PERSONAL COMPUTERS AND MANAGERIAL DECISION SUPPORT

Ronald M. Lee

August 1982
WP-82-75

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

CONTENTS

PERSONAL COMPUTERS AND MANAGERIAL DECISION SUPPORT

Ronald M. Lee

INTRODUCTION

Personal computers are presently making their entry into European business. While these machines are logically similar to big computers, the advantages they offer for applications in business and public administration are, I believe, quite different.

This article outlines the characteristics of the types of problems where personal computers are likely to be most useful, and comments on their somewhat different roles in large versus small organizations.

DATA PROCESSING VS DECISION SUPPORT USES OF COMPUTERS

The traditional applications of computers in organizations have been mainly "data processing." This refers to the automation of clerical and bookkeeping activities such as computing the payroll, sales order processing, updating inventory records, customer billing, etc.

The advantages presented by these data processing uses of computers are speed, accuracy and cost savings. For instance, a computer system to process sales orders and send bills to customers is justified if it does this more quickly, with fewer errors and at less cost than the manual system.

---

* Translated version to appear in the Portuguese managemenbt journal, NEGOCIOS.

During the 1960s, there was much talk about so-called "Management Information Systems" (MIS). The idea was that the automation begun at the lower, operational levels of the organizational hierarchy would extend gradually upward to higher and more sophisticated levels of decision making. The ultimate goal was a "totally integrated" information system where all the organizational processes were systematized and controlled by the system.

This movement has occurred to a limited extent. For instance, inventory re-ordering, once a job requiring experience and judgment, is now controlled by computer in many companies. On the othr hand, the overall impact of computers on actual managerial activity has been rather small.

The reason for this is that organizations exist in dynamic environments. While certain of their activities are routine and unchanging, other activities are concerned with adapting to changes in the environment: reacting to unforeseen difficulties; finding and exploiting new opportunities.

The job of most managers is in this latter role. They deal with the unforeseen problems; they handle exceptions; they negotiate new types of contracts; they make plans to direct the organization into new areas of activity. When a particular managerial task becomes regular and routine, it is given over to a sub-ordinate. Thus the jobs of most managers are defined to be non-routine. It is not surprising that systematization efforts have not succeeded here.

Non-routine means that the types of problems encountered are new and unusual. They may have certain similarities with other problems previously encountered, but there are also differences which make a standard procedure insufficient. We may imagine a dimension of "structuredness" of managerial problems. At one extreme are problems that are completely unstructured. Theyt present a situation that is totally new and unfamiliar, and the manager must deal with them in a way that is completely intuitive and judgmental.

At the other extreme are problems that have become completely structured. We may assume that these are passed on to a sub-ordinate and become candidates for automation in the data processing system.

In the middle of this dimension are problems that are "partially structured." These are problems that still require managerial judgment, but have some aspects that can be treated analytically. The use of computers to assist in these kinds of problems is the focus of "Decision Support Systems" (DSS).

The key word here is "support." These are systems intended to aid or assist in certain parts of a larger process which still depends on managerial judgment. The focus here is not on standardization or attempting to automate the manager's job but in providing convenient, easy-to-use tools that

improve the manager's decision making capability. The emphasis here is on effectiveness rather than efficiency. What is needed are capabilities that fit the manager's needs of the moment, and can be adapted and modified as these needs change. A DSS is successful if it is relevant and useful in the manager's activities, not in economizing on clerical costs.

DEVELOPING DECISION SUPPORT SYSTEMS

Decision Support Systems, consequently, emphasize usefulness rather than technical sophistication. They typically consist of a miscellaneous assortment of small, ad-hoc programs that serve a diversity of specific functions. These are generally written by a staff assistant, the "DSS builder," who works closely with the manager.

Because the issue in a DSS is to provide computer capabilities that are relevant to ongoing and changing managerial needs, it is more important for the DSS builder to have a background closer to that of the manager than technical understanding of the computer. (It is thus more a job for a business student than an engineering student.)

The DSS develops as a series of interactions and experiments between the manager and thg DSS builder. It is a process of trial and error evolution rather than careful design. During this process the manager learns more and more how to use the technology in his or her decision making. Some programs may be used only once or twice, others may be modified over and over as the manager learns to exploit the technology.

AN EXAMPLE: BANKING

It is interesting that while DSS focuses on higher level decisions than data processing applications, the technical requirements are in most cases much simpler. To illustrate, consider the computer applications in a bank.

Banks make heavy use of data processing. These systems update the thousands of deposit, withdrawal and loan payment transactions that the bank receives each day. These systems must be carefully designed to be efficient, reliable and secure. The task that the system performs is well-specified and routine. The implementation of the system requires sophisticated computer equipment and expert designers and programmers.

