

Computers: Applications in Industry & Management

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COMPUTERS: APPLICATIONS IN INDUSTRY AND MANAGEMENT

Proceedings of the International Seminar
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29 July – 17 August, 1979

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PREFACE

The contents of this volume constitute a selected part of the background material offered to the participants of the UNESCO sponsored International Seminar "Computers: Applications in Industry and Management" held at the University of Patras, Greece, in the summer of 1979. This 3-week, 120 lectures Seminar, set as its objectives the presentation of the possibilities and the knowhow offered by modern hardware and techniques as an essential support in facing the problems of planning, managing and developing of industrial units as well as in structuring and running public and private administrative services that handle large quantities of diverse data.

The broad subject tackled justifies the inclusion of contributions related to the fundamental concepts of the Science of Management, e.g., Data and Information Processing, Analysis Design and Implementation of Systems and Information Systems, Computers and Related Technology (including Mini and Micro Systems), Teleprocessing, etc, while the need for specific and detailed guidance of the new and old user of modern hardware and software is covered by many practical examples to be found in all contributions. Other entire contributions, referring, e.g., to Interrelation, Classification, Coding and Storing of Data, to Data Base, to Graphics, to Computer Security, to Industrial, Transportation and Traffic Applications, to Automobile Manufacturing, to Production and Inventory Control, to Banking, to Communications, etc, cover exclusively important applications of computers.

It is thus hoped that not only the reader of broad interests but also the specialist seeking further knowledge on the latest developments in the field of applications of computers as well as in the trends of computer uses will find useful information in this volume. The spectacular reduction in the cost of computers of all sizes, the development and growth of computer uses in the 80's, are examples of well covered subjects of general and special interest.

In a volume of broad educational objectives such as this, aspects necessitating improvement are bound to occur. The editors, therefore, will be grateful to critical readers for whatever recommendation they may consider appropriate to make, especially in view of their intention to revise this edition after the new holding of the Seminar this year.

The organizers of this series of International Seminars appreciate the moral and financial support offered by UNESCO, the Greek Government and the Senate of the University of Patras and acknowledge the importance of the contributions of all faculty members who did their best in presenting so efficiently such a wide spectrum of topics.

Patras, 1980

C. L. Goudas and G. C. Pande

***"The papers reproduced in this volume express the views of
the authors, and not necessarily those of Unesco."***

OPENING ADDRESS BY UNESCO REPRESENTATIVE

Dr. Yakup Paker

Mr. Chairman, Ladies and Gentlemen,

I am very happy to participate in your seminar and to observe our informatics programmes in action in the field to-day, here in Patras, in this beautiful corner of the Mediterranean, under the clear skies so rich in history, tradition and culture.

You may wish to know what Unesco does in informatics. First, the word informatics needs clarification. This is taken from the french word "informatique" which describes the emergent discipline of data processings, machines, techniques and applications in their widest social and economic contexts. In this sense it includes computer science yet it has a wider meaning. It is not, however, information science which is related to documentation and library science.

Last year in Malaga, Spain, Unesco organized an intergovernmental Conference on informatics called SPIN. This was the first conference of its kind which nearly 90 countries attended. During this meeting consensus was reached upon various recommendations which set a programme of action for Unesco in informatics as well as other intergovernmental organizations such as IBI, non-governmental organizations such as IFIP and member countries.

It is not appropriate to summarize the SPIN conference here. Yet, there are a few major conclusions that can be drawn which are worth mentioning:

- Informatics is a very important activity for both industrial and developing countries where this is seen as an instrument of progress.
- For developing countries informatics is seen as a high priority area where inability to master it is assumed to lead to the widening of the gap that separates them from industrial countries.
- Most countries are concerned to have endogenous informatics capability and a certain degree of self-sufficiency in this field.

At SPIN a general consensus has been expressed that education and manpower training is a prerequisite for informatics, regardless of the level of development. In particular, continuing education in this fast moving field, was seen as neglected area, not readily covered by existing University or other higher education institutions' regular programmes. In this sense we believe that your Seminar is filling a very important gap.

