EDP ANALYZER

APRIL, 1979
VOL. 17, NO. 4

HOW TO PREPARE FOR THE COMING CHANGES

IBM's announcement of its new 4300 series of processors seems to be that company's response to the 370-compatible CPU competition. The drastic reduction in price, for a given level of performance, will slow the growth of the plug-compatibles. The next step, as we see it, will be for IBM (and the other mainframers) to introduce exciting new computer capabilities. We see these as being office systems, automated aids for system development, and so on. But these new capabilities can also mean problems for users. Now is the time to take a look at the benefits and problems of those capabilities. In this report, we discuss one way to go about it.

As we discussed in our November 1978 report, within five years the micro-computer manufacturers will very likely be able to make single chip micros that are plug-compatible with today's main CPUs and that can execute between one-half and one million instructions per second. We see these micros as the most serious competitive threat yet for the mainframers. And the threat is significant; CPUs that today sell for several hundred thousand dollars or more might be replaced with micros selling for as low as a few thousand dollars. The threat is real; it will soon be within the technical state of the art.

IBM's new 4300 series offers 370-type performance at greatly reduced prices—in the order of a 70% reduction, in some instances. These prices were designed, we believe, to quickly slow the growth of the plug-compatibles. And it should be effective in meeting this objective, we would think.

But the micro-computer technology is developing so rapidly that, in another year or so, the plug-compatible manufacturers may well find that they can once again underprice IBM. Further, the very success of the 4300 could give them a larger market to aim at.

Drastically cutting prices is not a solution that IBM will want to use over and over again, it seems to us. Having slowed the growth of the plug-compatibles, the next logical step would seem to be to try to stay one jump ahead—by offering exciting new capabilities. At the forefront of these capabilities would be end user features, including (1) office systems that are integrated with data systems, (2) systems to support managers and executives, and (3) automated aids for system development. All of these end user features are well along in development; it is just a matter of the mainframers capitalizing on them, it seems to us. For instance, IBM considers its new 6670 to be "a step toward the office of the future."

But, in addition, the mainframers are sure to offer advanced technology features. IBM's 8100 distributed data processing system, announced last fall, is an example. Also, new database hardware/software is another likely area. The goal will be to move out ahead of the plug-compatible manufacturers.

Some of the characteristics of the new environment are the following, we think. These advanced technology and end user features are ready for the marketplace. The mainframers may put them into an integrated package, to lure customers away from the plug-compatibles, and that would accelerate their acceptance. Because micro-computers are potentially so cheap, many of these features will be made available on micros, for use by organizations of all sizes, from large to small. True, these new advances will likely be introduced first in the larger organizations in the computer-manufacturing countries, but their use will soon spread throughout the world.

The types of changes we are foreseeing thus may well be more pervasive, and will spread more rapidly, than has been true of past change in the computer field.

When might these changes begin to occur? Some of the advanced technology is already on the market, but in somewhat piecemeal fashion. The same is true of the end user features. We have been discussing user experiences with some of these in our recent reports. If IBM's action with the 4300 effectively slows the plug-compatibles, as one would expect, then this should be followed up very soon by other announcements. The strategy would be: stop the plug-compatibles, then pull out ahead of them.

So these pervasive, rapidly spreading changes are imminent. Now is a good time to start preparing for them.

Now? With all of this still so much conjecture? Let's examine that question in more detail.

Why prepare now?

We think you would do well to start now to prepare for the coming changes. It will not be wasted work, we feel, because it is something you very likely will have to do anyway in the not-distant future. Any preparation you can do before the announcements of the new capabilities will help you in two ways: (a) it will help you make a better selection among the competing offerings, and (b) it will help you to minimize the 'pain and suffering' that generally come with conversions to new technology.

What about this better selection? Why not just stay with the offerings of your current mainframe manufacturer? Competition is heating up in the computer field. More and more users are willing to consider alternative sources to their mainframe suppliers. We think that will be even more the case in the future. Micro-computers are bringing a large number of very capable suppliers into the field, because micros have dramatically lowered the cost of entry.

Then how about this 'pain and suffering,' how can it be reduced? Much of the difficulty of converting to new technology has come from the unexpected and unfamiliar problems that users have faced. After enough users have made a particular conversion, the problems become recognized and better understood; later conversions go more smoothly.

What we are saying here is that work *is* going on today that can help identify the problems associated with converting to the new capability features that are in the offing.

Just what is this work and where is it going on? Well, that's the subject of this report.

What preparation entails

Each of the features of the new environment—office systems integrated with data systems, computer support for managers, automated system development, and the use of advanced technology—have been discussed at length in the technical literature. So there is a good amount of information available for study.