By contrast, consider the types of banking problems where computer decision support might be used. In this case a loan manager analyzes the financial reports of the company and generally interviews the company's management representatives. The analysis involved may include computing a number of financial ratios -- e.g., debt/equity, quick ratio, accounts

receivable turnover, etc. While these computations help the analyst decide whether or not to grant the loan, the final decision is nonetheless judgmental. The particular calculations made will depend on the philosophy of the financial analyst and will also pobably vary with the decision situation. On the other hand, these do not require great sophistication from the computer standpoint. The amount of data involved is fairly small, and the computations are fairly straight-forward.

Whereas the bank's data processing system may take years to develop and install, a financial ratios program might be written in a few days. What matters however is that it be relevant and useful in evaluating loan applications. The program might thus be modified a number of times to add new computations, options, etc.

DATA PROCESSING VS. DECISION SUPPORT

As we have seen, managerial decision support sypes of problems have a quite different character than those typical in data processing. Data processing is oriented towards the operational, day-to-day activities of the firm. These involve a high volume of transactions so that the system needs to include large scale data storage (hard disks, magnetic tapes). The data processing programs must check for all possible types of variation in the input data (including checking for errors and invalid types of transactions), and since these transactions often have a legal/accounting significance, special care must be taken to maintain historical files and audit trails. The emphasis in data processing is on efficiency, in terms of speed, accuracy and cost savings. The problems are mainly technical: program design, organization of data files and databases, data communications aspects, etc. Data processing sysems are usually large, complex and highly inter-connected to other systems. For this reason, development of these sysems must be carefully planned, designed, implemented and tested. New projects are considered under a system of priorities and availability of staff, and work is scheduled months in advance.

Managerial decision support problems, by contrast, are technically less complex. They are typically oriented to just one or a few users, and do not inter-connect with other systems. The amount of data involved is small in contrast to data processing problems. Program calculations may be mathematically complex (e.g., a regression analsis or internal rate of return program); but the amount of data verification (which accounts for much of data processing programs) is small by contrast. What does matter is that the decision support program fit the problem of the moment. Programs are thus often written on an ad-hoc basis and frequently changed.

It should be apparent that these types of problems do not fit well into the organization of the data processing department. They present small, "rush" orders which not only

are unchallenging to the data processing staff, but are actually distracting and disruptive to their larger projects.

On the other hand, because of their lack of familiarity with the local circumstances and purpose behind the request, the data processing staff may tend to mis-interpret the problem or complicate it unnecessarily. Most importantly, because of the bureaucratic orientation of the data processing department, these requests compete in the overall priority and scheduling system, and by the time the requested program is delivered, the problem for which it was needed may have already passed or changed substantially.

TIME SHARING

In response to problems such as these, a number of larger companies introduced a time sharing access to their central machine. With this, the other line and staff departments could acquire a terminal and interact directly with the computer to develop their own programs as they needed them.

This approach has been only partially successful. A key aspect is that the computer system itself had been designed with technically sophisticated users in mind. For instance, the "operating system" program used to manage data files was often the same as that used by the data processing staff, having many more options and complications than were needed for decision support problems., Also, the programming languages available were often the same as used by data processing, e.g., FORTRAN, COBOL, PL/I, with the analogous problem of being too complicated for the need.

An important step forward for these types of applications was the introduction of the language APL. This language offered a much simpler way of handling data files and the language itself was much "higher level," e.g., a program that wold be 100 lines in FORTRAN might be only 5 or 10 lines in APL. (APL is correspondingly less efficient, but that is less important since the focus is on occasional, ad-hoc problems.)

While an important step forward, the APL approach has been only partially successful. One obvious limitation is that not all data processing compouers support APL, so that it is an alternative only for some companies. Another limitation is that the language itself uses a very compact, mathematically oriented notation (including many Greek letters) which, while well suited to people with a mathematics or engineering background, is rather intimidating to others.

PERSONAL COMPUTERS

Up until about 10 years ago, manufacturing computers was strictly a large-scale, high capital investment operation limited to large companies such as IBM, CDC, Siemens, etc.

More recently, however, computer components such as the arithmetic units and computer memory have been mass produced as standardized semi-conductor "chips" which can be inserted into printed circuit boards. As the design of these standardized chips was oriented towards small-scale computers, that the production of these small machines became largely a matter of assembly. This meant that small companies, with limited capital, could design and manufacture their own brand of micro-computers. Consequently, in the last 10 years or so years there have been dozens of companies maketing new types of micro-machines, with varying capacities and designs.

Because of their small size and relatively low cost, these machines were generally oriented towards use by a single individual, and so have acquired the name "personal" computer.