Finally, informatics is an international phenomenon. At SPIN international cooperation, regional or bilateral arrangements, were given encouragement. Thus, we note with satisfaction the so many participants coming from distant corners of our globe and also the distinguished international team of lecturers in your Seminar.

We would like to congratulate Professor Goudas and his colleagues for their initiative and tremendous organizational effort that they have put into preparing this seminar. We are happy that Unesco was able to help in the sponsorship of this important event.

I wish you a very successful Seminar.

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INFORMATION AS A CORPORATE RESOURCE

A. S. Douglas

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The importance of information resources for survival, in the environment of contemporary industry and management and the effect of information processing and timeliness of availability is discussed. The management of information resources including the technical consideration, i.e., hardware and software, as these are related to the essential questions of decision making is also considered.

1. INTRODUCTION

The primary objectives of any corporation must be to survive in an environment which is generally hostile. There are, of course, many ways in which survival is possible - one only has to study the animal kingdom to realise that - and the lesson of the failure of the dinosaurs to survive is that size is not necessarily a virtue in this respect!

Survival requires the anticipation of threats, the identification of opportunities, the laying of plans to ward off the one and take advantage of the other, and the initiation and control of actions designed to implement the plans.

The information needed for survival thus includes that received in respect of threats and opportunities through sales reports, published data, private information, industrial espionage - the range is unlimited - which we may term "external" information, together with what is known of the status and capability of the "internally" controlled system. It is evident that little of the external information lies within the control of the corporation, although its collection and analysis obviously do, whereas the "internal" information is collectable in a theoretically controlled environment.

2. HANDLING INFORMATION

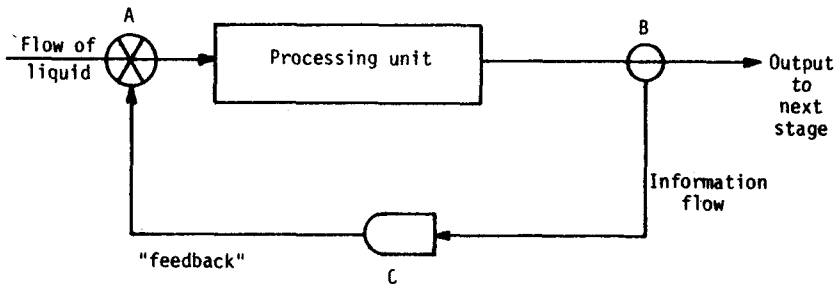
External information tends to enter the system in an irregular stream, through mainly informal channels. The general objective must be to sift the incoming information to identify threats to plans or to the existence of the organisation itself and to spot opportunities to improve one's present situation or future prospects. The analysis of such data involves an element of "pattern recognition" which may be difficult to specify for automatic action. However, sifting the data to present it in a suitable form for human recognition may be a valuable aid to management, if done rapidly enough.

Examples of information analyses which can usefully be done are provided by statistical tables and analyses prepared from market survey questionnaires or from published Governmental figures, which can throw light on "external" trends in a variety of ways.

3. TIMELINESS

To be useful, information must be timely. That is to say that; relative to the time scale of action, it must arrive at a point where the relevant response can be made successfully.

As an example let us take a liquid flowing through a pipe driven by a pump into a processing unit, which then outputs a liquid product. We wish to maintain approximately constant flow of output despite the surges caused by the pumping action. To do this (see Figure 1), we place a valve, A, on the input pipe and a flow meter B, on the outlet. We now take the readings from B and pass them to a controller C, which is able to open or close A incrementally. However, the process of altering the setting of A takes time, as does the "thinking" of the controller. In addition time is taken in going from A to B via the processing unit.



A is a control valve allowing input of liquid to the processing unit.
 B is a sensor reading the output flow.
 C is a controlling element acting on A as a result of information passed from B.

