# Use of case studies in teaching data processing

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**The design of systems requires practical and creative teamwork drawing together concepts from several academic disciplines. Any course of education which aims to teach systems design must reflect this requirement. An excellent method of meeting the requirement in an academic course is the use of case studies. Case studies involve students in understanding an environment, in assimilating information, in examining a situation in breadth and depth, in working in teams, in carrying out realistic design tasks, in practising design techniques, in integrating concepts from several disciplines, and in handling real-life complexities. This paper describes the approach of the Department of Computer Studies and Mathematics, Huddersfield Polytechnic, to the use of Case Studies.**

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## 1. Philosophy behind the use of case studies

### 1. *Why?*

In teaching data processing the main objective is to produce students who are capable of designing systems in a commercial (i.e. industrial, administrative or governmental) environment. This involves them in understanding the environment, in being able to practise current design techniques expertly, in creatively constructing efficient and effective systems, and in integrating several separate disciplines (ranging from relatively unstructured business and organisation studies to relatively structured computer science and operational research). Case studies forming part of an academic course for would-be system designers provide precisely such involvement.

The main reason for using case studies is because system design is essentially a practical task which really cannot be taught except through practice. Just as students will never understand COBOL programming unless they write some COBOL programs, so they will never understand system design unless they practise it. Such practice in case studies can give an appreciation of the complexity of the design task in real life (which is bound to be simplified in a lecture course) and an opportunity for experimenting with the theoretical concepts covered in the lecture sessions. The theoretical model of necessity tends to ignore some of the parameters which will affect the operational system; the practice of design highlights these parameters and forces the student to rethink/think about his understanding. Above all the student is forced to realise that in practice there are no black and white solutions to design problems and that experience and judgement carry at least as much weight as theoretical approaches.

A second reason for using case studies is to impress upon students that system design is a team activity and that success in design invariably depends on other people—not only in terms of the users who will have to operate the eventual system, but also in terms of the many people contributing to the design process (user, systems analyst, programmer, etc). There is no better way of giving students an understanding of problems of communication and leadership than by allowing them to work in groups on a design exercise and to learn the necessity for working with people whose attitudes, viewpoints and ability they may question. In the real environment, design is carried out in teams with different people bringing different expertise to the team; this type of situation can be reflected within case studies.

A third reason for using case studies, linking the previous two, is the requirement for integration of subjects taught on a course. All too often students fail to see the relationship/importance of various subjects to the rest of the course; by using a case study which involves the student in drawing on topics from different subjects, a degree of integration can be achieved. The academic world tends to analyse the complex situations of the real world from the viewpoint of different disciplines; the practitioner has to bring these views together on handling a real situation. Case studies provide just such an opportunity within a course of education.

Finally, but no less important, case studies are a valuable teaching method. They force students to practise rather than to sit listening (and experts in teaching methods assert that far more is learned by practising); they stimulate discussion and encourage participation; and they allow a flexible approach to a subject because the students can question ideas expressed in lectures as they tackle the problems within the case study. The lecture may give intellectual awareness; the case study is more likely to give the student a realisation of the aptness, applicability and validity of a particular idea. Case studies, of course, are not a panacea for the teaching of systems design; they have many constraints (e.g. artificiality, administrative problems, narrowness of approach, lack of availability, maturity of students, etc.) which are discussed later; but properly handled they can be enormously beneficial to staff and students alike. Case studies provide an opportunity for deepening students' understanding and making students more sensitive to problems, for open discussion of contentious issues, for critical introspection by staff and students; they allow staff to get to know students on a more informal basis; and, perhaps most important, case studies can allay fears or reduce anxieties that have arisen in students' minds during lecture sessions.

### 2. *How?*

It is important that the objectives of a case study used in a particular situation are specific and clear to the students, especially if the case study is large scale. The case study is never to be seen solely as a vehicle for entertainment, a means of provoking discussion and sharing ideas or a gap-filler in the timetable; it may well entertain and achieve cross-fertilisation of ideas but these are by-products of the main aims.

The specific aims of a case study must be carefully defined by the staff and can usually be grouped under the following headings.