Thus preparation entails, it seems to us, reviewing the literature that deals with the forefront of the field—the National Computer Conference proceedings, ACM Conference proceedings, IEEE Computer Society Conference proceedings, and so on. We refer to these publications in many of our issues. Also, research that is going on in selected areas must be tracked down; you can get clues as to who is doing what from the above-mentioned publications. From all of this material, try to develop some guidelines that will help you evaluate the new product announcements.

Easy to say, hard to do. Most user organizations will need help in doing this preparation. And where are they to get this help?

Where to get help?

There are several sources of information to which user organizations tend to turn when investigating the feasibility of using some new computer technology. Let's see how those sources seem to fit this situation.

In-house study. The most typical case, of course, is where a person or a small team of people is assigned the task of evaluating the use of the new developments. That will probably be the case in this situation, to the extent that it can be used. However, the staff members may find themselves frustrated by the numerous unknowns in this particular study because so much conjecture is involved. They may feel that they must wait until the specific new products are actually announced before they can really come to grips with the study.

Hire the talent. Some users may decide, if current staff members do not seem to be able to carry off this study, to hire someone from the outside who can do it. This addition may be in the form of one or more new staff members, or it may involve the use of consultants. The problem then is to find someone on the outside who has the *actual capability* for doing the study. And this may not be easy.

Attend seminars. Publicly offered seminars are a good means of learning something about a new technology in a short period of time. For instance, there are numerous seminars being offered on office automation. However, public seminars are offered mainly for already-popular subjects. It is quite likely that it will be some time before seminars are offered that treat the new environment with any breadth of coverage.

Suppliers, and particularly the mainframe manufacturers, offer seminars on the use of new technology. However, we suspect that these will not be too satisfactory for the purposes discussed here. When these seminars deal with the forefront of the state of the art, they tend to stress the benefits and slight the problems.

Rely on user groups. User groups of both hardware and software products have proved to be a valuable source of information on the use of new technology. In fact, they are perhaps the main source of such information for users. The subjects that these user groups normally address, however, involve fairly immediate problem areas for which short range solutions are desired. Also, the suppliers do not encourage these groups to speculate about new products other than to ask "What features would you like to have?" It is not too likely that these groups will be of much help in the next year or two for analyzing the new environment.

Professional society meetings. Professional society conferences and meetings typically deal with more general subjects than do user group meetings. Further, they usually are not as concerned about the use of specific hardware or software. And they are interested in more general solutions to problems. So, in a sense, the professional society meetings should be a good place to obtain information about the new environment. But, in fact, these meetings may not address the subject of the new environment in any broad sense in the near future. It seems much more likely that they will continue to report on work at the forefront of the art but in reasonably narrow, specific subject areas.

University research groups. University research depends upon the availability of funds, upon any constraints on the research subjects for which the funds may be used, and upon the personal interests of the researchers. So it is unlikely that any university research projects today are exploring the implications of the new environment, in all of its breadth. But, in fact, university research projects *are* investigating many aspects of the new environment, and are analyzing and extrapolating trends. These projects are perhaps the best single source of information about the new environment, in our opinion.

Combination of approaches. It would make sense to use most or all of the above sources of information, for performing the type of study we are discussing. At the outset, the study might be conducted by one staff member on a part-time basis, and then expanded as the need for specific additional information becomes apparent.

The new environment has almost arrived. Pieces of it are available on the marketplace. But the full picture of that environment has not yet become evident. So you will probably not find ready-made sources of information that can give the broad analysis of the environment that you will need. But it seems to us that university research groups probably come closest to being this 'ready-made source,' if the information from many projects can be pulled together to give a broad coverage.

To illustrate, let us consider some research that is now going on at four leading universities in the U.S. that bears on the new environment. And then we will discuss how an effective user/researcher interface might be set up.

Some university research

We recently visited four leading universities to learn more about the computer-related research they are doing that might bear on the computer environment of the early 1980s. Although we talked to specific groups of researchers at these universities, we were aware that there are other people at these same institutions who are working on other aspects of information system research. So the following discussion is only indicative of what work is going on; it is in no way a comprehensive coverage of it.

First, a brief summary of the research groups contacted, with the universities listed in alphabetical order.

Massachusetts Institute of Technology, Cambridge, Mass. We talked to the Center for Information Systems Research in the Sloan School of MIT. CISR consists of some nine Sloan faculty members, two full-time researchers, and almost 40 part-time student employees plus administrative personnel. There are 14 corporate research sponsors who contribute about $20,000 per year each toward the research. About one-half the projects have been requested by the corporate sponsors, and the other half have been initiated by the research staff. Also, a good amount of government support is received. The projects cover a wide range of subjects, from primarily human issues (such as implementation problems) to mainly technical issues (such as database organization). The sponsors provide money, ideas, and research sites, and describe their problems and needs to the researchers.

