

# MANAGEMENT HANDBOOK

*for  
Engineers  
&  
Technologists*

BARRY T. TURNER &  
MICHAEL R. WILLIAMS

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8662752 BARRY T. TURNER  
and  
MICHAEL R. WILLIAMS

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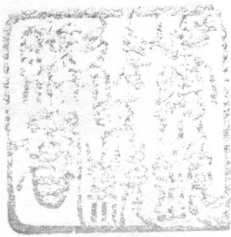
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# Preface

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This book looks at some of the important issues that face a technologist or engineer as he takes up management. There is a need for more than technical expertise – the engineer must have an understanding of the disciplines he has to collaborate with.

Management still means getting things done through people. But situations have changed and people are not as 'docile' as they were some years ago. They want more from their job than mere subsistence. To obtain effective performance, management must ensure that people get more rewarding jobs. The engineering manager has a large role to play here, for we have become increasingly dependent upon the scientist and the engineer. As a result of the increasing tempo of technical progress, many people are now concerned with the kind of society it is creating.

The pessimistic views of the intelligentsia are epitomised in current criticism of our materialistic society. Creature comforts, it is suggested, bring mediocrity, boredom and spiritual decline. But, as the Luddites found, you cannot put the clock back, and engineers will continue to meet human needs. They should seek to do this in a way that will create the maximum happiness for the majority of people.

Science and technology, however, are not self-sustaining, nor independent of other elements in society. Instead it is recognised that a delicate balance exists in an industrial economy between various forces such as consumer demand, productive capacity, scientific innovations, investment levels, government policies, etc. Since technologies tend to interfere with the environment, the engineer has to enter the debate on the cost-benefits balance of any proposed projects. This introduces the influence of subjective values on so-called objective decisions.

Technologists may well prefer to solve specific technical problems and leave the social and political decisions to others. But, as managers, they no longer find this possible, for management demands an overall approach that includes human and environmental consequences. A symptom of this increasing interdependence of society and technology is the sudden upsurge in the number of technologists and engineers whose counsel is sought in government departments and by the managements of industry and business.

It is significant that, in the course of their work, many engineers have become managers. Most have had to do this without prior education or training for such a function. Unfortunately, too few engineers make this transition easily, mainly because they persist in trying to remain good engineers and thus concentrate on technical details at the expense of the broader sweep of their new responsibilities. How often one hears it said that, in promoting Jim, we lost a first-rate engineer and obtained a mediocre manager.

This book sets out some of the ways in which engineers can help themselves to become successful managers. It seeks to give them an understanding of what management entails and how it is accomplished. It gives copious references where these principles, techniques and suggestions can be followed up in greater depth.

In these days of increasing change, it is vitally important that our resources should be harnessed economically and efficiently. Management is a key factor in achieving this so that management aptitudes and potential need to be developed to full maturity, if the best result for society is to be achieved.

While there are many books on management, there are few written from the technologist's viewpoint. The authors hope that this book will help practising technologists and engineers to make a successful transition to management.

BARRY T. TURNER and MICHAEL R. WILLIAMS

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Our Society increasingly depends upon technology. In relation to their importance, the number of professional engineers and technologists in this country form a comparatively small percentage of our population. It is significant that in the course of their work many engineers and technologists have had to become managers. Unfortunately too few succeed in making a transition to a managerial position easily. They have to learn not to concentrate on technical details at the expense of the broader sweep of their new responsibilities. It is a common observation that engineers dominate continental industry but have a subordinate role in the UK where they appear to lack the management skills they require for the higher seats of power.



For many years now engineers and technologists have been identified as having a crucial part to play in the development of the products, projects and services which, it is hoped, will take the UK out of its industrial decline. This country lives by exporting, and manufactured products still comprise 85 per cent of our exports. At the turn of the century engineering was the root of our prosperity, but since then, and particularly recently, our stature has been declining and so has our share of world markets. At the same time the lamentable status of the engineer and the dearth of new recruits to the profession have caused great concern. What are the causes?

