New approaches to systems analysis and design
Welcome

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This seminar is being held as a tribute to the late Eric Norbury Mutch, Editor of *The Computer Journal* from its foundation in 1958 until his death in January 1969.

In 1956–57 he had helped to bring together the groups of scientific and business users to form The British Computer Society, he was a subscriber to the Memorandum and Articles of Association, and he served on Council for eight years. When Council agreed to found the Journal he formed an Editorial Board of eleven members and negotiated a procedure with the printers, which enabled us to make the most use of honorary effort and placed a minimum load on the then BCS office staff of three.

Our publicity efforts, though amateur by present day standards, and the editorial levels that we were able to set, with the help of the Board and other referees, resulted in the Journal rapidly achieving international recognition. By Volume 6, in October 1963, when the BCS had 2,900 members, the Journal had 1,200 overseas and 300 home subscribers which bore the bulk of the cost of publication.

From his wartime career on radar at Malvern, throughout his work from 1948 with Dr Wilkes at the University of Cambridge Mathematical Laboratory, where Edsac made its first computation on 6 May 1949, Eric Mutch was always concerned to see that the latest technology was made available to the USER, through the help of his operating instructions and guidance manuals.

Over a period of some twenty years, from 1949 to 1969, Mutch lectured at Cambridge courses, at seminars and summer schools, and by invitation to professional bodies in London, at the Northampton College—now The City University, at Dundee and elsewhere. In his introductory lectures he was able to get across to mature students the potential power of the new electronic computer over its mechanical predecessors, particularly its ability to modify its own orders by binary arithmetic, even when there was only a single accumulator.

I well remember our first editorial meeting at Cambridge and his excitement, which I shared, at our first paper—'Parallel programming'—by the late Stanley Gill. This introduced us to the 'new world' of computing, where the machine's facility for multi-job and multi-user began to open the door to the direct use of computers by clerks, engineers, and students, in a manner which we could not dream of in 1958–59. We had little concept of that 'new world' then but Eric soon met it in his position of Superintendent of Computing Services at Cambridge.

When Eric died in 1969 the functions of systems analysis and systems design had already been established and were developing rapidly. Eric Mutch would have been delighted to bring together a seminar such as we are going to have today. The Editorial Board is most grateful to Peter Hammersley (the present Editor) and all those who have helped to organise it, and the others who have come here to talk to us. It will, I feel sure, be a proper tribute to his memory, ten years after his work with us suddenly ceased.

Chairman's introduction

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Computers have been around for some thirty-odd years and have been used as part of business and administrative information systems for about the same time. But it is only since the 1960's that their use for data processing has been at all widespread, though the rate at which computer systems have been introduced in that period has been astonishing. In these thirty-odd years the craft of designing and implementing computer based systems has been pioneered, has evolved, and has reached its current state. If we examine the state of data processing in 1979 from a distance, then what we notice most is the way the use of computer systems has spread, and is continuing to spread at a rapid rate. We may also note that the vast majority of organisations who have adopted computers, not only continue to use them, but continue to increase their use of computers.

In the face of this remarkable success story, it is possible to ask—Why 'new approaches to systems analysis and design'? Are new approaches necessary or desirable? In the mid-1960's, and again in the 1970's, as generation of computer architecture replaced generation of computer architecture, computer people and users grumbled at the cost and effort of adopting these new tools. Are we now going to insist that systems analysts and designers forget their established methods and learn new approaches?

If we come closer to the computing reality of 1979 and go forward to consider the requirements of the 1980's, we observe a number of features which suggest that the established methods and techniques of systems analysis have not served us as well as the continued growth of computing might have led us to expect. Further, the technology itself is changing and requires new approaches if it is to be utilised effectively. Some of the aspects of computers in data processing which suggest new approaches are needed, are the following:

1. The recognition in study after study, including the recently published BCS report, that there is often a difference in perception between EDP people and users as to the success of computer systems. Users report that the computer systems cost more and take longer to develop than had been estimated and that when they are implemented they are not quite as useful as had been expected, or are difficult to work with. Above all users complain about the inflexibility of computer systems. In a sense users are looking

back to a 'golden' pre-computer age, when they were responsible for their own data base. In general, they not only initiated systems change but implemented it as well, perhaps with the help of O & M specialists. There was no doubt that they had the knowledge necessary for making changes in systems, and they also had the skills. Above all they felt they had control over the change process.