For more information about CISR's research, see Reference 1.

University of Michigan, Ann Arbor, Mich. We visited the Database Systems Research Group in the Graduate School of Business Administration. This group is an off-shoot of the ISDOS project that we discussed month before last. It consists of four faculty members, one research scientist, 18 part-time students, and administrative support. Funding is mainly from grants by the U.S. government and some from industry. The group conducts basic research, applied research, the development of operating prototype software, and the validation and testing of this software.

For more information about the DSRG, see Reference 2.

University of Minnesota, Minneapolis, Minn. Our visit here was to the Management Information Systems Research Center, the research arm of the Department of Management Sciences, College of Business Administration. The MISRC is staffed by six full-time equivalent faculty members, a full-time assistant director who comes from industry on a two-year leave of absence, over 70 part-time students, and administrative support. There are 15 corporate sponsors from the Minneapolis-St. Paul area. About 60% of the Center's funds come from research contracts, 20% from sponsor annual fees, and 20% from miscellaneous sources. Four major areas of research are: experimental (e.g. how to better meet the information needs of decision makers), organizational, applications, and system software.

For more information about MISRC, see Reference 3.

University of Pennsylvania, Philadelphia, Penna. We talked to a group within the Department of Decision Sciences. The group has about 15 research/teaching faculty members and 25 part-time students, plus administrative support. The research in the decision sciences is sponsored mainly by agencies of the U.S. government. In addition, they have a grant from IBM to support their masters degree program plus faculty research in decision sciences. A substantial amount of the research has been directed toward developing computer software in support of the projects they are working on. Some interesting results have come almost as by-products of their sponsored research.

For more information about this research, see Reference 4.

One further point should be made before discussing some of the research. In a short space, it just is not possible to describe all of the research that even these four groups are doing. So we have selected a few projects as illustrative. We are not citing specific reports; if these discussions catch your interest, we think you should ask about the availability of all reports dealing with the specific subject.

We have divided this discussion into five categories: (1) organizational impact, (2) office systems, (3) computer support for managers, (4) automated system development, and (5) other research. Thus these categories cover most of the new environment that we foresee.

Organizational impact

When an organization is attempting to install new computer-based systems, what factors seem to contribute to the success of such projects and what factors lead to failure?

One MIT project has studied this question as it applies to the decision to either centralize or decentralize information systems. Sponsors requested this project because of the growing interest in mini-computers and distributed systems. The goal of the project has been to develop a rigorous and hopefully quantitative model that would help decision makers in making the centralized versus decentralized (or distributed) decision.

The first step in the project was to collect a list of claimed advantages and disadvantages for centralized, decentralized, and distributed systems. Then four empirical studies were conducted. One was an analysis of how centralized processing was conducted at a ten-campus state college system. Another was a survey of the information systems at 15 large construction companies. Then in-depth studies were conducted at two organizations. Finally, case study material was reviewed for some 40 organizations, as reported in computer field literature.

Based on their empirical findings, the project members developed their initial concepts on how best to approach the centralized versus decentralized decision. They saw it not as one large decision but rather as a series of subordinate decisions. To accomplish this, they viewed an organization in terms of a group of relatively (although not completely) independent sub-systems. Each sub-system was a 'logical application group'—a series of related activities making up a complete application. There is generally an intensive transfer of information within one of these groups, but a minimal transfer of information among groups. Each group could then be analyzed on its own merits.

Project members began to see the centralized versus decentralized decision in three dimensions—system management, system development, and system operation. Any or all could be either centralized or decentralized.

Then, based on the empirical material, a table of 39 factors was developed that project members felt were related to the decision. For example, one factor was the decentralization of company operations; if this condition exists, it strongly implies the desirability of decentralized information systems. On the other hand, the existence of another factor—a uniform planning and control system throughout the organization—only weakly implies the desirability for a centralized system. Others of the 39 factors include the nature of the product line, the current centralization or decentralization of data processing, and the geographical separation of activities within the logical application group.

Each logical application group would then be analyzed in terms of these 39 factors. In any given situation, some factors would deserve more weight than others. In the end, the decision to centralize or decentralize could be made for each logical application group, based on an evaluation of the factors.

To help validate this model, the project then analyzed the 40 case studies reported in the literature and the reasons given in each case for favoring the selection made (centralized or decentralized). The case studies did in fact support the validity of the model but, of course, this was not considered proof of the validity.