## 1.1 Salary

The low salary structure of engineers has had the effect of discouraging the brightest brains from entering the profession.<sup>1</sup> Furthermore the image of industry presented by the media has acted as a further deterrent to those who wish to make a worthwhile contribution to Society. As a result many of this country's products are of inferior design and produced at too high a price to be competitive.

Who is a professional engineer and what he does has been defined many times and a set of standards were established in 1970 for responsibility levels, salaries and status.<sup>2</sup> Inflation has led to heavy pressures on traditional payment differentials and while engineers have recently improved their real position, many of them still earn less than manual workers in the same organisation. After hesitating for a long time over grounds of professional responsibility, many engineers have now joined independent trade unions, and many more have been forced into TUC unions. The independent unions, free from political influence and national control, would seem to be the best instruments for the professional employee,<sup>9, 10</sup> but they obviously wield less 'industrial muscle'.

Nevertheless, the problem of the engineer's status in Society remains. The word 'engineer' is commonly used to denote almost every person employed in construction or manufacturing industry, including thousands whose skills are comparatively simple and undemanding.

'Status' cannot be legislated into being. A proper salary helps to increase it but money is not the only reason for the engineer's decline in status.

## 1.2 Sophistication and complexity

While science generates knowledge, technology uses it in the mastery of Nature to meet human needs. Engineers and other technologists use scientific explanations to control and reshape nature.

As technology has become more complex, specialisation has increased, as it has

## 4 Management for Engineers and Technologists

from the very beginning of civilisation. In recent years few individuals have been able to create, and identify with, any whole product or project. Engineering has become a corporate creative activity which depends on careful management. The decline of engineers in top management has been apparent during the same period.<sup>3</sup> Engineers and technologists are often placed under accountants or arts graduates and forced to justify all their proposals to them. Here then is another reason for the sad decline in the engineer's status.

### 1.3 Technology and society

Yet, at the same time industrialised communities have become dependent upon technology to such an extent, for food, communication, entertainment, health and other services, that the very fabric of society has been affected. With this increased dependence, as usual, has come disillusionment. Technological change has not solved all problems and has even created some new ones though these are much exaggerated. As with computers, problems caused by people are often blamed on machines. People are asked: Do we want all this high technology? Has it not often created monumental white elephants which have yielded poor results for their soaring costs<sup>4</sup> and have caused public concern? One has only to review the construction of power stations in the UK to realise how abysmal the results have been. Much of this has been due to incompetent engineering management.

Here, then, is a further reason for the decline in popularity of the engineering profession.

### 1.4 Centralisation of design

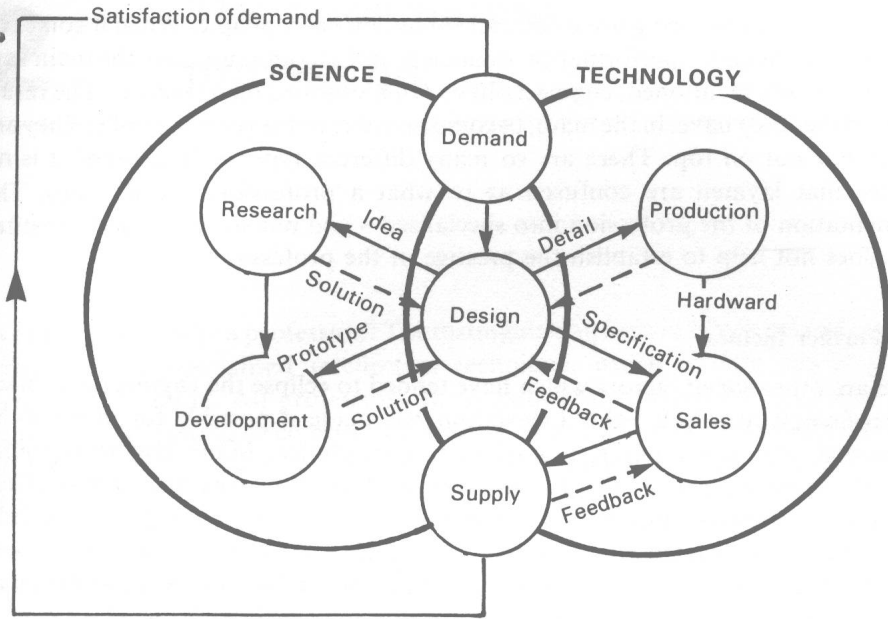
The Finniston Report<sup>5</sup> on the engineering profession, awaited so eagerly, was in many ways disappointing. It failed to produce anything new except for the proposal to introduce quango-controlled registration by a new engineering authority and new engineering degrees divided into three categories. Unfortunately it failed to emphasise the central role of design in engineering and the importance of production.

