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## GET READY FOR MAJOR CHANGES

Our past two issues have indicated that some important changes are on the horizon, in the form of the automated office. In addition, we foresee another source of change coming. We think that IBM and the other mainframe manufacturers will introduce a new generation of computer systems in the not-distant future (and we think IBM's new 8100 is only a step toward this new generation). Yes, there have been a lot of predictions about such 'future systems' and when they would arrive. But we think their arrival cannot be delayed much longer; the pressure from 'plug-compatible' processors is getting too intense. And worse (for the mainframers) is yet to come. Lurking in the wings are plug-compatible micro-computers, at micro prices. To counter the micro plug-compatibles, we see the mainframers introducing quite new systems that are loaded with 'goodies'—systems that will mean significant changes in the DP plans for most user organizations. In this report, we give our views on what these new systems may be like.

Lewis M. Branscomb, chief scientist for IBM, gave a noteworthy keynote address at a computer conference last spring. (No complete text of the address has been published but a summary was given in *Computerworld* of June 5, 1978; also, we reported it briefly in our August 1978 issue.) His remarks are worthy of examination, since they perhaps give some hints on what the next generation of IBM computer products might be like.

"Will the processing of the future be centralized or distributed, maxi or mini, top-down or bottom-up?" asked Branscomb. "The answer to all such questions is Yes," he continued. "Computers will become more useful by being moved closer to people...by having their functions distributed. Communications facilities will be more heavily used."

Today's distributed systems must be considered elementary, he said; in the future, they will be used in more sophisticated ways in order to avoid people costs. He quoted an International Data Corporation study that estimated 1975 average DP costs as: 19% communications costs, 46% computer costs, and 35% staff costs. Other studies have shown that unit communications costs are falling at the rate of 11% a year and unit processing costs are coming down at least 15% a year, while unit salaries are *rising* about 6% a year. If one extrapolates the 1975 figures out to 1983, taking into account these cost trends,

one concludes that communications costs will be down to 10% of the total, computer costs down to 17%, and staff costs will be up—to 73%—for the average installation. That is what will happen *if* the present environment continues to 1983, said Branscomb.

To assess the full impact of these figures, one must also recognize that total DP expenditures are growing rapidly. In 1975, it has been estimated that the total U.S. expenditures for DP were $26 billion. By 1983, this figure is expected to reach $75 billion, he said.

If the 1975 environment continues out to 1983, this means that 73% of the $75 billion (or $55 billion, twice the 1975 total expenditures) would be spent on salaries. While the number of people in data processing will grow, it will not grow at *this* rate, said Branscomb. Instead, by a better use of technology, his company expects that the 1983 averages will be more like the following: communications, 39%; computers, 37%; and staff, 24%. It will be the new distributed systems that will hold down people costs.

Future distributed systems will include office systems merged with data processing systems, Branscomb continued. Further, some of the technical issues confronting the designers of these systems include techniques for distributing and finding data, for synchronizing the updating of distributed data files, and for communicating practically and economically using data encryption.

No, Branscomb said nothing directly about IBM's future products. But, at the same time, we think there are some clues. Perhaps it is risky to try to 'read between the lines' of Branscomb's remarks, but let's try. The important change in the next five years will not come from replacing today's main CPUs with plug-compatible CPUs; that would only bring hardware costs down and make staff costs relatively higher. Instead, a new, more sophisticated generation of distributed systems will be installed—to help contain the people costs. *That* will be the important change. At least, that comes through to us from Branscomb's remarks.

Moreover, Branscomb apparently sees this new environment as being in effective use by 1983. Otherwise, how can the average DP costs in 1983 be affected to the extent that he predicted? If such systems are going to influence total 1983 DP costs to any significant extent, deliveries will have to begin by 1980 or 1981 at the latest. And, to us, that means IBM's newly announced 8100 Information System will have to play a major role in the company's strategy.

Maybe we are reading more into Branscomb's remarks than he meant. But then again, maybe not. If he submitted his figures as meaningful ones, how else can they come about? Certainly they will not occur through a continuation of (or even minor modifications to) today's DP environments.