#### 2.1 *Illustration of points of a lecture course*

In this situation, the case study will be preceded and followed by a series of lectures; in particular the points made by the case study must be highlighted at the end in lecture/tutorial

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sessions. For example, the importance of choice of interviewees and order of interviewing in an investigation can be well illustrated in Reliable Motor Company (Appendix 1.1) by discussion later of the pitfalls in a particular choice/sequence.

2.2 *Training in techniques*
Here a lot of time will be devoted by the people running the case study to assisting and advising the students on techniques. Techniques like file design or interviewing will never be learnt merely by reading or lecture. It is only when the student is confronted by a specific problem (NB in its context) and is able to discuss the possible approaches that any appreciation of the techniques will be gained. By forcing students to implement (in both program specification and programming) their file designs in General Chemical Company (Appendix 1.2), they realise the impact of decisions taken during system design on the program structure (and vice versa) and they can see more efficient and simpler solutions.

2.3 *Experimentation with ideas*
There is never one solution to a problem in system design and it often happens that teams of students, following their own ideas, will propose completely different solutions to a particular problem. (This depends to a large extent on the amount of direction given by staff.) In the XYZ case study (Appendix 1.3), where students can be confronted with a completely open-ended, unstructured problem in information system design, different ideas on company policy and structure result in widely divergent statements of information requirements (and consequent physical design of the data base); provided that the students can justify their decisions, all such statements are valid. Thus as the students experiment with ideas and concepts in the case study, the differing approaches can be discussed almost as a case study in themselves.

2.4 *Sensitivity training*
This paper has emphasised the role of human beings in system design and it is this aspect that case studies can especially highlight. The need for students to be sensitive to other people's requirements can be experienced as the students work together in teams; an awareness of the students' own failings/irritations will be demonstrated much more meaningfully in group relationships than by staff comment; and leadership qualities can be identified and nurtured in case study group activities. Reliable Motor Company (Appendix 1.1) is particularly devoted to interpersonal skills in interviewing role-playing staff; and XYZ (Appendix 1·3) to such skills in formal meetings (to determine company policy, etc.).

2.5 *Attitude formulation*
One of the keys to successful systems design is the attitude of the designer to his job and other people. This cannot be developed easily as part of an academic course; to some extent it is already fixed and to some extent it can only be influenced and changed in a concrete environment. But openness of mind, patience, analytical investigation, constructive criticism, etc. can to a limited extent be influenced in college—but only through practical work.

Exactly what one is trying to achieve in each area must be identified and will determine the way a case study is chosen and the point in a course at which it is run.

3. *What?*
Before going any further, it is necessary to make clear what is meant by 'case study' in this paper. Many different types of exercise are described by different people as case studies, particularly in teaching decision making; most of these are small scale exercises involving no more than say 3-5 hours of student work in analysing the case and coming up with a possible solution. Such small case studies tend to concentrate on individual, organisational or situational problems in which students are provided with a limited description of the case, invited to diagnose and produce a solution to the problem and then to compare their solution to the one actually employed; thus they are narrow in scope and examine, usually, one particular problem.

The kind of case study used in teaching systems design is quite different. It is on a much larger scale, involving students in 30-150 hours of work (sometimes this total time will consist of several separate, small tasks carried out on the same material); it examines a problem broadly and in depth; students are required to digest and analyse large amounts of information; extra information is made available if identified as a result of investigations and interviews; students work in teams rather than individually; the case study tasks are realistically equivalent to tasks which would be carried out in industry; evaluation of student performance includes CCTV/VTR recording of interviews and presentations; the output from the case study sessions is a detailed report (sometimes more than one) of findings and proposed design; ongoing work is monitored and evaluated by staff in the role of system development managers; several problems, techniques, and concepts are covered within one large case study and are examined inter-relatedly rather than in isolation; and the complexities of real life (together with its monotony) are mirrored as truly as possible.