Thus this project at MIT has identified 39 factors that should be considered before making the centralized versus decentralized decision for any application. If the model is valid and the decision is made in harmony with the evaluation of the factors, then a successful information system can result. If any of the dominant factors are not in harmony with the decision, then trouble could be expected.

When we visited them, they had found fifty major private organizations who were willing to provide data by which the model could be tested, as the next step in its development. So this research is continuing.

University of Minnesota. Another way to look at the success/failure of new information systems is in terms of user job satisfaction with the new systems. This approach has been investigated at the University of Minnesota.

In the first phase of this project, some 79 users in eight Minneapolis-St. Paul organizations were queried both before and after new information systems were installed. Each information system required a minimum of six person-months to develop and served from three to fifty users. Using these before-and-after responses, the project members investigated: (a) Did the user's decision structure and environment change when the new system was installed? (b) Was the user's view of system performance, such as the user's job satisfaction and the fulfillment of the user's information needs, changed by the new system? and (c) Was this view of system performance influenced by the characteristics of the information system department?

Based on this empirical data, the project then developed a set of 12 hypotheses to be tested. These hypotheses made use of five dependent variables—user information satisfaction, user job satisfaction, system utilization, user decision structure, and user decision environment. Also, three independent variables were identified—the before and after state of the organization, the technical sophistication of the information system department, and the managerial sophistication of this department.

The empirical data was statistically tested against the hypotheses. The major conclusion was that the impact of a new information system on user job performance is much more influenced by managerial sophistication of the information system department than by technical sophistication. It is not so much *what* technology is used as *how* it is used. And in about one-half of the projects studied, user job satisfaction increased.

The new computer environment for the 1980s, that we have been discussing, will emphasize using latest technology, distributed systems, and end user features. Research projects such as the ones described should help identify the factors that management should consider before moving (boldly) ahead into this new environment, in order to assure a reasonable chance of success.

Office systems

One project at the University of Pennsylvania, funded by the U.S. Office of Naval Research, has dealt with developing aids for making operational decisions. Out of this project, almost as a by-product, have come some very interesting developments in office automation systems. These developments results from the researchers' needs for managing the decision support system (DSS) project.

This office automation work has been grouped under the acronym DAISY. DAISY (meaning 'decision aiding information system') is a super-structure system designed to use and to work with existing data systems, programs, models, and so on. It attempts to tolerate (and automatically correct) many types of human input errors, such as spelling errors. The DAISY data directory tells the location of data within the overall system to which DAISY is tied.

There are several office support functions that are managed by DAISY. The *decision function* makes use of a set of 'prompts' that helps the decision maker to get started on a decision and to move from the general to the specific situation. By starting with the general situation, the decision maker is less likely to overlook some important element of the situation.

The function also provides a 'what if' as well as an 'actual decision' capability.

Also, DAISY provides access to *decision models*, to aid the decision-making process. DAISY accesses a selected model and provides the necessary data.

DAISY provides both local and global *data handling*. Local data is 'scratchpad,' working data. Global data is any data that can be accessed from any DAISY terminal.

Another function performed is that of *triggering*, based on the occurrance of an event. While many types of triggers occur, two types are prevalent. One type occurs when a decision is made that makes several other decisions relevant; a notice to this effect is given to the decision maker. The other type is when a change in value of information above or below a threshhold causes a notification to the decision maker.

The other main function of DAISY is that of *alerting*. This is similar to triggering except that it is more complex; it plays the same role in support of the decision maker as does an intelligent staff assistant. It can be based on a combination of both states and triggers existing in multiple databases.

The project has developed a 'manager's terminal,' for use with DAISY. It uses a color CRT on which the user can define several areas or 'windows,' each with its own background color. One area might be for messages, another for alert and trigger messages, still another for the manager's main working area, and so on. The idea of the terminal is that a manager generally must have a comprehensive view of his whole operation.

This research into office automation has consisted of six parts: communication, information storage and retrieval, data analysis, decision aiding, personal assistant services, and linkage to the corporate database. In turn, a good fraction of the total effort has been directed at the communications part. Six general types of communication have been identified and support provided. These types are: formal vs. informal, reply required vs. no reply required, messages vs. documents, internal vs. external, and voice vs. text vs. graphics. Software has been developed for supporting a number of these types of communication.

In the area of information storage and retrieval, the project has investigated providing the equivalent of 'electronic file folders.' It was found that the department chairman had over 2,000 folders in his (paper) files, while project leaders often had in excess of 1,000 folders in their files. The electronic version of these files aims to provide improved access and retrieval capabilities.