Figure 1
Control loop

Now the controller only sees the situation at B. If the first four readings, taken at equal intervals are, say 10, 9, 8, 7 - a surge from the pump followed by a slowing movement - the controller naturally considers it should open A further. We will suppose that it gives the instruction, which, however, does not operate immediately, but delayed by one time cycle. The next reading is 6, but the 6th reading shows 11, since the opening of A at this point coincides with a surge from the pump. But 6 has now been fed to the controller, which thinks more opening correction is needed, and despite the fall off as the pumping ceases, the flow of 11 is maintained. The first 11 is now fed to the controller, which seeing its mistake shuts down A sharply, and then, shuts it further on getting the second 11. The delay coupled with no pumping action ensures that the flow at B is sharply reduced, which induces a delayed opening of A just as the pump surges. Instead of a steady flow at B we have wild swings.

Let us now take out the delay, and suppose the controller acts instantaneously on A. Now A is opened in time to increase the flow for the 5th reading to above 6, and although A may well be too far open at the next time interval, the error will be corrected over time - the oscillations will be "damped". Improved control can be got by plotting the data and extrapolating it so that the oscillations are anticipated, and the "feedback" injected so as to accelerate damping. All control engineers are fully familiar with the results of delayed "feedback" in control loops in electrical and mechanical systems, although it seems that managers are rather less aware of comparable effects in human systems. It is, perhaps, in reducing

delays in control loops that the computer has its major role to play in corporate control.

A further element of timeliness can be seen in the planning function, where the ability to explore more possibilities within a given time, dictated by either internal control factors or external events, may well be important.

We may observe that the control of cash and credit transactions is of the greatest importance to the survival of the company, and that timeliness in reporting problems is normally vital.

Of course, speed in response is not necessarily a virtue. Rapid ordering of goods may be desirable, whereas rapid payment for those same goods may not be. Indeed most corporations "borrow" from their suppliers by delayed payments, up to an accepted limit at least. However, there is virtue in knowing quickly what commitments exist, even if the actual meeting of them is delayed:

4. SOME EXAMPLES OF TIMELINESS

Timeliness is a slippery customer, though. Consider the circumstances of a company set up to rent sacks to farmers. Charges might be set weekly, and we may suppose that peak sales are during the Summer. But the sacks will tend to stay around even after their usefulness has ended - particularly if returning them is a bit of a chore. One certain way to remind the farmer to send them back, however, is to send him a bill. But as the sacks are rented, it is not in our interest to remind him. So, if his credit is good, you would probably only send in one or two bills a year, and make sure those are late - more haste, less money! And that is indeed what is done.

On the other hand, airline, reservations offer a counter example where speed of response is important. Once a plane has taken off with an empty seat, the commodity the seat represents is lost permanently. So we make the maximum effort to ensure that the seat can be sold at the last possible moment.

5. INTERNAL INFORMATION

The internal information in a business depends materially on the system set up to keep track of movements of stock or parts from one process to another. This starts with a customer order, which triggers a demand on the warehouse, which, in turn, may trigger a demand on production. The latter sets off demands for raw materials or bought in items for assembly. Each activity can be seen as a transaction between two parties, the "buyer" and "seller" of services. Keeping track of these transactions is done by means of paperwork, and/or by the use of punched card machines or computers. This paperwork not only serves to trigger actions, but also to account for them both in physical and financial terms.

From these transaction records, data can also be extracted to use for planning purposes as well as for control. Control data can be got, for example, by comparing currently recorded costing against those derived statistically from past performance. These same costings can be used to estimate the cost of planned extensions of operations. Execution of such plans can be monitored by comparing actual costs against those budgeted in the plan.

6. ON THE QUESTION OF DECISIONS

It is often considered that the importance of information lies in the effect it may have on the decision process. This is clearly true. The argument is then usually taken forward to emphasise the need to influence the "decision-takers" by making available data to them, and hence to justify the use of computers. This

argument is suspect on two counts. Firstly the real decision-takers are usually hard to pin down, and, secondly, it tends to ignore the importance of informal and indirect communications.

In large organisations, few, if any, people take positive decisions. Rather is an idea generated by someone not in a position to implement it and then it is passed through a series of "screens", consisting of people or Committees who can turn the idea down, but cannot themselves approve it. The screening process is continuous even after a first "round" has failed to reject it, and later "rounds" can throw it out on all sorts of different grounds. It may be thought that it must be a good idea if it survives this process and must have been a poor idea if it did not. Regrettably this is not necessarily true. The reason for this is that large groups tend to acquire a "climate of opinion" which will ensure that an idea at variance with the climate, however good in itself, will fail automatically, whereas a poor idea in tune with the climate may well be unobjectionable.