The introduction of computers into information systems changed the pattern of systems evolution. The technology —computers—appeared to require rather special people to make it useful to the organisation. Attempts to recruit office personnel into computer departments met with only limited success. As a result, a new specialist function grew up in organisations—the EDP function, which was made responsible for the development and implementation of a new computer based information system. The line managers, who had up to the time of the introduction of computers been responsible for the evolution of systems within their own functional areas, lost this role, partly because they could not cope with the new technology, partly because the new systems paid little regard to functional boundaries. It seemed that to get the most out of computers required the construction of large centralised systems. At the same time the role of the O & M specialist in systems design, at least for computer supported systems, almost disappeared.

Systems analysts have recognised the gap that exists between themselves and users. They recognise that the relationship between users and specialists has to change and that new roles have to be defined for both groups in a system project. These roles must involve the user much more in the design process and make the specialist much more the partner of the user. And these new roles require new tools for analysis and design if the user and the specialist are going to play their part in the analysis and design process.

2. The realisation that the success of computer based systems depends critically on the extent to which the operation of the system wins the approval of those who work with the system and those who use the system. If the system does not gain the approval of those who have to work with it, a number of consequences may follow:

   (*a*) The system may be actively resisted, and the workforce may refuse to allow it to be implemented, or if it is implemented, they may degrade it by various acts of misoperation, or even industrial action.

   (*b*) Those who work with the system may develop their preferred informal system to substitute for the formal computer system. A whole network of such systems may grow up, adding to the cost of the whole system, and ultimately making the computer system redundant and ineffective.

   (*c*) The system may be passively resisted resulting in low performance standards, and inefficiency.

   (*d*) The workforce may resist the system by looking for alternative jobs or by high rates of absenteeism or even by health problems amongst those who most dislike the system.

   Conventional systems analysis has placed too little emphasis on ensuring that the system is designed in a way which enhances or at least does not reduce the job satisfaction of those who work with computers. A new approach is needed which is capable of addressing itself to the problem of job satisfaction and user approval.

3. The way values are changing in Western industrial societies, and the movement towards industrial democracy. Until quite recently it was possible for management to make changes in production methods or task structures in order to increase productive or administrative efficiency, without consulting either employees or Trade Unions. It is now beginning to be recognised that people have a natural right to play a part in determining their own work situation. Hence, any change designed by management requires the prior approval of those who might be affected by the changes. This principle is now enshrined in the laws of Sweden and Norway, and recognised by the German co-determination legislation of 1976.

   The implication of this social movement on the development of computer based systems is profound and requires again a major reappraisal of the approach to the analysis and design of systems.

4. The problem of systems inflexibility, which are reflected by:

   (*a*) The high costs of maintaining computer based systems. In organisations which have been using computers for some years the cost of maintaining systems can be as high as 70% of the whole EDP budget.

   (*b*) The actual life of a system as against the original life expectancy. A system which has to be replaced earlier than anticipated may not earn the full expected return on the capital invested in its development.

   (*c*) The development of costly and often informal and unofficial substitute systems.

   (*d*) The growth of user dissatisfaction which makes it more difficult to introduce new systems.

   In the 'golden age' systems were relatively flexible. Computers, in that they have to be programmed before they can perform any task, are inherently less flexible than systems based on people. Nevertheless, the computing fraternity has developed a wide range of tools which make it more possible to achieve flexible systems. What is needed is an approach to analysis and design which is capable of identifying the extent to which a system is sensitive to changes in its environment, or changes in technology. If that is possible, the designer is in a better position to estimate the life of the system and what aspects of the system may have to have flexibility built into them.

5. The other major aspect which suggests the need for a new approach is the changes which are taking place in communication and computing technology, and the consequent reduction in the cost of computer hardware.

   These developments enormously increase the opportunities for the use of information technology, both in areas where the use of computers is widespread, and in entirely new areas. They have also given the opportunity to individual users in an organisation to make themselves independent of existing EDP groups in an effort to recapture the freedom of the 'golden age'. We know that information technology in unskilled hands can lead to disaster, and the painfully learned lessons of the past 30 years may have to be relearnt by those who try to use the technology without applying the standards and tools which have been evolved over the past 30 years.

   The advent of the new technology, with its application areas of distributed processing, electronic mail, EFTS, word processing and the automated office, and other new opportunities will again require a fresh look at how we analyse and design systems.