While the need for innovation was stressed, the need for multidisciplinary synthesis in translating laboratory ideas into viable products was sadly neglected. Design calls for much ingenuity and imagination and is at the core of all engineering, co-ordinating, on paper at least, all other activities, as indicated in Figure 1.1.

Unfortunately the Finniston Report's proposals for the 'formation' of engineers do not say how designers are to be produced. Design skill can only be acquired by combined practical and theoretical training. A designer learns by trying; design is a creative activity as Lord Kearton has pointed out.<sup>6</sup>

Thus, a major factor contributing to the decline of industry in this country, and the engineer in particular, is the lack of understanding of this central function of design; which is reflected in the low status of designers, even relative to other engineers. The designs of many products are not competitive but they do define the products, their life, maintainability and sales appeal, once and for all. They also tend to define the production/construction methods and often the machine tools used.

The creative aspect of this work takes place in the minds of individuals and



**Figure 1.1** *Design: the link between science and technology (first produced by E. Crooks and reproduced with his permission)*

cannot easily be externalised, but most modern products are too complex for any one designer so that creative team work is needed. The amount of thought and effort needed is largely hidden from the user's view. Here then is another reason for the decline of the engineering profession: it is not really understood by the laity.

Much of the Finniston Report originally appeared to be dead leaving everything as before.\* However recent events have given new impetus and direction to the profession which gives rise to some hope of change in the future. The new engineering overlord, the Engineering Council (EC), has, at the time of writing, come into being under Royal Charter and the recent poll of all chartered engineers taken by the CEI gave an overwhelming vote to transfer the register of engineers over to the EC. There also appears to be a reasonable hope that by sponsoring 'Engine of Change' projects the EC will obtain substantial government contributions to the total cost of such endeavours.

There is also considerable backing being given by the DOI to design work. The Design Council is to support an awareness programme and offer consultancy on design at both school, university and at other educational establishments as well as to industry. The Prime Minister's initiative in calling a Downing Street Seminar on 'Product Design and Market Success' is to be applauded and is starting to bear fruit in a number of areas. A concerted campaign to reverse the decline in design effort under the keywords of 'Design for Profit' has been launched. So what appeared to be a somewhat damp squib to start with seems to be sparking at last, for which all engineers and technologists must be thankful.

## 1.5 The problem of identification

Professional engineers often lack contact with the ultimate customer since functions

\*In the Commons debate on the report, out of a total of 625 MPs only 12 were present.

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such as sales and servicing are often carried out by other people. When it comes to assessing a company's performance, financiers and accountants have the main say. And, as already mentioned, engineers have often shunned management. The result has been that they have, in the main, become invisible to the general public. They are on tap but not on top. There are so many different types of 'engineers' it is no wonder that laymen are confused as to what a professional really does. The fragmentation of the profession into specialised – and not so specialised – institutions does not help to establish the prestige of the profession.

### 1.6 Further factors

There are other social factors which have tended to eclipse the engineer and place the profession in a bad light. Legislation has made it possible for many to be dragooned into some union not of their own choice. Many engineers found themselves, through no fault of their own, pushed into gargantuan nationalised industries or mergers which left them powerless and voiceless. In the public's mind a trade union is associated with manual, not intellectual, activity. Can an engineer join a trade union's membership without compromising his status as a professional? Most lawyers, doctors and accountants are not associated with the TUC!