Plug-compatible maxi mainframes, such as the Amdahl 470 and the Itel Advanced System (which is manufactured by National Semiconductor), are already in use. They have demonstrated the viability of the approach. "Let the mainframers do all the operating system development; plug-compatibles can run the software without change and at a savings of 20% or so." So say the adherents of the maxi plug-compatible CPUs. IBM has already responded to this competition with their 303X mainframes.

Mini-computer plug-compatible CPUs are now arriving, to offer the same type of savings for the low to medium range of the IBM 370. These include the National CSS 3200 (based on the Two Pi V/32), the National Semiconductor System 400, and the Magnuson M80. The mainframers can be expected to respond to these systems, we think.

IBM's new 8100 system may well be that company's response to those mini plug-compatibles that compete with the low end of the 370 line, in addition to being IBM's key support of distributed processing.

But it is in the area of micro-computer plug-compatibles that we see the biggest threat to the mainframers. The National Semiconductor System 400 is really an assemblage of several microprocessors, plus memory and firmware, to make the system compatible with the 370. National Semiconductor claims the power of the 400 exceeds that of a model 138. So, in a sense, the micro plug-compatibles are already here.

But the logical complexity that can be put on a chip is doubling every year. Speed is constantly increasing and power requirements are dropping. We checked with several people who are

close to micro-processor technology about what could be done in the next few years. They all agreed that it should be *technically feasible* to produce single chip processors that are plug-compatible with, say, the 370 and that operate in the range of one-half to one million executed instructions per second (that is, between a 148 and a 158), within five years. Multi-chip 'minis,' such as the 8100, can already operate in this speed range. Just the threat of such plug-compatibles must be taken seriously by all mainframers.

Further, the plug-compatible micros have the promise of greatly reduced prices. Individual CPU chips may sell for under $10 (depending on the volume sold, of course). When mounted on circuit boards, with memory and control added, etc. the price component of the hardware might be, say, one thousand dollars. Other price components must be added before the eventual sales price is reached, of course, including sales, service, and administrative costs, plus profit. But the purchase price of a 158 CPU is about $1.5 million, and the cost of the micro could be much, much less than that. If competition drives the prices of the micro plug-compatibles down, as one would expect, users could then buy several plug-compatibles to replace an existing mainframe—one to use and the others for backup.

IBM, of course, will bear the brunt of the plug-compatible competition, as it has already. But none of the other mainframe manufacturers will be immune from it, we suspect. Some new minis on the market can emulate just about any instruction set, for instance.

So perhaps the above interpretation of Branscomb's remarks are not too far off target. Today's mainframes, particularly the IBM 370 mainframes, seem to be threatened by the plug-compatibles. The mainframe manufacturers will have to respond in some fashion. Just how might they respond? And when?

### Some observations

If one grants that the plug-compatible competition for today's mainframes really is just getting underway and will become more intense in the not-distant future, one can make several not-unreasonable observations.

*One*. Competition and technology advances will drive down the plug-compatible prices, to the point where users might switch to them in droves. If plug-compatible manufacturers offer, say, price advantages of only 5% to 10% over the mainframe manufacturers, many users will stay with the mainframers and pay this premium for the security they feel it buys. But as the plug-compatible price advantage rises to 25%, then 40%, then 60%, and perhaps even over 80%, many of those users will come to feel that the security is no longer worth the price difference. They will be willing to install the plug-compatibles.

*Two*. The mainframe manufacturers, and IBM in particular, will compete with the plug-compatible maxi CPUs; witness the 303X. And we suspect they will choose to compete with the plug-compatible minis; look at IBM's 8100. But that is the end of the line for this type of competition, we think.

In the past, the mainframers have used much improved performance at slightly higher prices as the lure in selling new systems. But with the competition of the plug-compatibles, they have had to offer both improved performance and *lower* prices. Maintaining profit margins is getting tougher.

With the arrival of plug-compatible micros, we feel that the mainframers will be forced into another course of action. They won't want to lower their prices *that* much. Consider, for instance, what micros that are plug-compatible with the 8100 would mean to IBM.

