, accurately and without bias
- identify and evaluate and, where possible, quantify risks.

Honesty and integrity

Professional engineers should adopt the highest standards of professional conduct, openness, fairness and honesty. They should:

- be alert to the ways in which their work might affect others and duly respect the rights and reputations of other parties
- avoid deceptive acts, take steps to prevent corrupt practices or professional misconduct, and declare conflicts of interest
- reject bribery or improper influence
- act for each employer or client in a reliable and trustworthy manner.

Respect for life, law and the public good

Professional engineers should give due weight to all relevant law, facts and published guidance, and the wider public interest. They should:

- ensure that all work is lawful and justified
- minimise and justify any adverse effect on society or on the natural environment for their own and succeeding generations
- take due account of the limited availability of natural and human resources
- hold paramount the health and safety of others
- act honourably, responsibly and lawfully and uphold the reputation, standing and dignity of the profession.

Responsible leadership: listening and informing

Professional engineers should aspire to high standards of leadership in the exploitation and management of technology. They hold a privileged and trusted position in society, and are expected to demonstrate that they are seeking to serve wider society and to be sensitive to public concerns. They should:

- be aware of the issues that engineering and technology raise for society, and listen to the aspirations and concerns of others
- actively promote public awareness and understanding of the impact and benefits of engineering achievements
- be objective and truthful in any statement made in their professional capacity.

Appendix 2: A legal perspective

Rules of ethics set by professional bodies are intended to guide members of the professional body as to what to do in difficult situations, particularly where there are conflicting pressures or considerations which need to be reconciled. The rules of ethics of some professional bodies are enforceable by disciplinary action by the professional body, but the principles discussed in this guide are more in the nature of precepts, providing authoritative guidance to engineers who are members of a range of professional bodies.

Law is also seen as a set of rules about what people ought to do. Legal duties and ethical duties may overlap, but ethical rules do not have the force of law; that is, their breach does not give rise directly to criminal sanctions or civil liability enforceable by the courts.

On the other hand, many of the situations addressed by the Ethical Principles involve concerns about risk to life or property or the environment and, in some cases concerns about confidentiality or accusations of wrongful conduct. Since the law tends to become involved if and when there is actual injury or damage to life or property or the environment, or where there is an alleged breach of confidentiality or unjustified accusation of wrongful conduct, the question may arise in legal proceedings as to the effect on legal liability of both efforts to follow the engineering ethics guidelines and of failure to do so.

Following ethical guidelines can increase exposure to the risk of involvement in legal proceedings, as illustrated by the example of doctors who fear to respond to calls for medical assistance when they are not on duty because it could lead to them being sued if the treatment goes wrong. It is important to appreciate that actions taken in response to ethical guidance are likely to be judged on the basis of professional standards of due skill and care, and ethical guidance is only an element of such standards. Ethical guidance does not grant exemption from professional standards of due skill and care.

Probably the most important practical point is to appreciate that if legal proceedings occur, the outcome depends primarily on evidence (for example to prove that one has exercised due skill and care, or given an adequate warning), and that the most cogent form of evidence recognised by the courts or any other tribunal is that provided by contemporaneous written records, preferably communicated at the time to those likely to be affected to allow them to challenge if they disagree. Engineers need to understand the importance of establishing such contemporaneous written records, and how best to do this. Diaries are a valuable means of providing a contemporaneous written record, but the most effective means is usually a letter. There is a maxim that an engineer needs to recognise when "the time has come to write a letter". If and when such a time comes, the engineer needs to appreciate what to put in such a letter and who to send it to. Guidance on the contents of such a letter is straightforward:

- Be clear and complete.
- Strip out all excess and emotion.
- Recognise the purpose of the letter.

The question of who to send the letter to may be more complex, since the problem may be that the person to whom the letter should be sent as a matter of protocol is perceived as a person who will not act in response to the letter. Some specific guidance on the effect of the Public Interest Disclosure Act is given below and this may be relevant.

