

Engineers & their perceptions of Managers & Management Studies

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BACKGROUND

Over the past few years a management studies course has been incorporated in several Hatfield Polytechnic schemes leading to CNAAC (Council for National Academic Awards) Diploma and Master qualifications in science and engineering subjects. Several basic questions have arisen about the nature and function of the course which may be summarised as follows:

- (1) Should the aim of management studies be to increase a course member's effectiveness as a scientist or engineer, or to develop him/her as a manager?
- (2) Should the content and process within the management studies course be as close as possible to those prevailing in science and engineering disciplines or should there be a deliberate divergence?
- (3) Should management studies be a mandatory or optional part of a science or engineering scheme or should it be omitted from such a scheme altogether?

These questions had been considered at the design stage of the management studies course. Indeed its short duration of approximately 30 timetabled hours made it essential to make choices. The resulting course thus aimed at increasing effectiveness by providing a greater understanding of the management environment of science and engineering activities. Contrast was provided with science and engineering approaches by participative sessions and an emphasis on management concepts, human behaviour and the development of personal skills; management science and the consideration of organisations as engineering systems were avoided. The course was made a mandatory part of each scheme.

Comments by course members on the ten or so courses provided have on the whole been favourable. There had, however, been several developments, which pointed to the need to review the choices made. For example, it appeared in informal conversation that a significant proportion of course members, though studying for a higher qualification in science or engineering, were seeking development as managers. It was also noted that on most courses the responsiveness of individual course members ranged from enthusiastic and highly motivated to uninterested and very reluctant.

Management studies tutors reported greater incidence of resistance to learning than on other types of course in which they were involved. On one intake the course as a whole appeared highly resistant to learning; one of its members suggested that the course would be more readily accepted if it were "designed more like conventional technical lectures, i.e. the presentation of information with a much reduced reliance on personal response". It is interesting to note that engineering tutors also reported exceptional difficulty with this particular course group. In one Diploma scheme, the management studies course had been replaced by an additional engineering speciality, one of the justifications being that management could be studied separately.

Another development which has created a need to understand more fully the relationship of management to science and engineering studies is the provision of "enhanced" undergraduate schemes in engineering.

As a starting point, a pilot study has been carried out in the context of a particular management studies course within an M. Sc. (Engineering) scheme. The perceptions of course members about engineering and management were explored and their views sought on the content of the course and its relevance in the scheme.

THE COURSE

The course membership comprised three graduate physicists and four graduate engineers. Ages ranged from early twenties to mid-thirties. Five members were employed in manufacturing industry and the remaining two were in the Government/Public Services sector. The course took place on the basis of one day per week over four successive weeks. Timetabled sessions totalled 28 hours. Assessment was by means of tasks carried out outside time-tabled hours before, during and after the course. An outline course programme is shown in the Appendix.

THE QUESTIONNAIRES

Information and opinions were obtained from course members by means of questionnaires. One questionnaire was used at the beginning of the course before any management topics had been discussed. This asked about the course members' perceptions of themselves as managers, their views on the place of the course in the MSc scheme and what they hoped to obtain from management studies.

Another questionnaire was used early in the first session, after an exploration of definitions of management. Each course member was asked to indicate on the

questionnaire what in his/her view was the most appropriate statement regarding "good" engineers and managers respectively and which were their most important categories of understanding and skill. Course members were also asked to identify their most important resources and objectives in the context of their work. At the end of the course two further questionnaires were used. These were largely a repeat, for comparison purposes, of the questions covered in the first two questionnaires but also requested views on the course and about any other management courses which had been attended previously. In addition, course members were asked to state what distinguished an engineer from a manager and to identify some of the more important managerial aspects of their own jobs.

RESPONSES

One course member was absent on the first day so that only six beginning/ end comparisons can be made. In summarising results and stating conclusions, however, all seven contributions have been used.

Engineers or managers?

At the beginning of the course only two members regarded themselves as managers. These were the only two who had previously been on management courses. They were also the oldest members of the course and were both in the Government/Public Services sector. By the end of the course two others had shifted to considering themselves to be managers though one specified that this was not in connection with work but applied to his personal life. The member who had been absent on the first day regarded himself as a manager. Thus at the end of the course five considered themselves to be managers, in some respect at least.