Similar research work has been conducted in the other four parts of office automation—data analysis, decision aiding, etc.

The project initially saw office automation as a set of components for performing the types of functions just decribed. But after two years of research, it became apparent to project members that these components, by themselves, were not enough. Instead, what is needed is an integrated system of tools and the procedures for their use. So the research now aims at creating an integrated set of functions, including computer-assisted generation of messages, documents, and graphic material, electonic mail, tele-conferencing, manager's calendar and schedule management, analyzing and tracking manual processes, and aiding human communication by way of integrating voice, data, and graphics.

As mentioned, the original DAISY concepts were a by-product of work done on the operational DSS. The results were so interesting that an office automation project was started and has carried on the work. The office automation systems that the project has developed continue to be used by people at Wharton in support of their daily project activities.

Computer support for managers

The research work just described applies to two aspects of the new environment—office systems and computer support for managers. There is a good amount of work going on in the latter area, not only at the four universities we visited but also at numerous other research locations. We will cite just one related example, a project at MIT that aims at better defining the information needs of a chief executive of an organization.

All too often, the chief executive must wade through myriads of reports, memorandums, letters, etc., seeking relevant information. Much of this material has not been prepared specifically for the chief executive, and most is irrevant for the job. Still, the chief executive must make this effort, to find the few 'nuggets' of useful information that might be there.

The MIT project has tackled the problem of how better to supply the chief executive with the information that he or she needs. Several approaches were considered. The approach selected was the 'critical success factors' (CSF) approach.

The CSF method says that, within an industry, there are several factors that are almost essential to the success of a company. For instance, in the automobile industry, these factors probably are styling, a quality dealer system, cost control, and meeting energy standards. But, in addition, a specific company may have a few more CSFs based on its competitive position, geographic location, and so on.

It is information pertaining to these CSFs that is crucial for the chief executive, said the MIT researchers, since they deal with the heart of the business. The information is needed for making plans, identifying problems, and dealing with corrective action.

The CSF approach requires that the chief executive allocate two or three two-hour time periods to meet with the study analysts. First, they identify and state the executive's goals and objectives; this may or may not be easy to do. Then together they develop a list of six to eight critical success factors—for the industry and for the particular company. It may take two or more meetings to develop a list of CSFs that the chief executive is satisfied with. Then the chief executive and the analysts define the information that will be needed about each CSF, where it will come from, and how reliable it is likely to be. 'Hard' data, such as financial data or share-of-market data, may be relatively easy to come by. But meaningful 'soft' data, such as the morale of key people in each CSF area, probably will be harder to obtain. However, after two or three sessions, the information needs and sources will come into focus, and the construction of the chief executive's information system can begin.

Note that this approach defines the chief executive's *critical* information needs, not *all* of his or her information needs.

The project team located a chief executive in the Boston area who was willing to try out this approach, to test it. The company is a rapidly growing electronics manufacturing company with sales of about $100 million per year. The study followed the pattern described above. Originally, nine CSF factors were identified; after the second meeting, the list was pared down to seven. For each of the seven factors, two or three prime measures were identified. Some factors involved hard data, such as the price/earnings ratio of the company versus its main competitors. Other factors involved soft data, such as customers' opinions of the company's products.

The chief executive was pleased with the results of the study and initiated steps to get the CSF information on a regular basis. And he recommended the approach to other executives in the company.

Automated system development

The Database System Research Group at the University of Michigan has done a good amount of work on the question of automated tools for designing databases. This work has been sponsored, in large part, by the U.S. Naval Ship Research and Development Center.

The project team members recognized that database design tools had been and were being developed at a good number of locations. The first goal of the project was to develop a software system by which a variety of heterogeneous design tools could be made easily available to a designer. So an 'interactive database design laboratory' (IDDL) was developed.

In the IDDL software system, all input parameters are stored in a separate design database and in a standard format, so that all tools that require the same data actually access the same data values. 'Disk seek time' is an example of such a parameter. Also, interface software has been provided for interfacing each of the selected packages.

In the typical use, the designer provides a set of parameters, calls for a particular design tool, executes it, stores the results, changes some of the parameters, and repeats the process. After each execution, the designer has the option of using another tool. The designer specifies which results are to be displayed and which are simply to be saved for later printout.

The designer can quickly make several runs, with different values of the input parameters, and look at key results to see if things are going properly. At the end, all results can be printed out for later study.

The project team uses three levels of database design. At the top level, following the requirements determination, the data entities and their relationships are defined. No consideration is given to efficiency at this stage. Following this step, logical design is performed, where efficiency *is* considered. The process is iterative; logical design may point up the need for changing some data entities and/or relationships. The next step is physical database design—fitting the logical design onto the equipment configuration. Again, iteration generally occurs.