This "climate of opinion", whilst very tangible and real to those in the organisation may be unperceived by "outsiders" and is always hard to pin down. Moreover, within the organisation there are those who are working to change the climate but who, until they have done so, will behave within its confines. The climate is thus fluid and can sometimes change dramatically when the change agents exceed those holding the original view. Relatively short-term appointments to jobs - as happens in many large organisations - obviously favours changes, although it may bring other problems. Large organisations are generally too static and require to adapt or die, so that the other problems are usually preferred to a static climate.

In recent years I have watched two large organisations - the Ministry of Defence and the Post Office - grappling with the question of packet switching. A few years ago, say five, the introduction of such a novelty when proposed, was rejected. It is, however, now certain that anyone not proposing it for a future project will be required to justify his scheme in detail, even if it is not rejected outright. Altering the climate of opinion has moved significantly in the intervening period.

Influencing the climate of opinion is a very different task from influencing an individual. Many people with different backgrounds and self-interests are involved. Means of communication are often, perhaps usually informal. The cross-connections between individuals outside the corporation are usually important.

Some corporations attempt to influence, if not control these cross-connections by paying for the membership of the country club, or by starting internal activities limited to corporate staff - the cricket, squash, football or golf teams, choral societies, bands and so on. Dependence on the corporation outside office hours is encouraged, so that the internal climate can be to some degree manipulated. The techniques are well described in Marxist literature, as well as in such books as "Organisation Man", and are of a quasi-political nature. It is at least arguable that access to the factual data relating to the business is of little or no importance in this manipulative process, and indeed propagation of the truth may well be inimical to the personal or group interests of some of the manipulators.

Setting aside the kind of power politics described above - most organisations cannot afford to introduce too much of it in practice, (except where it is encouraged by the State) - nevertheless it is necessary to realise that changes in the climate of opinion also imply changes in the power structure of the system and may have adverse effects on individuals or groups. These are then likely to react to ensure their own survival even at the expense of corporate survivability.

Clearly any attempt to manage the corporate information resources must take these matters into account. However, for many purposes it serves to consider first the nature of the managerial task in a more mechanistic light.

7. MANAGEMENT OF THE INFORMATION RESOURCE

The sources of information are thus seen as both external and internal, the internal sources normally being based on the transaction processing system set up to record and control corporate activities. In so far as information can be of value in several facets of corporate operations, we must consider how to make it available to those who need to use it. We would like to minimise the cost of data collection without destroying the timeliness with which information is provided, particularly when used in control loops. We would like to facilitate the carrying out and presentation of analyses using the raw data, whilst retaining only such of it as may be needed later, so as not to unduly clutter up our storage systems. How is this to be done? More than one of the above objectives clash. So we must also ask "who is to manage the resource?" and "To whom will he report?"

Let us begin with the assumption that someone is to be appointed as a manager with the remit to ensure that effective use is made of information within the corporation. Clearly his job cuts across line responsibilities, since all departments make use of information. He will obviously have much to do with the finance department, who are usually mainly responsible for the accounting parts of the transaction processing system. In doing his job, he will, no doubt, make use of operational research techniques and will propose and comment on the use of computing machinery where appropriate. But it is clear that his function will not be the same as an O.R. or a D.P. manager. He will also, no doubt, make use of library facilities, but his job is not that of a librarian. In dealing with external information he will be trying to organise the use of much that is gathered and presented informally. He will also be concerned with those internal information flows, which are often as significant in opinion forming as formal flows, as has been indicated above. He will need a "patron" within the political and power structure to protect him and permit his work to proceed.

There is, of course, no doubt that his preferred patron, in these circumstances will be the managing director. Failing him, he will probably find his next best boss is the finance director, especially if, as is often the case, he is more influential at Board level than any other director. Just possibly an assigned "external" director - a Vice Chairman of the Board - might be suitable provided he carries enough weight with the executive. There is precedent for any one of these arrangements in setting up both O.R. or D.P. groups at corporate level.