Regarding the effect of the course, at its conclusion two members thought that the course would make them more effective as engineers, two thought the course would develop them as managers while the remaining three thought it would help them both as engineers and managers. There was a shift over the course by three members — one member had at first hoped it would help him as a manager but ended up stating that it would be of benefit to him as an engineer. The other two were originally doubtful about the effect of the course but by the end one had firmed up on a management and the other on an engineering outcome. None thought as its conclusion that the course would have little or no effect.

Perceived attributes of engineers and managers

General attributes. At the beginning of the course, the majority of members thought that the most significant attribute of both good engineers and good managers is that they should "thoroughly understand their subject." At the end, however, while the subject orientation of engineers was reinforced there was in the case of managers an overwhelming shift to "ability to cope with uncertainty".

Areas of understanding. All but one course member thought at both the beginning and the end that the most appropriate area of understanding for a good engineer is that of "general principles obtained by scientific method". By contrast, in the case of a good manager, the overwhelming choice was for understanding behaviour, either of individuals or of groups.

Skills. At the end of the course all but one member thought that the most important skill of an engineer is to "apply technical knowledge". For managers, however, three regarded "making decisions" as the most important, two favoured "communication", one chose "handling people" and one favoured "analysing complex situations" whereas at the beginning of the course there had been more emphasis on "handling people".

Basic distinctions. In the main, course members saw engineers as dealing with "hard facts", "physical facts", "quantifiable variables obeying physical laws" and carrying out "precise analysis using mathematics". Managers were seen as "handling a constantly changing situation", dealing with "uncertainties and people", "generalities" and "abstract ideas", developing a "feel for a situation, using guidelines and axioms" and "making decisions without many concrete facts available". One course member considered that engineers sought technical perfection whereas managers strive towards commercial compromise. Another stated that an engineer applied technical knowledge and experience to solve individual problems in contrast to the manager who had many problems and organised himself and others to solve them. One member regarded the thought processes as "often similar". Another stated that "all engineers are managers" and that "more managers should be engineers".

Course members' statements about their jobs

Resources. Asked to name the two or three most important resources available to them in their work situation, the most cited was their own knowledge or expertise. Also mentioned by two or more of the six members were equipment, others (technical staff, people and the knowledge of others) and time. Single mentions were ideas, facilities, stores back-up and "common sense allied to experience".

Objectives. Among the two or three most important work objectives "money" and "job satisfaction" were cited by about half the course membership. All but one stated an objective which indicated a response to challenge, such as "establishing and building up company", "beating a specification laid down by manufacturers" and "solving particular engineering problems. . . in given time scale". One regarded increasing his knowledge as a most important objective while another cited the economic use of resources.

Managerial aspects of engineering jobs. At the end of the course, the members produced quite an assortment of statements about the managerial content of their jobs. Most cited aspects of self-management, for example self-discipline, organising their use of time and organising their own work effort. Only two members, those who had previously been on a management course, unambiguously described managerial activities in terms of downwards relationships — for example work delegation, junior staff training, appraisal, staff welfare and the effective use of men. Others could be interpreted in different ways, e.g. "ensuring availability of resources for work to be carried out" and "ensuring information received is correct". "Liaison" was probably a lateral managerial function and "advising superior re work" was clearly upwards-directed. Other aspects mentioned included "24 hours on call", "communicate and plan" and "define and abide by manning hours/costs for particular job".

Course members' comments on Management Studies

Place of Management Studies course in MSc Scheme. At the end of the course two members thought it was an important part of the scheme, one regarded it as a useful part, three thought it did not matter whether or not the course was in or out and one stated that it ought not to be in the scheme. There were beginning/end shifts in both directions.

Likelihood of taking a management course. Four members thought they were likely to have attended a management course if it had not been a part of the scheme. Three thought they would probably not otherwise have taken a management course.

Previous management courses. Comparison by two members with management courses previously attended yielded "in abstract very similar but previous course aimed more at needs of particular organisation" and "did not conflict in any way, 30% overlap".

Modifications to course. None of the course members wanted curtailment of any part of the course. All suggested developments but there was no pattern except that "more

interviewing" was twice mentioned. Taken with some of the additional comments, the most popular area of development would seem to be interviewing, presentation and communication using, where possible, CCTV.

Additional comments. All comments on the course were favourable, for example "enjoyable and useful", "opened eyes. . . very interesting. . . variety in course was a great feature" and "useful alternative to the grind of. . . engineering".