The first tool that was tied into IDDL was a file and database design evaluator. This is an analytical tool that accepts a set of input parameters defining a database design and predicts input/output and CPU time for that design. Current cost of operation is about 10 cents for running one set of input parameters for a linear file, and about 30 cents for a CODASYL-type database.

When we visited the University of Michigan, the first two tools had been tied in to IDDL. By the end of this summer, they expect to have eight or nine tools tied in. Also, the first data structures provided for were linear files and CODASYL-type databases. Hierarchical and relational database structure facilities are being added.

The experience to date with IDDL has shown that it is feasible to integrate a variety of heterogeneous analysis and design tools. However, this approach results in gaps and overlaps in the design process. So several corrective steps are being taken over the next couple of years.

For one thing, IDDL itself is being used to develop tools to fill the gaps. Experience has shown that about two-thirds of the effort in developing a new tool has gone into solving user interface problems. Since those are now handled by the IDDL software, the tool developers can concentrate on the tool algorithms.

Perhaps more important, the project is aiming to make IDDL into a *designer's workbench*, where the database designer has a full set of tools for performing the function. The concept here is to extract the algorithms from the tools and make them into an integrated set of tools. This workbench would be, in effect, a decision support system for database designers; it will not automate the design but rather will provide support services for human design.

Eventually, the project hopes to extend their approach to cover the design of distributed databases.

Other research

As mentioned, in a limited space we cannot discuss all of the relevant research at these four universities that applies to the computer environment for the 1980s. But we will briefly mention some of the other research that is going on, particularly in the area of database management.

At MIT, they are seeking ways to greatly improve the speed at which very large databases can be searched. One approach being studied is through the use of many parallel microprocessors, for conducting hundreds of searches in parallel.

At Michigan, they have built software tools to aid in converting both databases and database programs from one DBMS to another; we mentioned this work in our May 1978 report. And they are studying the technical issues involved in attempting to distribute a CODASYL-type database across a network.

At Minnesota, they have developed a database about DBMS, listing the characteristics of about 50 of today's DBM systems and of about 15 data dictionaries. One goal is to find what information about DBMS must be collected and stored in support of the database design process.

And at Pennsylvania, they have developed a CODASYL-type DBMS for mini-computers that so intrigued them that some of the developers set up their own company to develop it further and market it. It has since been modified to work on some of today's micro-computers.

In addition, we have discussed relevant university in a number of our past reports—for instance, May 1976, April 1977, June, August, September, and October 1978—which we will not try to summarize here.

All in all, we feel there is so much university research going on—that applies to the computer environment of the 1980s—that just learning who is doing what research will be a non-trivial task.

Let us now look at how users might benefit from this research.

Effective interaction

We hope that the above discussion has illustrated that there is a significant amount of *useful* research in the information sciences going on at universities. Contrary to the belief that "those researchers are off in a world of their own," we think that the projects described above are dealing with real-world problems. Further, we think these (and similar) projects could provide a valuable source of information on the computer environment for the 1980s.

How can an organization—public or private—develop an effective interaction with one or more universities, to aid in preparing for upcoming changes in the computing environment?

The universities say they are ready, willing, and able to interact with users, and that the next step is up to the users. Maybe so...but again, maybe not. Let's consider the problems of setting up an effective user/researcher interaction.

It may not be easy to set up an effective interaction. We remember a four-hour panel session on this subject at the 1975 ACM national conference. At the end of the session, no consensus was reached on even one approach to an effective interaction. The users said, in effect, "Here are our main problems. We wish you researchers would study them and suggest solutions. And please state the solutions in terms we can understand. We can't understand the papers you write." And the researchers said, in effect, "Each of you users states your problems as specialized cases. We seek general solutions. Here are the problem areas in which we have already done good research. The results of this research could be applied to your problems if you would only make the effort to understand them. Don't expect us to sugar-coat the results for you." Four hours of discussion did nothing to bridge this gap.

An effective user/researcher interface was the subject of a one-day meeting we attended, just prior to the 1978 National Computer Conference. The meeting was sponsored by the Computer Science Board, a group of computer scientists from leading universities and research centers.

The *problems* were defined quite well at this meeting, we thought. The researchers want more funds for research (and/or the equivalent, preferential prices for computers, etc.). They want to do the type of research for which the results can be published, so as to contribute to knowledge and to enhance the image of the universities and the researchers. On the other hand, the users want *useful* results that can be applied to their specific problems. It is hard enough, they say, to get anything useful from internal research projects; how then can one get such results from a university? Further, users generally are confronted with the not-invented-here resistance to anything done by outsiders. These differing self-interests make for a difficult interface.