**2. Practice in using case studies**

1. *Stages of work*
It is perhaps worthwhile at this point to identify the work stages of a typical case study in order to indicate what the students are required to do. The following stages have to be completed in any case study (different case studies vary in detail and depth but not in the basic stages):

(*a*) assimilating the introductory information about the case study and ensuring that it is understood
(*b*) identifying extra information which is needed in the light of the problem and information which has been made available
(*c*) identifying the real problem to be tackled amongst all the information provided (i.e. 'seeing the wood for the trees')
(*d*) acquiring extra information until a total picture of the situation is available to the group
(*e*) producing possible solutions to the posed problem which are realistic in terms of available information and understanding how and why such solutions may be appropriate
(*f*) documenting the possible solutions
(*g*) evaluating the various solutions/ideas that have been proposed and their implications
(*h*) accounting for the decisions that have been reached in groups or individually
(*i*) presenting, orally and in writing, the findings
(*j*) discussing and reviewing the findings with other teams and members of staff in comparison with other findings and model solutions
(*k*) reviewing the case study in the light of its declared objectives.

All of these work stages need to be present; they are usually iterative in the sense that fact finding, analysis and design are involved at several stages and because work done at previous stages may need to be revised; and part of the exercise is allocation of work to the group and between individuals and control of progress.

2. *Choosing and running the case study*

The most critical factor in using case studies as an aid to teaching is the choice of case study; a 'wrong' case study can destroy students' understanding of the very lecture material that it was intended to reinforce. In choosing the case study the lecturer must be quite clear about his aims (i.e. what he wants to achieve in using the case study); these must be stated and known by the participants. He must take into account the state of knowledge of the students, the role of the case study in the overall teaching programme and the specific points which the case study is to cover. (In running the case study he must ensure that these points are covered; he may therefore need to be selective about the part of the total case study material which is to be used—irrelevant material is very misleading to the student.) He must also attempt to anticipate the objections of the students and choose a case study which is relevant to their situation. He must make sure that the case study is introduced with a clear programme of work so that the students know exactly where they are going (the students must feel confident that the staff are familiar with the case study and know the answers to their possible difficulties). Finally the case study must be as real and as consistent as possible—students look for excuses to criticise case studies for their unreality and inconsistency.

The most frequent objections which students make to the use of case studies are:

(*a*) 'The case study is unrealistic in terms of our experience in industry'

(*b*) 'The case study is full of inconsistencies which make it impossible to produce reasonable solutions' (some students tend to identify and elaborate on irrelevant inconsistencies refusing to grasp the total picture at times)

(*c*) 'The time scale is ridiculous compared to the time spent on such a task in industry'

(*d*) 'The size of the problem is unrealistic'

(*e*) 'There are too many red herrings in the material'

(*f*) 'The case study is too time-consuming and seems to go on for too long'

(*g*) 'We are never quite sure what we are supposed to be doing'

(*h*) 'There is not enough guidance from staff to enable us to produce even an outline solution to the problem'.

These objections must be foreseen and the case study chosen and run in such a way as to forestall them. Sometimes, even with a well chosen and well run exercise, such objections are voiced because the students want to be handfed. This should be avoided because a major role of the case study is to force students to formulate overall solutions and to develop them individually so that they gain confidence in performing design tasks. There is a lot of difference between discreet guidance and handfeeding.

Three of the case studies used very successfully at Huddersfield Polytechnic are described in the Appendices—Reliable Motor Company, General Chemical Company and XYZ Pottery Company. All three are based on realistic situations; they are used at the appropriate point in the courses (e.g. RMC at an early stage when students are concerned with investigation; GCC when students are familiar with computer systems design: in these two the tasks are highly structured; and XYZ in the final year when the design of a total management information system is being considered, and a rather unstructured situation needs to be examined). Material is used selectively (the selection varying from year to year in the light of student ability and interest); the case studies are used in blocks to avoid too much time on one case; model solutions are produced (usually reflecting the students' ideas); and all three develop from an understanding of the business situation, through outline and detailed system design, to program specification and programming. Key factors in the use of any of these case studies are the initial briefing session, the use of standard documentation (to polytechnic standards), control points at the end of every 3/6 hours of work, division of work within and between groups, the use of CCTV or VTR and the feedback sessions to discuss the students' approaches. Staff from several disciplines/departments are usually involved on an ad hoc basis, being called in by the case study co-ordinator when their expertise is required; whilst this creates administrative problems at times, it avoids wasteful deployment of staff.

The experience at Huddersfield Polytechnic has been for students to become so involved and interested in case studies that they spend far more than the allotted time for the case study in their own time producing their solutions (which are frequently of high quality); it is usually necessary to restrain rather than create enthusiasm; and, despite the objections listed above, on the whole the students are strong supporters of the use of case studies.