DISCUSSION

Effectiveness as an engineer

There are at least two ways in which an understanding of management can lead to the greater effectiveness of engineers:

- (i). "Understanding some management processes which the engineer can apply to his/her own personal activities". The engineer in this context can, for example, achieve more by planning and controlling his/her own work. This can be said to be a form of self-management and clearly course members were aware of the need for and to some extent were practising management in this sense although in most cases they had not sought or received any formal tuition. Some of the course members were further distinguishing between two types of self-management, namely management of their own work and management of their life. The survey questionnaire did not distinguish sufficiently between these categories. Thus when course members stated that one of their most important work objectives was "money" or "to make money" it was not clear whether or not reference was being made to the financial rewards for themselves or for their employing organisations or both.
- (ii). "Understanding the organisational environment in which the engineer exists". An engineer may thereby be better able to communicate, to use "the system" for engineering ends and so on. As a matter of general principle this approach is sound enough but there is considerable difficulty in choosing the particular topics of value to engineers working in a variety of organisations. There is also a need to examine the possible effect of this kind of management education on the creativity of engineers. It could be argued that a single-minded devotion to specialist engineering activities and a complete disregard of resource implications, non-technical objectives and other managerial aspects is essential for the technical "breakthroughs", inventions and innovations expected of at least some engineers. Such engineers may have more "cutting edge" if they are

unaware of the broader implications of their activities. Would a management studies course actually reduce rather than increase the effectiveness of an engineer of this type? Reference has already been made to the higher incidence of resistance to learning noted in specialist engineers on management courses. Are these the highly creative engineers resisting what they instinctively feel is not good for them?

In this connection it is useful to make a distinction between an engineer who is single-minded and one who is closed-minded. The former will consider alternative viewpoints and make judgements in accepting or rejecting them in pursuance of a particular purpose whereas the latter will not even consider alternatives. A management studies course will provide a broader perspective in which a single-minded engineer may pursue his/her speciality. It may be especially beneficial to an outstanding design engineer since there appears to be an affinity between design and management in that both require the synthesis of solutions to problems involving a number of disparate variables. Closed-minded engineers, on the other hand, will probably not derive benefit from a management studies course and may adversely affect other course members unless special efforts are made to identify them at an early stage of the course with a view to their receiving special consideration and assistance. Most course members are in neither of the categories of single-mindedness or closed-mindedness and present no especial difficulties.

Engineering and management attributes

Given that there are some differences in the attributes required for engineering and management [1] can the two sets of attributes be developed together, coexist and, better still, complement and reinforce each other [2]? It could be that engineering education and practice have a conditioning effect which is contrary to some of the requirements of management. Moreover, investigations [3] have indicated factors in the psychological make-up of individuals which predispose them towards science and engineering and thus any conditioning may be a reinforcement of tendencies already present. These points are particularly relevant in connection with the "enhanced" engineering degree schemes now being promoted in U.K. universities and polytechnics. Should management studies be included and, if the answer is in the affirmative, should they run alongside engineering studies from the start of a course or should they be "tacked on" at the end? In simple terms, if management and engineering studies are undertaken together throughout the course will this result in

the development of "schizophrenic" engineers, successful at both engineering and management? These are fundamental considerations which need detailed examination.

Development as managers

The fact that the two engineers who regarded themselves as managers at the beginning of the course had previously attended management courses has interesting implications. How had they regarded themselves at the end of the previous course? Was there a delay in their regarding themselves as managers? Do they now have jobs with a higher managerial content than at the time of the previous course and, if so, were they moved or impelled in that direction because of the effect of the previous course? From the details each course member gave about their managerial activities it appears that the two engineers concerned had more readily identifiable managerial jobs in that they were responsible for the work of others. It would be advantageous to obtain more explicit information on this point in any future surveys. It would be interesting too to follow up those members who did not at the end of the course regard themselves as managers.

Personal skills development

Included in the curricula of many courses provided by the management studies groups within educational institutions is the development of communication, interactive and other similar skills. These skills are not, of course, the exclusive province of management or managers. Behavioural development can be regarded as a "free floating" subject which finds a natural home within a management studies unit. The members found this part of the course of particular interest. There was not enough information from the survey to determine if they saw this in terms of self-management outside their work situation, increasing their effectiveness as engineers or developing themselves as managers. Clearly it could apply to all three.