8. TECHNICAL CONSIDERATIONS

In undertaking the task of management information, it is clear that the manager will need to ascertain how existing flows take place, to describe them, make suggestions for "improvement", and then implement those "improvements" which are deemed acceptable.

This requires, firstly, a period of operational research and systems analysis to describe the flows and generate suggestions for improvement. A detailed understanding of the transaction processing flows, both inside and outside any computing machinery used is essential. A full awareness of the latest techniques for categorising, storing and retrieving data, and for describing the flows is needed. In implementing changes the capabilities of both man and machine must be exploited in the best way, and the projects will need to be set up and controlled efficiently. The products of such projects must be flexible and maintainable, and should thus make use of techniques designed to achieve this.

The manager must thus have a knowledge of O.R. and D.P. techniques. He should also be able to carry out analyses of the systems involved, set up data bases on an efficient basis, make models of the external world within the computer, and use the best structured programming techniques. Regrettably few such paragons exist, and moreover the techniques involved are far from fully researched. No doubt, in

later discussion, we shall be able to realise how much can be done and how much has still to be done to provide viable training for the information manager. At the moment the best we can offer at the School is the M.Sc. (Analysis and Design of Information Systems) which follows the IFIP syllabus (1974) more or less.

9. CONCLUSION

Clearly much more can and will be done about the technical means available to the information manager. Up until now the information available from internal sources in a corporation tends to be very detailed and somewhat indigestible. As a consequence information useful to managers is often lost, overlooked or delayed. By storing the information in a suitable form, such as a data bank, it is hoped to overcome this, to enable information used in both planning and control to be collected at minimum cost, and to be readily available in a timely manner, and in a consistent form to those who use it.

Admirable as this aim may be, and susceptible as it is of attainment using computers, I hope I have said enough to indicate that this is not the panacea for solving all problems in the information field in a corporation. Interactions between men and machines and between men and men are still the most important preoccupations of corporate management and are likely to remain so!

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ADMINISTRATION IN THE CYBERNETIC AGE

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The present contribution aiming to cover the broad field of the administration under the light of contemporary technological innovations, is divided into seven sections. The first deals with the relationship and impact of computer on administration, while a retrospective view of men and organizations is presented. The second section gives an account of the basic elements of administration, such as structure, function, processes, etc. In the third section we give a retrospective view of the developments in the art and science of management. The important function of decision-making, its principles, techniques and role in strategic planning are treated in sections four and five. The final two sections deal with the details of every day organizational operations and the present and future role of computers in such operations.

1. INTRODUCTION

Computers and Administration

Administration as an art is as old as Mankind. Since men made their appearance on Earth, they had to join forces in order to succeed in their endless struggle for survival and betterment. Man is, indeed, an administrative animal who, in spite of his physical weakness, was able to dominate our planet; thanks to two main properties: innovating mind and administrative talent. His innovating mind led to the development of tools, devices and machines increasing his limited biological capacities. His administrative talent played the role of multiplier by putting together the mental capacities and the extended physical potential of large numbers of human beings for the realization of the most ambitious objectives ranging from the control of rivers up to conquering the moon.

The history of Mankind is actually a history of Administrative Institutions and innovations by which desirable objectives were materialized through the synergic combination of individual efforts, talents and capacities. If one looks on the record of human achievements and failures, he can see that in the majority of the cases these achievements and failures were directly correlated with the ability or inability of men to build up and to manage successfully institutions and organizations capable to foresee needs, threats, challenges and opportunities, to study and analyze problems, to plan for the future and to mobilize, direct and manage successfully human energies and material resources toward the fulfilment of common goals and aspirations.

Later I will try to sketch briefly human development tracing the process of institutional and organizational development. At this moment, I would like to draw attention on a prevailing trend in underestimating the importance of administration as a lever of progress vis-à-vis technology. In an era as our, characterized by an astonishing and unprecedented technological progress, it is not surprising that