And as one participant pointed out, if the user organization comes across a very talented researcher at the university and hires him/her, that ruins the co-operation with the university.

Still other problems came to light. One cause is a university's reward system. Researchers feel they *must* publish their results; a published paper counts more 'dean's points' (toward tenure, promotion, etc.) than does an idea that is adopted by a user. (As one researcher said, "If you haven't published, you haven't done anything.") But users who pay for research, on the other hand, would prefer to be the sole beneficiaries of the results. And even if the eventual publication of results is agreed upon in advance, who 'owns' those results at the end of the project? And how are 'secrets' protected during a project? And are project results sufficiently documented, as the project progresses, to protect the investment in case some project team members leave?

Even if the researchers know what the user organization seeks, in the way of results, (a) the researchers may not want to work on that subject because it is not a 'popular' research subject, or (b) even if willing to work on it, they may be penalized for doing so by the university reward system, or (c) they may be willing to work only on the 'fun' part of the project and ignore the details that are essential for practical use.

We said earlier that the universities were 'ready, willing, and able' to do their share toward an effective user/researcher interface. This Computer Science Board meeting pointed out that the situation is not quite that simple.

But enough about the problems; what about solutions? The Computer Science Board meeting suggested a variety of familiar (to them) solutions. The most attention was given to a 'people interchange' type of solution. This involves (a) user people getting time off from work to teach university courses, on an adjunct professor basis, and/or (b) researchers being given part-time work at user organizations, to work on user problems. This type of interchange would help sharpen the skills of the user people, would make them more aware of research results, and would help in the screening and recruiting of graduates for employment. It would also make researchers more familiar with industry problems, a necessary step for effective interactions.

Other 'conventional' solutions were proposed for an effective user/researcher interface. These included student co-operative employment programs, hiring students and faculty members for the summer, workshops and seminars, and intensive short courses.

Yes, all of these solutions could help provide a better interface. But it seems to us that they all fall short of what is sought for the problem we are discussing—which is, how to prepare for the computer environment of the 1980s? We have mentioned them because, if and when you talk to university people about possible interactions, these ideas are almost sure to be brought up. And, in our opinion, they are not really what you will want for the problem at hand.

Can an effective user/researcher interaction be set up? Yes, indeed; many companies have overcome the above problems and have contracted with universities to do research.

Also, please note: all four of the organizations discussed above are located in schools of business, where concern for management's problems usually is high.

So there *are* ways to set up effective programs—programs that could help to prepare for the computer environment of the 1980s. One such program, at the University of New South Wales, appears to be the type of interface that could be quickly set up with most universities.

University of New South Wales

The School of Accountancy at the University of New South Wales, in Sydney, Australia, began a program in 1975 that they call their 'information systems forum.' It is a user/academic interface program that started out with representatives from 21 user organizations in the Sydney area. It has grown each year and now has representatives from 36 user organizations. For more information about the program, see Reference 5.

Each member organization nominates two representatives to the forum, one of whom must be a general manager who is primarily a *user* of computer services. Typically, the two representatives are the DP manager and (a) his/her boss or (b) the manager of a major user department. It is important that both data processing and user viewpoints be represented, we were told.

The purpose of the forum is to disseminate knowledge and to promote discussion of common problems with information systems. It relies on there being a reservoir of experience and opinions among the participants about the matters under discussion. As topics become more specialized, participants withdraw from active participation and the discussion falls flat.

So one key to the success of the forum is the selection of topics that are relevant to the interests of the member organizations. For instance, members are often asked to prepare and present case study material on selected topics (such as their use of database management, project management, etc.), giving both their good and bad experiences with the use of the technology.

But more germane to question we are discussing, the forum also presents research results that have been compiled by university representatives. These include not only the results developed locally but also the results of relevant research done at other locations.

The forum has also been successful in getting the members to support the researchers by providing data, tests sites, and so on. Further, a 'club' type of atmosphere has developed; the resulting social interchange has helped to build a confidence in each other's abilities among the participants.

It seems to us that this approach could have quite wide applicability, and that most colleges and universities would welcome such an interaction. For a minimum program, member organizations could provide the funds needed to support the university people pulling together and reporting on research results on particular topics, from wherever such research is being done. As we have indicated in this report, we think there is a good amount of research going on that would be useful to user management. We cannot think of an easier way to start gathering relevant information on the computer environment for the 1980s.