Management and engineering units

The relationship between the organisational units dealing with management studies and engineering studies in educational institutions is of great importance. The publicity for a scheme as well as the interviewing and selection of candidates is usually undertaken by an engineering unit. The expectations and motivation of course members with regard to the management studies course may thus be determined by engineering tutors.

Another aspect of the relationship is especially relevant if the aim of the course is to improve the effectiveness of the engineer. Both the engineering and management content can be seen as contributing to the same aim, by imparting knowledge of engineering and an understanding of management respectively. Management studies can therefore be regarded on a basis of parity with engineering studies within a scheme rather than as an appendage or addendum to the engineering content.

Management courses for engineers

The indications from the course members on the place of management studies in an engineering scheme were ambiguous. This was due in part to the design of the survey questionnaires; the members were not asked direct questions concerning mandatory or optional status for the course. The responses of the two members who had previously been on management courses were particularly interesting. Both stated that it did not matter whether or not management studies was in the scheme but one added that he thought all engineers should have some management training while the other commented that his response was a personal one because for him the ground had been partly covered elsewhere. The one member who thought the course ought not to be in the scheme regarded himself as a manager, thought that the course would make him more effective as an engineer as well as develop him as a manager and stated that he would not have come on a management course if it had not been a compulsory part of a scheme.

CONCLUSIONS

It is in the nature of management that numerous decisions need to be taken without some of the information or understanding considered to be desirable or necessary. Subsequent research or events may provide a more objective background against which previous decisions may be reviewed and then confirmed, revised or supplanted as necessary. This is the situation with regard to engineering and management studies. A number of major developments are taking place with only a relatively rudimentary knowledge and understanding of some of the key factors involved. The pilot survey of course members' perceptions has resulted in the identification of many basic issues. There are no doubt more issues yet to be brought out. It is to be hoped that both the identification and investigation of issues will continue.

Some of the further investigations may be made by means of survey questionnaires which could perhaps be used on all courses to provide a build-up of survey information as well as to enable each course to be monitored. Investigation of other

aspects can be carried out quite separately from courses and may clearly extend over many years. Meanwhile some tentative conclusions can be reached concerning the role of management studies in postgraduate engineering schemes.

- (1) Management studies courses should aim at increasing the effectiveness of engineers by imparting an understanding of the nature of management and by developing abilities in self-management as well as certain personal skills. Such a course should be considered on a basis of parity with other areas of study (e.g. scientific or technical) all of which should be regarded as making a fundamental contribution to the effectiveness of an engineer. If the other areas of study are mandatory, management studies should be likewise.
- (2) In contrast, a course aimed at management development should be optional. It should preferably be included in a postgraduate engineering scheme since it is the intention of some course members to develop as managers as well as engineers. There is some advantage in having engineers take the first steps in management development together, as a course group, though later it would be beneficial for engineers to be included in groups in which other disciplines and functions are represented.
- (3) The content of management studies courses should provide considerable contrast with conventional engineering courses. Thus there should be an emphasis on concepts and heuristic models which enable managers and management to be better understood. Some basic ideas about human behaviour and their relevance to the course members' own situations should be explored. Techniques used by managers, mathematical models, etc., should generally be avoided.
- (4) The process or style of a course should be participative with course members encouraged to share their own insights with each other. Discussions, syndicate exercises and group work should be used in preference to lectures.

Finally, with regard to the education of engineers at undergraduate level, whilst acknowledging that many of their attributes and attitudes are of value in the practice of management, it is important to recognise that engineers also possess characteristics which are contrary to the management ethos. It is possible that some of these adverse characteristics are maintained, fostered or even generated during undergraduate studies; postgraduate management studies can be regarded to some extent as offsetting the deleterious effects of earlier engineering courses. The inclusion of management studies in some of the "enhanced" engineering schemes is a

particularly interesting development. It is likely that the education of engineers who can make an early contribution to management and rapidly develop as managers will only be achieved if management studies runs alongside engineering studies throughout the undergraduate schemes and provides contrasting process and content.

APPENDIX

M.Sc. in Engineering : Outline programme of Management Studies Course:-

Day 1

Task 1
The Nature of Management
Organisation
Managerial Control

Day 2

Task 2
Financial performance
Leadership
Communication

Day 3

Task 3
Managerial styles (CCTV)
Industrial relationships
Presentation exercise I (Preparation)

Day 4

Task 4
Presentation exercise II (CCTV)
Industrial relationships
Task 5

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