*Three*. It looks to us as though the mainframers will compete with plug-compatible micros by coming out with a radically new generation of computer systems. *This is the heart of our argument, upon which the rest of the discussion is based.*

*Four*. These new systems can mean *conversion*, perhaps as bad as the conversion from second to third generation computers. The only way to lure users to these new systems is by offering such attractive 'goodies' (enticing sales features) that the conversion efforts will be outweighed.

*Five*. The sales features must be practical and within today's state of the art. But they must be things that have not previously been put together to form integrated packages of features.

*Six*. And, of course, the mainframers must provide relatively painless migration paths, for moving users' current programs and data files to the new systems without the need for rework.

These migration paths would, at the least, involve the equivalent of the emulation feature that allowed, say, 1400-series programs to run on the 360.

*Seven*. If the above reasoning is right, then what roles do the IBM 303X and 8100 play? One answer: they may not be what they seem! They may play an important role in the new systems and, at the same time, may be a trap for the plug-compatible manufacturers, as we will discuss.

### Why speculate?

What is the advantage of this speculation, one might ask? Why not just wait to see what the mainframers actually do, rather than trying to second guess them?

If we are foreseeing things at all correctly, it means that the next five years in the computer field will bring *major* changes for just about all users. On the one hand, the plug-compatible manufacturers will offer substantial cost savings that involve little or no conversion effort. On the other hand, the mainframers will counter with all sorts of good things in their new systems. Both sides will be pressing users for quick decisions.

Looking back at the days when the third generation computers were first announced, we would have to say that most of the users who entered early orders just had no idea what they were letting themselves in for. The 'pain and suffering' involved were often intense. It looks to us as though that situation is ripe for repetition.

Of course, the mainframers will include among their goodies some features that apparently will make conversion *much* easier. They know how users hate the idea of a big conversion, and they will want to make it look like they have taken care of that problem.

So, back to our question: why speculate? As we see it, the features that would (will?) be incorporated in the new systems are based on developments that are ready for field use. Most of them are going to be adopted anyway by users. All that the new systems really would do is accelerate their adoption. So considering these changes is not a waste of time, in our opinion. It is something most users should do anyway. Then, too, as the new systems *are* announced, users will be pressed for fast decisions. Having lead time for these decisions will be helpful. We think you will be facing these decisions within the next few years. It is not too early to begin thinking about them now.

But there is perhaps a more pressing reason why some organizations should consider such speculations. Those are the organizations that are on the verge of purchasing one or more of today's CPUs. If the expected residual value of the CPU five years or so from now is an important factor in the decision, then we think those organizations ought to check into the subject of this issue *very* carefully. Market values of today's CPUs could drop dramatically in a few years.

## The new environment

We remember quite well the day of the announcement of the IBM 360, in 1964. The reaction of the audience we were in—and, as we heard later, of just about all of the audiences—was, "Wow! Look at all of those great features! No other computer line offers anything like that!"

Subsequently, upon reflection, it became apparent that just about everything that IBM had included in the 360 had been discussed in the technical literature. What IBM did was to select what they considered to be the best of the developments and package them into an integrated system. True, in some cases, they extrapolated developments. They had successfully developed operating systems for the 7044 and 7090 computers, for instance, which they felt laid the groundwork for OS/360. Things went a bit awry in that project.

But the point we are making is the following. As IBM and the other mainframers announce new systems within the next few years, just about all of the features of those systems have already been discussed in the literature. And this includes the features that will be used to persuade users to go this route instead of the plug-compatible route. What *isn't* known, of course, is just which developments will be selected by each manufacturer and how they will be packaged.

For the discussion that follows, we have reviewed the technical developments that we have read about and heard about in the last two years or so. We have discussed some of these in past issues of EDP ANALYZER, and in those cases the developments have reached field use. From this

list of developments, we have selected the ones that we believe the mainframe manufacturers are most likely to choose as sales features.

Here is our best guess, then, about the main characteristics of the expected new generation of computer systems—a generation that is being forced by the rapid developments in micro-computers.

***Modules of minis and/or micros***. The new systems will be modular in nature, we believe. Each module type would have a specific function to perform, such as a batch processing module, an interactive processing module, a communications front-end module, and a back-end database management module.

There may not be a range of speeds with these micros as there is with today's families of computers, but instead there may be only one or two speeds provided. The reason is that fast micros cost very little more to manufacture than slower ones. Processing capacity will be increased by adding more modules.