3. *Some of the problems of the case study method*

The case study method of teaching is not without its problems, as will be clear from comments which have been made already, and so it is perhaps appropriate to examine some of the problems encountered at Huddersfield Polytechnic.

Without doubt the major problem is an administrative one. The nature of case studies is such that usually they are more suited to block work than to odd hours in a weekly timetable. Ideally one would prefer to stop lectures every few weeks and run a major case study over several days but of course this does not always suit teaching programmes or administrative timetabling convenience, especially when staff from several departments are involved. Three approaches have been adopted to overcome this at Huddersfield. One is to treat certain work on case studies as ongoing work which has certain hours allocated to it week by week (this is particularly appropriate for programming, operational research and material assimilation activities, which are not particularly suited to intensive block weeks, and to activities which do not require team teaching). A second approach is to allocate one day per week purely to system design practical activity during which members of staff are available but not necessarily timetabled for class contact throughout the period. The third approach which works very well with third year students is to cancel all classes for a series of full weeks (not necessarily consecutive) during which the only work to be done is case study work; this suits the students because they can concentrate their minds purely on the case study and usually encourages better performance; it also means that all staff can be available at some time during the week for problems of an interdisciplinary kind; but it can also be very wearing on staff who have to be available for long periods usually in addition to their normal teaching load. The second and third approaches are essential when group work, conference sessions or detailed design activity (e.g. data base schema design) is being carried out.

The comment on staff effort leads on to the next major problem area, which is the amount of effort which is required of members of staff to understand and be familiar with voluminous case material (especially, for example, on the XYZ case study). Because the students have a relatively free rein to develop their ideas in many different directions, the staff must be prepared for many different questions and possible approaches and must be in a position to assess varied proposals. This usually means that the staff involved must have some industrial experience on which their judgements can be based and must be happy to work in a 'thinking-on-your-feet' situation. Staff effort is also required in both maintaining existing case material so that it accurately reflects current issues and problems and can be used in relation to the most advanced technical possibilities, and in developing new case studies to increase the range of available problems for the students to handle. All the case studies which have been produced at Huddersfield (some based on the industrial experience of students, others of staff) have taken many months of work to produce in a useable form.

Associated with this work of maintenance and development of case material is the problem of making the cases realistic. Realism usually is concerned with what appear to be unimportant details like the names of people who appear in a case, financial values (in an inflationary era) and quantitative measures of every aspect of a procedure (e.g. volumes, frequencies and trends in orders; salaries, absences and turnover of staff; or sequence, timing and quality of production). These details are most difficult to obtain and to keep up-to-date, but it is such details which give the case atmosphere and credibility. At Huddersfield Polytechnic, experience shows the importance of noting all the questions which students ask (particularly the ones for which no answer is readily available) and making sure that material is updated in the light of these questions. Case studies, despite their artificiality and their description of a 'dead' situation, have to be treated as dynamic and alive if they are to have continuing usefulness.

Another possible source of problems is the attitude of the students and in particular their maturity (of outlook, not age). Motivation of students, especially in group activity, is very dependent on group cohesion and interpersonal relationships. Some students find case studies challenging, others find them boring, and others use them as an opportunity to opt out; some students are shy and uncommunicative in group situations, others let their group down by not pulling their weight. The important point to bear in mind in case study usage is to devote a lot of time to creating the right environment. Finding suitable accommodation, preparing case material, providing OHP material for presentations, planning the individual case programme in relation to lectures, selecting the student groups and appointing group leaders are all activities to which considerable time should be devoted. Overcoming the shyness of individual students is the job of sensitive leadership (by the student team leader and the members of staff) and considerable time can be required during case studies for student counselling.

Bringing the reluctant student into line is a staff responsibility, though peer group pressures are often effective, and usually requires staff to make students aware of the importance of the case in terms of overall progress on the course. Staff must also support (emotionally and practically) any group which feels let down by a student member. Above all staff must believe in the case study approach (and in the particular case study) and must communicate their view of its importance and usefulness to the students. As in all aspects of education, staff attitude will be the major influence on student attitudes.

In handling problems associated with absence or lack of progress by certain students, it is important to have available 'model solutions' which can be a starting point for subsequent work. These model solutions should therefore be produced in advance to be available at each control point in the case programme. They should not be regarded as 'the right answer'.