Another major legal point is that where an engineer comes under a duty to warn, the approach of the courts in recent cases has been that for the warning to be sufficient, it must be persisted with, almost to the point that if no action is taken in response to the attempt to warn, the warning was not sufficient.

The Public Interest Disclosure Act 1998

Situations arise where no injury to life, property or the environment has yet occurred, but an engineer, in the course of his employment, has concerns that there is a substantial risk which is not being addressed by others. Action by the engineer in making such concerns public in response to ethical guidance may upset his employer and lead to threats to his employment.

The law in this area has developed in the UK with the Public Interest Disclosure Act 1998. Workers who disclose information relating to health and safety matters now have statutory protection of employment rights in defined situations under the Employment Rights Act 1996 Part IVA, as inserted by the Public Interest Disclosure Act 1998. 'Workers' are defined to include individuals working on an agency basis as well as employees working under a contract of employment. For the protection rights to apply, the disclosure must be a 'qualifying disclosure' as regards content, the person to whom it is made, and the motivation for making it.

As regards content the information disclosed must, in the reasonable belief of the worker making the disclosure, tend to show that a person has failed, or is failing or likely to fail to comply with any legal obligation to which he is subject, or that the health or safety of any individual has been, is being or is likely to be endangered.

The legislation contemplates three classes of persons to whom disclosure might be made, and imposes different rules on motivation in each case. In all cases, the disclosure must be made in good faith to be a qualifying disclosure. The first class of persons to whom disclosure might be made is the worker's employer or, where the worker believes the failure relates solely or mainly to either the conduct of a person other than his employer or a matter for which a person other than his employer has legal responsibility, to such other person. A disclosure to a person under a procedure authorised by the employer is treated as a disclosure to the employer. Disclosures to this class of persons are subject only to the requirement of good faith to qualify.

A second class of persons to whom disclosure might be made comprises persons prescribed by order of the Secretary of State. The Public Interest Disclosure (Prescribed Persons) Order 1999 names the Health and Safety Executive as a prescribed person in regard to matters which may affect the health and safety of any individual at work, or of any member of the public in connection with the activities of persons at work. The professional engineering Institutions are not prescribed persons under the Order, nor is SCOSST. To qualify, disclosures to HSE as a prescribed person are subject to a requirement not only of good faith, but also of reasonable belief that the matters fall within the area for which HSE is a prescribed person and that the information disclosed, and any allegation contained in it, are substantially true.

The third and final class of persons to whom disclosures might be made comprises all other persons. Such disclosures are subject to more stringent requirements to qualify. Either the worker must believe that the employer will react adversely if the disclosure was made to him (either by subjecting the worker to a detriment or by concealing or destroying evidence) or the failure must be an exceptionally serious matter. In either case, the disclosure must not only be made in good faith, but the worker must also believe that the information disclosed, or

any allegation contained in it, are substantially true, the disclosure must not be made for the purpose of personal gain and, in all the circumstances of the case, it must be reasonable for the worker to make the disclosure. There are factors listed as relevant to whether it is reasonable for the worker to make the disclosure, including the identity of the person to whom the disclosure is made, the seriousness of the relevant failure, and whether the relevant failure is continuing or is likely to occur in the future.

References

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The Royal Academy of Engineering

As the UK's national academy for engineering, we bring together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering. We provide analysis and policy support to promote the UK's role as a great place from which to do business. We take a lead on engineering education and we invest in the UK's world class research base to underpin innovation. We work to improve public awareness and understanding of engineering. We are a national academy with a global outlook and use our international partnerships to ensure that the UK benefits from international networks, expertise and investment.

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Drive faster and more balanced economic growth

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Lead the profession

The strategic challenge is to harness the collective expertise, energy and capacity of the engineering profession to enhance the UK's economic and social development.

Foster better education and skills

The strategic challenge is to create a system of engineering education and training that satisfies the aspirations of young people while delivering the high calibre engineers and technicians that businesses need.

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