Also, fault-tolerant features will be stressed. For instance, the micros may be packaged in pairs, with each one of the pair handling half the workload. Thus, if either goes down, the other can take over the whole workload. Further, these systems may provide for on-line, automatic diagnosis of faults. In the past, users have wanted high reliability but have been unwilling to pay extra money for it. They may get that extra degree of reliability in the new systems 'at no extra cost.'

***Clusters of modules***. If a modular design is used, such as just described, then we think that the equivalent of today's mainframes will be formed by clusters of these modules. The 'mainframe' would be formed by connecting together a selected group of modules.

Today's multi-programming operating systems would thus largely disappear. Complex control software might well still be needed, however, for allocating system resources among the modules.

***Maxis, minis, and micros***. Branscomb said that the systems of the future would use both maxis and minis, in both centralized and distributed fashion. Many people tend to refer to micros under the term 'mini,' and he may have done that, too. To make the point clear, however, we will say that we expect the new systems will make use of maxis, minis, and micros.

For very high performance—measured in millions of instructions executed per second—the minis and the micros still cannot match the maxis. So, for large user organizations with very large workloads, the mainframers will want to provide the computing capacities of maxis. In fact, some of today's maxis might well be used for this purpose, as we will discuss. These maxis probably would be dedicated to large volume batch processing. Most interactive processing might be better handled by the mini or micro modules.

***Hierarchical distributed systems***. We think it likely that these modules of processing power will be organized in a hierachy by the mainframers, at least at the outset. Another main alternative, of course, is for them to be organized in a network of co-equal processing nodes. Our guess is that this second alternative will not be offered in the first announcements. The reason for this belief is the need for a migration path that the new systems must provide.

At the top of the hierarchy will be the *master cluster of modules*. This master cluster would replace the mainframe(s) that the customer is using. To aid conversion, this master cluster would include one or more *compatibility modules*—the mainframers' equivalent of plug-compatible processors. This module (or modules) must be able to handle the workload of the mainframes it displaces. This module would play the same role as the emulation feature in third generation systems.

The master cluster would also include a variety of specialized modules, for processing in the new environment. These would include batch processing modules, interactive processing modules, communications front-end modules, and file handling and/or database management modules. Another module type that will be needed, both at the top of the hierarchy and at various nodes, will be a directory for all data and information stored within the distributed system. Lower level directories might have data location addresses only for the files in their jurisdictions, and would have to refer any global requests to the master directory. Still another needed type is a linking module that can link the system to, and query,

existing data files on tape or disk. This feature will be essential for the management query features of the new systems, to be discussed below.

The master cluster probably would involve quite a number of each type of the micro-computer processing modules, since they will be so cheap. When a job is to be run, such as a batch job, one of the available modules would be assigned to it, to work on it in a mono-programming fashion. The equivalent of many levels of multi-programming will be provided by having many processing modules available for assignment.

Also, office systems will be merged with data processing systems. So the master cluster would have one or more office system modules. These would provide computer message services, content indexing, storage, and retrieval of messages and correspondence, etc. We discussed many of these office system functions in our last two reports.

These office system modules are almost sure to be among the features that the mainframers will highlight in their sales presentations. Interest is growing rapidly in the 'office of the future.' The mainframers are sure to exploit this interest, in order to lure customers to the new systems.

***Virtual storage***. To most people in the computer field, we suspect, the term 'virtual storage' applies to the segmentation or paging of programs in a multi-programming environment. As mentioned above, from the discussions we have heard, we suspect that multi-programming will be very limited or non-existent in the new systems. So why would virtual storage be used in them?

It has been pointed out to us that virtual storage can play an important role in the handling of data. Really, the programmer should not have to be concerned with whether data is in main memory or on disk or tape. It would be helpful if the programmer could just assume that the whole database is in main memory, and then let the system put the needed data there.

Somewhat in line with this virtual storage feature for data is the expected inclusion of magnetic bubble memories, or charge coupled device memories, in the new systems. These developments, which would fit between main memory and disk storage, are ready to be incorporated in products. In fact, Texas Instruments already offers a magnetic bubble memory. These intermediate speed, intermediate capacity memories will fill a gap in the storage hierarchy, and will make virtual storage more effective, we gather.