One other point on the problems of running case studies has already been made but will bear repeating. Staff and students must be quite clear what the objectives of using any case are. This means that the staff involved must have a clear view of what they are trying to achieve and this must be communicated to the students. If the students believe a case study is intended to give experience in documenting a system whilst the staff intend it to give practice in evaluation of alternative design strategies, then no one will be satisfied with the results. The objectives of using a particular case study will clearly determine the way it is used. With certain students highly structured exercises, which allow little discretion in selecting an approach to a problem, are more appropriate than unstructured progress via group decisions. The degree of structure can occasionally be varied between groups working on the same case depending on staff involvement in group decisions but this requires a sensitive appreciation of students' abilities and progress.

The last major problem of case study usage is discussed in the next section: the problem of assessing student performance.

4. *Assessment of student performance*

This is one of the difficult areas in the use of case studies, largely because much of the design work, quite rightly, is done in teams and it can be difficult to assess individual contributions. Also the assessment of proposals in a case study is subjective (everyone has a different idea of what constitutes good design). However, it can be argued that assessment in all subjects which are not 'black and white' is subjective and staff are employed in the light of their ability to make such assessments. Therefore effort has been concentrated on overcoming the problem of individual assessment as part of group activity and various methods have been developed.

(*a*) allocation of specific tasks (e.g. reports, or sections of reports) to individuals to be completed in the light of group discussions

(*b*) assessment of individual understanding of group ideas through interviews and presentations (with question and answer sessions) usually recorded on videotape

(*c*) assessment of individual understanding of group proposals through individual's written evaluation of proposals (own team's, other team's or model solution)

(*d*) discussion of individual contribution to group achievement with the designated leader of the group (possibly a staff member)

(*e*) open discussion of marks with individual students in an effort to reach agreement in comparison to other students

(*f*) assessment in groups of team and individual performance (usually several staff are involved with a case study and a reasonably objective assessment can be achieved by involving them all in discussion).

These methods are time consuming but they have been used successfully to the satisfaction of all.

Other problems associated with assessment in case study work are student absence and student indifference, either of which can affect individual or group performance. The problem is really no different from that which would apply to course work in any subject. In a case study which builds upon previous work as it progresses, it is essential that model solutions and remedial work are available to students who miss sessions of work.

If one takes a specific case study—Reliable Motor Company—students would be assessed in four areas:

(*a*) interview performance (assessed by at least two members of staff over two interviews)

(*b*) presentation performance (assessed by the panel of staff—at least four)

(*c*) individual section of the final report (assessed by a group of staff in the light of discussion with the student and the student team leader and observation by staff)

(*d*) individual contribution to the whole report (assessed as in (*c*)).

These assessments aim to reflect both a notional standard of work expected in the outside world and comparative performance between individuals and groups within and between years of a course.

**Appendix 1 Examples of case studies used at Huddersfield Polytechnic**

Many different case studies are used at Huddersfield Polytechnic, some purchased from external sources and others developed by staff. The ones that have been purchased have almost all been adapted to the particular requirements of particular courses. Usually the background material of the case study is only slightly amended (with additions and corrections) but the tasks carried out by the students are changed and the timescales are quite different from the original versions. Frequently the same case material will be used from year to year, but the tasks will vary. The three examples given in this section are based on case studies purchased from the National Computing Centre Ltd, but those readers who are familiar with the case studies will appreciate that the tasks performed by the students are quite different in many areas from those originally envisaged in the NCC material.

1.1 *Reliable Motor Company* (*RMC*) *case study*

(This case study is normally run at Huddersfield in several stages but for the sake of simplicity it will be described as a whole).

1. *Objectives*

(*a*) To reinforce the lecture sessions on fact finding, fact recording and analysis.

(*b*) To allow the students to practise techniques of fact finding, fact recording and analysis.

(*c*) To give a practical lesson in the problems of human relations.

(*d*) To provide an opportunity for students to design a system for sales order processing in outline and then in detail.

(*e*) To give an appreciation of the factors which affect decision making in a sales order processing/stock control environment.