It is highly desirable that engineers should be represented by an independent body free from political influence. The Engineering Council may be able to act in this role and it is to be hoped that they will have sufficient clout to be effective. Certainly the new *Employment Act 1982* gave engineers who decline union membership some cheer in the form of protection against dismissal.

These then are some of the factors that have changed the status of engineers. The position might be greatly improved if more of them became competent managers. As technology becomes more complex, the problems of management increase geometrically. In addition there are the increasing loads of national and international bureaucratic regulation; to that add the complexity of engineering management. One only has to think of the Health and Safety at Work Act, or product liability in the EEC.

Last, but not least, engineers have not been too articulate in stating their case to the public at large. They have not been trained to set out technical issues in a language that makes them easily understood and appreciated by a non-technical public.<sup>7</sup> The literacy of engineers has not been high and consequently the voice of the engineer is not heard clearly. The greater ability of lawyers, economists, architects, etc., to sell themselves has yielded them management and public service jobs that should have gone to engineers.

Engineers must in future take up positions in top management to give appropriate technological leadership in the boardroom.

Is engineering really a profession? The distinguishing feature of any profession is the exercise of a specialised intellectual technique, which is only acquired after prolonged training. All professions form associations which have, as their main functions, the testing of competence and the dissemination of knowledge. In some professions they also have the function of maintaining status and professional ethics.

## 2.1 What constitutes a profession?

A profession is an occupation requiring education, both liberal and yet specialised in certain areas.<sup>1</sup> It implies scholarship and involves mental rather than physical effort. Furthermore, the traditional learned professions of church, law, medicine and the fighting services, regard service to Society or God as an important characteristic of a profession.

None of these traditional professions creates anything, whereas the engineer offers products that can be sold. This inevitably brings engineering into contact with trade which, in this country, has been considered somewhat beneath the professions and need not involve personal advice to the client. Perhaps this is the nub of the problem, for personal advice carries with it the idea of dignity and authority, where acceptance of social responsibility takes precedence over personal gain. Thus, the essential features of a profession appear to be:

- 1 That its practitioners be educated to an agreed standard.
- 2 That its practice involves mental rather than manual effort.
- 3 That it ministers to individuals and is governed by the motive of service, having some standard of professional conduct.
- 4 That some kind of association be formed to advance the practice of the profession and enforce standards.

## 2.2 Engineering as a profession

The engineering institutions have laid down in their Royal Charters three main functions: qualification; the dissemination of knowledge; professional conduct. They engage in a whole range of activities such as meetings, courses and publications. One important aspect is co-operation with educational establishments in drawing up syllabuses.

In the past the most important aspect was the qualifying role of the institutions. They have held their own examination, although the majority of members qualify by complete or partial exemption. George Stephenson himself was refused admission to the Institution of Civil Engineers unless he submitted 'a probationary

essay as proof of his capacity as an engineer,<sup>2</sup> and this led to the first split in the profession. Many others followed.

All the important institutions also have codes of professional conduct and can expel members for breaking them, but they are less severe and less enforced than, for instance, that of doctors.

There remains the protective function. The Royal Charters granted to engineering institutions have always defined them as learned societies who are therefore unable to take on the protective functions which are normally associated with other professional bodies, such as the Royal Institute of British Architects or the British Medical Association. For over a hundred years the profession has lacked a corporate body which could speak for it, but it is becoming increasingly important to have such a body. The Council of Engineering Institutions, a confederation of 16 chartered engineering institutions, has well over 200,000 members, far more than there are of doctors, solicitors, or architects in the country. It should ensure that the profession has a voice in public and Government affairs, especially after the failure, through lack of support, of other organisations set up for this purpose, such as the Engineers Guild.

The CEI has done much to maintain links with international professional engineering bodies and at home has been watching the profession's interest as regards the increasing amount of legislation which affects them. In 1971 the CEI set up the Engineers' Registration Board to take over the separate institutions' qualifying function and it now controls the titles Chartered Engineer, Technician Engineer and Technician, designated CEng, TEng(CEI) and Tech(CEI), respectively.