***Intermediate node clusters***. These clusters of modules would play the same role as the host processors at the intermediate nodes of today's hierarchical networks. We would think that they would be made up of modules in much the same manner as the master cluster. However, they may or may not have network control functions.

Some form of distributed database is sure to be provided with the new systems. But since so much is not yet known about distributed databases, this feature will be quite limited at first, we think. In the first announcements, perhaps users will have only a few options on where master records can be stored and how duplicate files can be synchronized. We discussed some of the problems related to distributed databases in our August 1978 report.

***Communication network facilities***. The mainframe manufacturers are sure to push private network architectures (such as IBM's SNA), using leased lines. Private networks allow the mainframers to better control the types of equipment that can be connected easily to the network.

But because of the rapid growth of public data networks, the mainframers may also provide interface modules for connecting to these networks. However, the plug-compatible problem applies to terminals and remote processors just as it does to mainframes—and public data networks make it easy to connect a wide variety of devices into the distributed system. The mainframers will want to protect their markets, and probably will not push this feature.

***Security features***. Advanced security features are almost sure to be a sales point for the new systems. Existing and expected privacy legislation, in a growing number of countries of the world, will make these features almost mandatory in data systems of the 1980s, where personal information is involved.

The U.S. federal data encryption standard, which we will discuss next month, provides a very powerful type of protection for both stored and transmitted data. Its use is sure to show up

in the new systems, as it does in the 8100. In addition, more powerful user identification methods may be offered as compared with the simple password techniques now in use.

Security is another area where there are still many unanswered questions. A lot of research is going on, to try to answer some of those questions. Even so, we expect that the mainframers can put together an attractive security package.

### End user modules

It appears to us that the heart of the new environment will be end user job-oriented work stations. These will consist of a processing capability, storage, a means of information entry, and display. Quite possibly, too, application software will be an integral part of these work stations.

Some types of work stations are already in existence, such as data entry terminals, bank teller terminals, supermarket checkout terminals, factory labor and job reporting terminals, and so on. The key point for the mainframe manufacturers will be to make such terminals fully compatible with the rest of the distributed network.

Then, too, the equivalent of today's word processing terminals will be offered as a part of an integrated network. One of the main complaints about current word processing systems is their incompatibility; generally, they can communicate only with machines of the same brand (and even model). So the new office work stations will be able to create not only paper correspondence but also will create and receive messages via computer message systems, store and retrieve information in electronic files, and so on.

We suspect that the manufacturers will try to make the applications software an integral part of these work stations, for two reasons. One, the software probably will represent an increasingly large percentage of the total price, as hardware prices continue to fall. The mainframers will seek to increase gross sales figures by selling the application software. Second, they will want to protect themselves against plug-compatible work station manufacturers. They will seek ways to make it difficult to run the application software on some other brand of work stations.

It is possible, too, that these work stations, including the applications software, will be leased to customers on a 'per transaction' basis, the way photocopy machines are leased. The price per transaction might be quite low—probably a few cents—but with some minimum monthly rental figure. This approach would help to hold off the plug-compatible manufacturers.

However, it is in the areas of management oriented modules and system development modules that we expect most of the excitement to occur.

***Management oriented modules***. A good percentage of managers resist the use of keyboard-type terminals, for a variety of reasons. So, for management use, the work stations will tend to use other methods for entering information. These include the use of function keys and cursor control levers which still require a manager to use his or her hands for entering information. And, where managers *are* willing to use full-key keyboards, these can be attached to the work stations. Further, color graphics probably will be a feature of managerial work stations, for highlighting selected information and for showing data in graphical form automatically.

***Natural query languages***. One of the main things that the new systems are sure to offer is a powerful query capability for managers. By means of directories to all data and information in the system, plus linkage modules for accessing existing data files (on tape, disk, or in databases), management will be given query access to just about all of the data and information. Need-to-know security features should be provided, of course, so that just any user cannot browse through all company files.