2. *Resume*

The case study is concerned with the problems of the spares operation of RMC. The present stock control system is inadequate, depending almost entirely on the knowledge and experience of one man. The order processing system is cumbersome and inadequate. It is impossible to obtain adequate information about stocks or demand. Students are provided with a description of the current situation in RMC from which they are required to identify the additional facts needed. These are then acquired by interviewing staff of RMC (course tutors or students playing roles). The information gathered has to be recorded formally and analysed and a report, indicating the problems of the existing system and possible improvements to be undertaken, is made to a management panel. The students, after discussion of their proposals, go on to produce an outline design for a new system and then to produce a detailed specification of, say, one computer program. All interviews and presentations are filmed on videotape for subsequent analysis and discussion with students. The practicality of the detailed design is tested by the students having to write the program which they define.

3. *Time allocation* (*on HND course*)

(*a*) Supervised time (approx): 72 hours—in 24 3-hour sessions.

| | |
|---|---|
| Sessions 1-2 | Introduction to case study, discussion in teams, identification of extra facts required, determination of interviews and questions |
| Sessions 3-4 | Interviews with staff from RMC and parallel analysis of findings |
| Session 5 | Further interviews and analysis and review of findings |
| Session 6 | Analysis of filmed interviews and report writing |
| Session 7 | Presentation of findings to management panel |
| Session 8 | Review of presentation and proposals |
| Sessions 9-12 | Outline design of a new computer based system |
| Sessions 13-18 | Detailed specification of one or more programs in the sales order processing suite together with an associated user manual |
| Sessions 19-24 | Writing of the specified program in COBOL |

(*b*) Unsupervised, untimetabled time is expected to be at least as much and is usually more.

4. *Staff involvement*

Staff from many disciplines are involved at different stages as the case study progresses, data processing staff carrying out the co-ordinating role. Students are expected within the case study to apply concepts and techniques from economics (understanding market mechanisms and forecasting), accounting (especially interpretation of balance sheets), behavioural studies (problems of role, perception, personality and attitudes) quantitative methods (techniques of stock control, in particular), computing (detailed design of the computer system and programming in COBOL), and systems analysis (investigation, analysis and design).

1.2 *General Chemical Company* (*GCC*) *case study*

(This case study is normally run at Huddersfield in stages but for the sake of simplicity it will be described as a whole).

1. *Objectives*

(*a*) To demonstrate how a commercial system can be improved by using a computer.

(*b*) To place the system design task in its context (in this case, one of financial accounting and management reporting).

(*c*) To give practice in techniques of project planning and presentation of ideas to management.

(*d*) To give practice in the techniques of design and documentation of a suite of programs, to a level where they may be handed over for programming.

(*e*) To allow students experience in identifying information needs for systems design.

(*f*) To provide experience and understanding of types of sales ledger system and their impact on company profitability.

2. *Resume*

Students are provided with a statement of the existing sales ledger and credit control system of GCC. By analysing this and interviewing staff of the organisation (course tutors playing roles), they are required to identify and, to some extent, evaluate the information requirements of a new system. This is presented to a management panel and, if approved, detailed specification of the program suite is carried out. The outputs from the case study are a report on the proposed new system and its benefits to the organisation, a program suite specification, and a proposed implementation plan (taking into account the needs of users).

3. *Time allocation* (*on HND course*)

(*a*) Supervised time (approx): 72 hours in 24 3-hour sessions.

| | |
|---|---|
| Sessions 1-2 | Introduction to case study, discussion in teams, identification of extra facts required, interviews and analysis of findings |

| | |
|---|---|
| Sessions 3-5 | Outline design of new system including a review session and preparation of report |
| Sessions 6-7 | Presentation of findings (recorded on videotape) and review by management panel |
| Sessions 8-12 | Detailed computer procedure design resulting in program suite specification |
| Sessions 13-21 | Writing of one of the programs in the suite in COBOL (each student within a team taking a different one) |
| Session 22 | System testing |
| Sessions 23-24 | Production of a proposed implementation plan |

(*b*) Unsupervised, untimetabled time is expected to be at least as much and is usually more.

4. *Staff involvement*

Staff from several disciplines are involved at different stages as the case study progresses, data processing staff carrying out the co-ordinating role. Students are expected to apply concepts and techniques from economics (budgets and corporate information needs), accounting (sales ledger, credit control, liquidity), organisation studies (introduction of change), quantitative methods (CPA for implementation plan), computing (detailed design of a program suite and programming in COBOL) and systems analysis (investigation, analysis and design).