As a result of the Finniston Report<sup>4</sup> a new body, the Engineering Council (EC) will, with Government backing, take over all these functions.

There has been much criticism of the CEI's performance in the past but the constituent institutions themselves must take the blame for much of this apparent failure. The CEI only receives a small fraction of their income from them and decisions have to be unanimous so that the smallest constituent body has an effective veto.

Will the creation of a new bureaucratic body, with its members selected by the Secretary of State for Industry, enhance engineers' status and performance? It seems doubtful for it appears that the new authority will be toothless and unrepresentative, especially if it is dominated by the same people who have run the CEI.

For all their past efforts in advancing the art of engineering, the institutions have failed to convince employers of their authority and have been helpless to influence Government. Let them return, therefore, to the role they fulfil best – disseminating learning – and yield their other functions to the new Engineering Council. Even so the profession of engineering will remain badly fragmented, with all kinds of smaller bodies being formed to take care of new specialisations. Many small institutions are extremely active and virile and the growth goes on.

To a certain extent perhaps this is to be expected and healthy; for engineering is open-ended. But engineers do not seem to be able to distinguish between their professional interests – which are the same for all and need a single powerful organisation – and the specialised interests which could well be taken care of by specialised sub-groups. It is to be hoped that the EC will be able to do something positive for the professional interests of engineers and the organisation of the engineering profession.

### 2.3 Management not a profession

The position of management is different from that of the engineer as such. While management is now recognised as a subject for systematic study, it cannot be regarded as a profession or discipline in itself. It cuts right across the conventional disciplines and is something that has to be applied, regardless of the field of endeavour.

Lewis and Maude<sup>7</sup> have stated that the distinguishing basis for professionalism is a moral code of conduct for its practitioners. It is, so to speak, a guarantee of integrity. In engineering, the professional institutions do in fact have such codes, but it is questionable if they can ever be thoroughly applied to engineers who are employees. Dismissal from a company, not expulsion from an institution, is the most potent sanction. Engineers and technologists, in the main, work as employees in either public or private enterprises. The anonymity of the engineer's individual effort is very nearly complete, and heads of firms who are supposed to have designed and engineered this or that often have no claim to such achievements. This is far from the 'golden age of engineering', when the Telfords, Brunels and Stephensons could rightly claim to have originated engineering details and personally managed all the work placed with them. While the engineering profession does have a code of practice and, more recently, it has been suggested that some form of Hippocratic oath should be introduced for engineers,<sup>8</sup> it is really part of the management function to see it enforced.

Management's association in Britain is the British Institute of Management although other bodies cover specific areas of management, such as the Institute of Personnel Management and the Industrial Society. The BIM's founders stated that its success would depend largely upon its ability to determine criteria by which individual capacity in management can be assessed.<sup>7</sup> This the Institute has not been able to accomplish, in spite of the success in unifying many of the various management bodies, producing a prodigious number of publications and introducing a common examination in management studies.

The Franks Report on British Business Schools<sup>9</sup> finally forced the universities to take an interest in management studies, and the London and Manchester Graduate Business Schools are now operating. Others have been set up at Bradford, Oxford and Cranfield. But, in spite of all these activities, there appears to be no way of ensuring that an individual, after receiving the necessary training in management, will be able to manage. This cannot, in fairness, be said of a doctor or engineer for, after taking a university degree and with appropriate medical school or apprentice/graduate training, they can prove that they know more than the mere theory of their subjects. But the majority of the 500,000 or so people estimated to be in management positions today practise without any acquaintance with the BIM or its requirements.

Furthermore, there is no agreed code of professional behaviour for management. The Marlow Declaration<sup>10</sup> sets out some precepts and principles for industry, but this has never been universally accepted. The techniques of management are likely to be non-specialised and in the past only specialised techniques have given rise to professions.

The old type of entrepreneur – with the possible exception of the engineer – is vanishing, as will be shown in Chapter 3. It is hard to imagine how they ever could