Inherent in such a query capability will be 'natural' query languages that are easy for users to learn and to use. A lot of research has been done in this area, to the point where very interesting products should be appearing soon. These natural language queries would be converted into a network-standard query format, directories would be consulted to determine where the requested data or information is stored, and then query messages would be sent to the appropriate nodes.

This query feature, by itself, probably will be one of the strongest sales points made for the new systems.

***Managerial support services***. Several other managerial support services are within the state of the art and will be used to give an air of excitement to the new systems.

One will be an alerting service, wherein a manager specifies certain events (or a combination of events) that he or she wishes to be notified about. Examples might be: when a particular customer order is received, or if any customer order is changed in stated ways, or if a shipment is not received by a specified date. When such events occur, messages would automatically be displayed on the manager's work station.

A second type of managerial support will be computer message services, which we discussed in our last two reports. Many managers who have already tried them have liked them. Instead of being continually interrupted during the working day by telephone calls from others within the company, a manager simply asks for his accumulated messages when it is convenient for him to answer them. If he is willing to use a terminal, he answers them himself; otherwise, he asks his secretary to perform the keying operation.

Several other managerial services have been developed and seem ready for the marketplace. These include tele-conferencing (by way of computer message systems), maintaining a manager's calendar and schedule, and maintaining a manager's tickler file.

***Decision support systems***. Up to now, computer systems have not been used to directly aid the management function of an enterprise, to any great extent. Management has benefitted from the use of computers, of course, but usually indirectly, such as by having more accurate and more timely reports of company operations.

As we discussed in our May 1976 report, much work is going on in the area of decision support systems, to aid management in making more effective decisions. Generally, managers have not used these systems themselves but rather have used them through intermediaries. As managers become more accustomed to using their own work stations, they may be more willing to use decision support services directly.

What are decision support systems? The simplest form is the query system, mentioned above, which lets the user probe data files for details. Somewhat more complex services provide programs for analyzing the retrieved data, such as fitting trend lines to the data. Moving further up the scale, one reaches the use of simulation and optimization techniques. The use of critical path methods, for planning and scheduling a complex project, is an example.

All of these management support services—query facilities, alerting services, computer message services, and decision support services—have been worked on and have been reported in the technical literature. All are within the state of the art. The mainframe manufacturers thus have a wealth of developments upon which they can draw, for putting together an exciting package of features for their new systems.

What will not be mentioned in the sales presentations, in all likelihood, is the impact that these services probably will have on the management styles of the various managers and executives. Yes, the benefits these services promise can be very attractive. But users should be cautious of the side effects they are almost sure to bring. We will have more to say about this subject below.

***System development modules***. In addition to modules that directly support the management function, we think the new systems will offer modules designed to greatly improve the efficiency of the application system development process. These modules might be likened to what is now termed 'the programmer's workbench,' which provides a set of software tools designed to help the programmer.

We foresee modules designed to help system analysts, system designers, programmers, and data administrators. Month after next, we will begin discussing some of the new methodologies that are in use today and which may be forerunners of what the new systems will offer.

In brief, we think each development staff member—analyst, designer, programmer, and data administrator—will have his or her own micro-computer module with a set of tools. This module would include a display, with graphic (and very possibly color graphic) capabilities, for drawing and displaying system diagrams. In addition, each of these will be able to access common data and data definitions, common programs, and so on.

Also, we suspect that the mainframers will claim that these system development modules will make the task of converting application systems to the new environment *much* easier. This

'easy migration path' will be one of the main sales points.

***Generalized software.*** The mainframers might well, we think, seek to protect themselves against plug-compatible manufacturers by tightly coupling the hardware and the software in the end user modules, and by having the hardware represent only a small fraction of the price.

The key to providing this software is the use of generalized application packages. We discussed some successful user-developed generalized systems in our January 1977 report, and some successful supplier-developed packages in our May 1977 report. So good quality generalized software *is* within the state of the art.

As we mentioned earlier, if the mainframers charge for these end user modules on a 'few cents per transaction' basis, this would seem to offer very tough competition for the plug-compatible suppliers.

## Point and counterpoint

The basis for our arguments in this report is that the on-rushing micro technology is overtaking both today's maxi- and mini-computers. In three to five years, plug-compatible micros—that are capable of replacing many of today's maxis and minis, and at much reduced prices—will be technically feasible. Based on the eagerness with which manufacturers of minis have recently entered the plug-compatible field, we would expect the same to happen with the micros.