1.3 *XYZ Pottery Company case study*

(This case study is normally run at Huddersfield in stages but for the sake of simplicity it will be described as a whole).

1. *Objectives*

(*a*) To demonstrate the relationship of the information system to the overall policy and structure of an organisation.

(*b*) To give practice in the tasks of identifying information needs, logical and physical design of information systems, and evaluation of information systems.

(*c*) To allow students to take an overall approach to system design involving the application in an integrated way of concepts and techniques from organisation design, computing and OR.

(*d*) To develop the students' awareness of the human aspects of information system design.

(*e*) To provide an opportunity to experiment with the various theories of information analysis.

(*f*) To encourage the students to take a wide view of information system design in the total company context.

(*g*) To reinforce lecture sessions in all areas of the course.

2. *Resume*

The case study consists simply of a mass of information about a pottery company, its present structure and policies and its current systems, some computer-based. The students have a free hand in determining appropriate policies and structures, overall information requirements and priorities for computer development. Within the constraints which they themselves impose, the students go on to carry out a detailed logical design of the information system, which is in turn converted into a physical system specification and evaluated. The evaluation involves a development and implementation plan, an analysis (in outline) of costs and benefits and a suggested method of handling the organisational changes required.

3. *Time allocation* (*on HND course*)

(*a*) Supervised time (approx): 170 hours in modules either in block weeks or block sessions of 2-6 hours duration.
(The following modules are not in any specific order except that 1-4 must be run in sequence.)

*Module* 1 (30 hours)

Having read and digested the background information about XYZ the first task for each student is to consider the organisation chart and decide what changes, if any, would be appropriate. Each student is then required to acquire a detailed knowledge of one part of the company. To enable him to do this, he is appointed to a particular post in the company and provided with all available documentation relating directly to that post, together with a job description, a character study and a list of specific questions to be considered. There are opportunities to interview other students in their roles. Each student works independently in preparing a brief report on his job and its problems. Then a series of 'conferences' are called. All the production managers meet for a 'production conference'. Similarly with sales, finance and services. The purpose of the conferences is to discuss the objectives and future policy of the various functions and to exchange the knowledge gained individually. At the end of the conferences each student, who should then be capable of acting as a functional director, produces a report on the state of affairs in his division.

The final task is to determine the future policy of the XYZ company. This is achieved by holding a series of board meetings. The students are all promoted to be functional directors and each board meets under the chairmanship of the company chairman (a staff member) to consider the future.

In the initial stages each director must present a report to the chairman on the state of affairs in his division. The chairman and the other directors cross-question him on this report. In this way each student becomes more familiar with those parts of the company which were not previously studied. The discussion is then broadened to include all aspects of the company's operations, and the meeting terminates by drafting an outline statement of future policy. The points to be clarified in this statement include:

General policy on expansion, diversification, etc.
General policy on expansion of production capacity
General policy on expansion of stockholding capacity
Marketing and sales policy
Financial policy.

*Module* 2 (30 hours)

In this module the students turn their attention away from general management problems, although they still retain their role of functional directors at first.

The task in this module is to specify the overall information requirements of the company from the user viewpoint; in other words to design the upper levels of the company information systems model. The emphasis is on definition of the system as a whole, division into suitable subsystems and definition of the interfaces between the subsystems. At this stage no account is taken of how the system is to be brought into existence, or of the techniques to be used in running the system.

*Module* 3 (20 hours)

The students are required to consider the more detailed logical design of the company data base, the primary requirement being to specify the content, size and structure of part of the data base.

*Module* 4 (20 hours)

In this module the students take the logical structure of the data base and go on to recommend a physical structure (including subschema definition) and suitable data base management software for maintaining and organising this structure.

*Module* 5 (20 hours)
In this module the students are required to gather together all their previous work and to produce for management a concise proposal for the creation of the XYZ information system. This work is concerned with planning and control of the development, aspects of hardware procurement, evaluation of hardware, systems and performance, and a proposed plan for implementation of the information system taking into account its impact on the organisation.