Today's seminar addresses itself to some of the problems and suggests some of the new approaches which are beginning to be made available, and some of the tools which are being

developed to support the approaches. I do not expect that all these speakers will agree on all questions. Nor do I believe that there is a single correct approach which will meet our needs through the next few years. The most important attribute of any methodology is that it should fit the values and perceptions of those who use it. And because values and perceptions differ, there have to be a number of approaches. I hope this seminar exposes some of these new approaches to those who are searching for new methods to tackle tomorrow's problems.

Social aspects of systems analysis

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Participative work design: a contribution to democracy in the office and on the shop floor

The approach described in this paper represents the present stage of an evolutionary attempt to provide users with the opportunity and skills to redesign their own work systems. This approach has now been used by the author in four different kinds of enterprise: a British company manufacturing building products, an American insurance company, a British bank, and a large British engineering firm. In each of these establishments a new computer system was being introduced into an office situation and this was seen as providing an admirable opportunity for the redesign of work so as to (*a*) increase the satisfaction of staff and (*b*) increase their work efficiency. It was believed that these two objectives were not entirely independent. Many employees appear to become frustrated and dissatisfied when working in an inefficient and poorly administered work situation, although clearly there are many factors other than efficiency influencing job satisfaction and these will be discussed later in this paper. Similarly an important element in job satisfaction appears to be a feeling of 'competence' and people have difficulty in being 'competent' where work is not efficiently organised.

Participation philosophy

Three different levels of participation have been used in these four firms. First, an approach which may be called *consultative participation* which was used in the building products firm. Second, a *representative participation* approach in the insurance company and bank. Third, a *consensus participation* approach in the engineering firm. These can be described as follows:

Consultative participation leaves the bulk of decisions on how a new work system shall be designed and jobs structured with the traditional systems design group although there is a great deal of consultation and discussion with staff at every level in the user department. In the building products firm the work of a department dealing with customer orders was being changed from a batch computer system to a real time application, and this was seen by the systems design team who were computer technologists as providing an opportunity for increasing job satisfaction through the redesign of work. In addition to extensive consultation they organised clerks in the department into a number of small problem solving groups to consider different aspects of the new computer system. The form of work organisation eventually selected was based on an autonomous group structure, with small groups of five or six clerks responsible for all the tasks associated with handling a customer's order and dealing with customer problems.

Representative participation requires a higher level of involvement from the staff of a user department. A design group is now formed which is representative of all grades of staff in the department and, if a new computer system is being introduced, also includes the systems analysts. The departmental manager may or may not be a member of the design team, depending on his own wishes. This approach was pioneered by Professor Louis Davis, Director of the Quality of Working Life Institute at the University of California, Los Angeles, in the United States. His personal philosophy has always been that *no one has the right to design a work system for someone else and that the role of the expert should be to help the worker to design his own work system.* This approach was used in the American insurance company where the principal researcher was Professor Davis himself. It was also used in the British bank, although in this instance the initiative to try such an approach came from the bank itself which asked the author to assist them. In the two situations the introduction of a new or a new kind of computer system was used as an opportunity both for improving efficiency through the use of a higher level of technology and for improving the job satisfaction of workers through the redesign of work in a manner which the workers themselves decided would improve their job satisfaction.

Consensus participation takes the democratic approach to a higher level again by attempting to involve all staff in the user department continuously throughout the systems design process. Once again a design group is formed from representatives of the user department and the computer systems analysts. With the consensus approach this design group, with the exception of the systems analysts, is likely to be *elected* by the staff of the user department, whereas with the representative approach it may be selected by management. The role of the design group using a consensus approach is twofold. It will have to develop a new form of work organisation while continually receiving and giving ideas from and to departmental colleagues and allowing the final decision to be taken by the department as a whole. It is this last approach which will be described in detail in the remainder of this paper.

Design philosophy

A participative approach to work design means that the employees of a department or their representatives construct a new form of work organisation which is based on a diagnosis by them of their own needs. There are a number of different philosophical approaches to work design which such design groups may want to consider. The two most frequently used are *job enrichment* and the *socio-technical* approach. Job enrichment focuses on the job of the individual worker and tries to build up this job in such a way that it increases in interest, responsibility and challenge. The job may be extended by adding to it preliminary activities such as setting it up and acquiring the necessary materials, or completion activities such