But user organizations may decide that they want to go further, and to actually fund some of the research. We came across two examples of this.

Funding of research

Both MIT and the University of Minnesota have set up research sponsor programs, by which (generally private) user organizations help to fund research.

University of Minnesota. The Management Information System Research Center started its 'associates' program in 1968, through which some 15 companies in the Minneapolis-St. Paul area now contribute about $100,000 annually in non-directed research funds. The associate companies, among them, also provide a full-time associate director for the center. Each such associate director serves for about two years, while on a leave of absence from his/her company. In addition, as we mentioned earlier, the center receives about 60% of its funding from research contracts, where the subjects for the research are 'directed' (specified).

An effective user/researcher interaction has grown out of this associates program. Associate companies receive not only the results of research but also the reports of the non-directed research. The non-directed research is on subjects that the center's staff considers important. In addition, the program provides the associate companies with (a) about 18 meetings per year involving speakers who are prominent in the information sciences field, (b) a number of workshops and seminars per year, (c) up to 1000 hours or so per year of consulting by students in the school's MBA program, and (d) several other similar benefits.

So, for a typical annual contribution of about $5,000, these associate companies are put in close contact with research in the information sciences.

M.I.T. The Center for Information Systems Research began its 'sponsor' program in 1974. The program now has some 15 sponsoring companies who contribute $20,000 a year each toward non-directed research. The sponsors may also contract with the center for directed research.

The center performs both general research as well as management-oriented, applied research. Each sponsor organization nominates a senior executive to be on the center's *sponsors board.* Together with the dean of the Sloan School and the director of the center, this board reviews the research work undertaken from the standpoint of relevance and quality. About one-half of the non-directed research projects that are undertaken come from sponsor requests and the other half are on subjects that the center's staff recommends.

Each sponsor is also encouraged to send one employee to work at the center for up to one year, as a 'fellow,' on a project of mutual choice. A fellow remains on the payroll of the sponsor, who must also pay any living and travel expenses involved. The center provides office space and support mechanisms. Results of a fellow's research work are in the public domain but certain types of data can be kept confidential.

There are many other sponsored research programs at universities in addition to these two; for instance, the ISDOS project at the University of Michigan is another. But these two cases illustrate the type of user/researcher interaction that can take place when users are willing to help fund the research.

Conclusion

The dramatic rate at which micro-computers are developing is sure to cause major changes in the computer field, in our opinion. The fact that multi-chip micros, which are plug-compatible with today's CPUs, are already beginning to appear indicates to us that the mainframe manufacturers will have to take aggressive steps soon to counter this competition. IBM has already done so.

One way or another, the micro-computers are going to force the new computer environment of the 1980s. This environment will consist of at least the following major elements, as we see it: (a) office systems integrated with data systems, (b) computer support for managers, and (c) automated system development aids. Each of these elements is well along in development and is ready to become part of aggressive sales programs.

We think it would be very wise to begin *now* to prepare for this new computer environment. When the big sales efforts begin, it will be difficult to take the time to make proper studies; there will be too much pressure to "get your order in, to assure a delivery position." Preparing ahead of time will aid users make better selections among the competitive offerings and will help point up where organizational impacts could be severe unless preventive actions are taken.

As this report has indicated, we think that users should seriously consider turning to selected university research projects, as one important source of information about the forthcoming computer environment. We think the information systems forum of the University of New South Wales provides a relatively easy, inexpensive way by which users and universities can interact. In its simplest form, it can pull together relevant results from research conducted almost anywhere, and make this information available to the local user community.

As user organizations begin to see benefits from this interaction, they will be more willing to provide funds to support research. The sponsor programs at MIT and the University of Minnesota are examples of what can be done.

University research is not something to be dismissed as 'impractical.' We think that an effective user/researcher interaction can and should become a part of the computer use planning for many user organizations.

REFERENCES

1. For more information about the research conducted at MIT, write: Director, Center for Information System Research, Room E53-313, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Mass. 02139.
2. For more information about the database research conducted at the University of Michigan, write: Director, Database Systems Research Group, Graduate School of Business Administration, University of Michigan, Ann Arbor, Mich. 48109.
3. For more information about the research at the University of Minnesota, write: Director, M.I.S. Research Center, 93 Blegen Hall, University of Minnesota, Minneapolis, Minn. 55455.
4. For more information about the research at the University of Pennsylvania, write: Chairman, Department of Decision Sciences, The Wharton School, University of Pennsylvania, Philadelphia, Penna. 19104.
5. For more information about the information systems forum, write: Head, School of Accountancy, University of New South Wales, P.O. Box 1, Kensington 2033 N.S.W., Australia.

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