*Module* 6 (25 hours)
In this module the students assimilate information about current XYZ systems by designing and implementing in COBOL a program from the sales analysis suite.

*Module* 7 (25 hours)
In this module the students identify areas of XYZ which they feel would benefit from the application of OR (e.g. transportation, forecasting, etc.) and tackle the problems of applying specific techniques.

(*b*) Unsupervised, untimetabled time is not expected of the students on the HND course because of the course structure in the third year. The hours quoted above are more or less an accurate reflection of time spent.

4. *Staff involvement*

XYZ is a wide-ranging, unstructured case study which can be used in many different ways to suit student needs. Because it is concerned with total system design, staff from all disciplines are involved at many stages.

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# Book reviews

*Education and Large Information Systems*, edited by R. A. Buckingham, 1977; 197 pages. (*North-Holland for IFIP*, Dfl. 65·00)

The sixteen papers which make up this book formed the material for the 1977 IFIP working conference on educational requirements introduced by large systems. The papers are each followed by a short report of discussion and the whole is preceded by conference recommendations. Several papers are followed by an extensive up-to-date list of references which would be useful to those researching into recent developments in this field. There are descriptive papers on SWIFT, IBM European education, the Netherlands Telephone Customer System and graduate and undergraduate provision in various universities. The remaining papers deal with the interface between the needs of computer users, the education and training of data processing specialists and future problems which may arise from large systems. The need for recent, recurring and relevant experience is pointed out by Etzi alongside the need for more knowledge of available software packages. Zijlker points out that people should not be a part of a system but should ride on top of the system and control it with mutual communication. Engberg emphasises the need for flexible systems and discusses the disappearing work ethic, the objective of economic efficiency and the problem of organisational inertia. Lovick mentions the great difficulty of educating senior user managers. These highlights give some idea of the scope of this book.

P. Giles (Stirling)

*Foundations of Microprogramming*, by A. K. Agrawala and T. G. Rauscher, 1976; 416 pages. (*Academic Press for ACM*, £11·70)

Microprogramming has changed a great deal since Wilkes first coined the term in 1951. The objective given then for microprogramming, in Wilkes' often quoted words was 'to provide a systematic alternative to the usual somewhat ad hoc procedure used for designing the control system of a digital computer'. Present day definitions of microprogramming embrace a whole spectrum of programming activities from the control of individual hardware components such as gates to the writing of programs in what is close to a conventional machine code. The broadness of the subject matter, together with the variety of microprogrammable computers on the market, makes microprogramming a difficult topic about which to write a general book.

This present book manages to give the reader a fair grounding in basic microprogramming terminology and a comprehensive discussion of the types of hardware the microprogrammer is likely to meet. This discussion is illustrated by examples from a simple (hypothetical) microprogrammable computer, which however can only make one choice of hardware type for each component from the many offered. The reader is also introduced to some of the currently available microprogramming languages varying from a flowchart specification through to languages not unlike a general purpose high level programming language. The support software, such as translators, emulators, etc., is also given a section in the book. A later chapter includes developments both recent and future (as foreseen by the authors) in the area of microprogramming languages.

Following the general sections, the authors describe, in the terms defined earlier, a number of commercially available user-microprogrammable machines. These are categorised into three types: horizontally microprogrammed, vertically microprogrammed and those whose micro-architecture is a combination of the two. The term 'diagonal microprogramming' is used to describe this last case. Some 13 machines are examined in considerable detail, and another four are described briefly.

The authors conclude the book with an examination of current application areas where microprogramming is employed and topics such as emulation, graphics, signal processing and operating systems are discussed, followed by an attempt to put the whole book into perspective. In this final chapter, the reader is presented with an overall look at the subject including some crystal-ball gazing on the part of the authors.

The book is intended to serve as an introductory text on microprogramming and certainly a reader new to the area should be able to follow the discussion. He will no doubt finish the book, however, realizing that microprogramming is a vast area with many applications where most knowledge must be gained by studying special cases. The authors admit in their conclusions that 'the amount of work done on the subject prohibits a complete examination in a single book', and recognise this fact by giving an excellent annotated bibliography at the end of each chapter. This reviewer would certainly recommend the book as a suitable starting point for anyone wishing to enter the field of microprogramming.

C. R. Snow (Newcastle)