In the past, there has been a debate about how much real competition has existed in the computer field. This debate has culminated in the current lengthy law suit by the U.S. government against IBM. But it looks to us as though the competitive picture is changing. Plug-compatible hardware of all types, including the CPUs, is injecting substantially more competition than has existed in the past. And the competition from the plug-compatibles will get worse for the mainframe manufacturers, unless they take steps to counteract it.

Because IBM has the lion's share of the computer market, it will be the main target of the plug-compatibles. But the other mainframers will not be ignored. The technology has reached the point where no line of hardware is immune from this competition. All that is needed is that the plug-compatible manufacturers see a big enough market to warrant their attention.

But, you might ask, how does coming out with a new generation of computer systems really protect the mainframers against the plug-compatible manufacturers? If plug-compatibles can be built for today's computers, they can also be built for any new systems. So what is gained by the mainframers coming out with radically new systems?

For one thing, such new systems buy *time* for the mainframers. It takes about three years, we understand, from the initiation of a micro-computer project until that processor reaches the marketplace. In addition, it will be at least one year from the time that a new system is announced until the plug-compatible manufacturers will get enough details to complete their design work. It thus might be four years after a new system is announced before the plug-compatibles for it might appear. So, through a series of planned moves of this type, the mainframers might stay ahead of the plug-compatible manufacturers for most of the 1980s.

Then, too, the mainframers might lay some traps for the plug-compatible manufacturers, in the same way that IBM trapped the leasing companies when the 370 line was announced. With the 370, IBM announced the two top models for the line—the 155 and the 165. The leasing companies rushed in to buy them, for leasing at a discount to customers. After the leasing companies had made substantial commitments, IBM came out with the 158 and 168, which included virtual storage. Further, it proved to be very expensive to adapt the 155 and 165 for virtual storage. Suddenly, the two original models were much less attractive to customers.

So the mainframers' strategy might include both delay and misdirection for the plug-compatible manufacturers.

The plug-compatible manufacturers, in turn, could have an interesting counter approach. They could anticipate both the delay and the potential traps. Their main sales point might be, "Do not sign up for the new systems offered by the mainframe manufacturers. Instead, use our plug-compatible hardware with your present systems for several more years. In that way, you get immediate cost savings and avoid the conversion problem. Let a few big (brave) users do the

pioneering of these new systems. Then, when things settle down, we will have our plug-compatible versions of the new systems available for you. If you stick with us, you will continue to save money and avoid headaches."

### What about the 303X?

If the forecasted figures for 1983 that Branscomb presented have validity, and if we are seeing the upcoming competition from the micros in a reasonable way, then where do the IBM 303X and 8100 fit in?

The 303X will not make the change in the environment that will be needed if Branscomb's projections are to work out. After all, they are IBM's newest maxi CPUs and they do not appear to be the new systems of the type we have been discussing. Are they simply IBM's response to the plug-compatible maxis?

Then, too, what about the 8100 series for replacing the low end of the 370 line? Since the 8100 can tie in with 370s, is this not evidence that IBM is staying with the present generation of computer architecture, for at least a few more years?

We will consider both a Yes and a No answer to these questions. First, the No answer. It is an interesting one and *must* be considered seriously by both users and by plug-compatible manufacturers.

The No answer to the above questions is saying, in effect, that the 303X and the 8100 are really ploys in IBM's attack on the plug-compatibles. IBM's strategy might be: let the plug-compatible manufacturers tool up to make plug-compatible versions of these systems—and then, wham, come out with something comparable to virtual storage that leaves these manufacturers dangling.

And what would that 'something comparable to virtual storage' be? As we see it, it would be just what we have been talking about, a new generation of computer systems.

Well, then, what about the 303X the 8100? Where do they fit in? One answer: they could be the compatibility modules of the new systems!

What better way to convince customers that conversion to the new systems will be easy than by just absorbing the 303X and the 8100 into the new systems?

And, of course, IBM might have some 'cute' design features in these new CPUs that are not used at first and that the plug-compatible manufacturers do not recognize or appreciate. The importance of these features may become evident only when the new systems are announced.