Personal computers, particularly the more popular ones such as APPLE, PET and TRS-80, were originally designed for a consumer market: for use by hobbyists in their homes. This marketing orientation is perhaps one of the most distinctive features of these machines. It meant for instance that the total cost of the system had to be affordable to an individual consumer. The chips, mentioned above, were already fairly inexpensive. Permanent storage of data was limited to low cost devices such as cassette tape recorders and diskette ("floppy disk") readers.

The consumer orientation also meant that the operation of these machines had to be flexible, but simple. The assumption had to be that the user, while curious and motivated, was technically inexperienced with computers. The machines themselves, and the manuals that went with them had to be clear, easy to understand and completely self-teaching. If not, the stores selling personal computers would be swamped with detail questions and dissatisfied customers.

Thus, while the operating system (used to run programs and store data files) of a large computer may have a hundred or so commands or options, those for personal computers have around six to ten. Likewise, the principal programming language of these machines is BASIC, which while considerably less sophisticated than other languages, is much easier to learn and use by inexperienced users.

PERSONAL COMPUTERS AND LARGE COMPANIES

Almost accidently, personal computers are becoming quite successful in business, especially for the types of decision support applications discussed above.

Line and staff departments, frustrated with the lack of responsiveness from the data processing center for these types of problems, have found they can in many cases buy their own personal computer and write their own programs to solve the problem.

One key factor here is the low cost of these machines. While the data processing center would normally control all major investments in computer equipment, personal computers are priced low enough that departments can often buy one within their discretionary budgets, hence avoiding bureaucratic debates and delays.

Another key factor is that the consumer oriented design of these machines allows the local department staff to learn to use it on their own, without assistance from the data processing personnel. This is an important point, for the department now has the independence to experiment with applications specialized to their local needs, without having to coordinate with others.

The entry of personal computers into the larger business firms has been mainly independent of the central data processing departments. A possible subsequent stage of development would be a reconciliation of these two, into what might be called a "loosely connected network."

As decision support applications grow, certain situations may require access to the central computer. In some cases this would be to access larger computational capacity than the personal computer provides, though the more likely case is to obtain special data from a central database.

An additional feature available on most micro-computers permits them to function as a time sharing terminal. (This may involve certain technical problems of coordinating the communication between the small and big machines, requiring special assistance from the data processing department.) Using an ordinary phone line, or perhaps an in-house communications network, the main computer's time-sharing resources (e.g., APL) can thus be used through the personal computer serving as a terminal.

Further, the personal computer can be used to retrieve data from databases on the main machine, saving it on diskette for local use, or contrariwise, may send local data to the main machine.

An interesting extension is when the data sent in free form text messages. The main machine then serves as a central repository for an in-house "electronic mail" system for inter-departmental memos, etc.

PERSONAL COMPUTERS IN SMALL COMPANIES

Personal computers also present a special opportunity to small companies without a data processing department and thus with no organizational experience with computing.

After the consumer (hobbyist) market, small business has been the next target market for personal computer manufacturers. However, the marketing in this case, I

believe, has been mis-directed. In the vendor catalogs, the types of programs listed under "business applications" typically have to do with accounting, inventory, etc. These are data processing types of applications and, as discussed above, include the problems that are technically most difficult. Even though the smaller scale of the business may allow certain simplifications (e.g., in data base design), the problems are qualitatively similar to those in a larger company and involve analogous types of complexities.

One of the basic problems of a small company seeking to introduce computer technology is to gain organizational familiarity with the technology and what it can do. One would like to do this gradually, at low cost and low risk. For a small company to begin with data processing applications is to incur both. First, from the cost standpoint, the small diskettes of personal computers will probably not be adequate for most data processing purposes, so the company will have to move to considerably more expensive "mini" computers with hard disks almost immediately. Secondly, data processing applications can be more risky to start with since the data involved typically involve the company's business transactions. For instance, a data file accidentally erased could mean the loss of the week's sales orders.

A better approach for small companies just starting with computing is, in this author's opinion, to consider decision support types of applications as the first step.

Indeed, one may begin with applications of this type even before learning to program. One very popular commercial software package, called "VISICALC" (by VisiCorp, Inc.) is now available on nearly all brands of personal computers. It is specifically designed as a decision support tool and can be learned in a couple of days. It is made for problems involving a "spread sheet" of labeled rows and columns which are added, subtracted, etc. either row-wise or column-wise. It is especially useful for making "pro-forma" financial statements (i.e., income statements, cash flows analyses projected over future time periods). With it, one may ask "what if" questions, automatically re-computing the pro-forma statements under different sales and cost assumptions.

CONCLUDING REMARKS

This article has had two objectives. One, to distinguish managerial decision support uses of computers as qualitatively different from conventional data processing applications. The other objective was to consider the potential for personal computers in business organizations, large and small, especially as regards decision support types of uses.