Note, too, that this approach would allow IBM to resume the policy of trying to sell customers on trading up. If the 303X and the 8100 become the compatibility modules of the new systems, then trading up is re-introduced.

If Branscomb's projections for 1983 are to materialize (and we remember him saying in his talk that these were *his company's* estimates), then the process ought to be already underway to achieve them. The 303X and the 8100 might well then be the first steps in this process.

### What if it does not happen?

Now for the Yes answer to the above questions. What happens to our argument if IBM and the other mainframers do *not* come out with radically new systems in the next few years but instead stay with their present computer architectures? We will concentrate on IBM's case.

***Stay with present architectures.*** Since users are *so* sensitive about being forced to convert their programs and data files, after the sad experience of converting from second to third generation computers, any new system that involves the need to convert might be rejected in the marketplace. So, as much as the mainframers might like to counteract the plug-compatible competition by bringing out radically new systems, perhaps they feel like they dare not risk this. In brief, maybe the IBM 303X series is just what it seems—a replacement for the 148 to 168-3 CPUs and nothing else, to counteract the plug-compatibles.

While we do not think this is a viable long-term solution for the mainframers, consider what might be done under this approach. The mainframers *must* develop an adequate response to the plug-compatibles, both for today and for a few years hence when plug-compatible micros will be feasible. If this is the approach taken, then it appears that the mainframers are willing to concede a fair portion of the CPU market to the plug-compatibles, perhaps on the assumption that this will represent a decreasing percentage of total expenditures anyway. To retain as much

of the CPU market as possible, some features might be added to the present architecture to hold off the plug-compatibles. Two possibilities are: (a) more use of micro-code, and using new micro-code with each new release of an operating system, and (b) using data encryption whenever data is transmitted between the CPU and peripherals; encrypt at the source and decrypt at the destination.

So the competition might shift from CPUs to end user modules. The mainframers could offer all of the types of end user modules that we mentioned in this report, with particular emphasis on the management oriented modules and system development modules. And we think that the mainframers would protect themselves from the plug-compatibles by integrating hardware and software, and perhaps by transaction pricing.

So, even under this approach, we believe that users will find that the next few years will be a period of major change. They will be pressured by the plug-compatibles on one side and by the mainframers on the other.

***Won't happen so soon***. Another possibility, of course, is that the mainframers will come out with radically new systems—but not within the next five years, because they will not be ready in that time.

We believe that the mainframers, and particularly IBM, *will be* ready. Intel delivered its 4004, the first micro-processor, in mid-1971, and its popular 8080 in 1973. By 1974, the micro technology trend was apparent. During this same period, there was a lot of talk about IBM's Future Systems, with the System Q operating system. Then in early 1975, IBM watchers detected a sudden change at IBM, comparable to the one in 1960 when IBM decided to drop its proposed 8000 series, as well as its existing 1400 and 7000 series, and come out with the 'all purpose' 360 line. IBM subsequently confirmed that it had dropped the FS project, as a replacement for the 360/370. Our guess is that, in 1974, IBM recognized the micros as the competitive threat of the future and started to get ready for them. The other mainframers probably recognized the threat at about the same time.

Well, then, will the micro manufacturers be ready? They themselves may not be prepared to tackle the mainframers via plug-compatibles in the next three years or so; in general, they are not too familiar with the data processing field. But one must also consider the original equipment manufacturers (OEMs) who *do* know the field and who will urge the micro manufacturers on. We do not see any big delays here.

Obviously, we do not claim to know *the* answer about what the mainframers will offer. We have no inside information. As Will Rogers said, "All I know is what I read in the papers." It seems quite clear that plug-compatible micros for many of today's CPUs, including the 8100, will be technically feasible in the not-distant future. All that will be needed to bring them to the marketplace is for the plug-compatible manufacturers to see a big enough potential market. Even the threat of this competition is something the mainframers cannot ignore. So the micros are going to bring major change to our field in the next few years, we believe.

## The major impacts

If this new generation of computer systems is announced by the mainframers, how much upheaval might the new systems entail when users install them? Here are our thoughts on the matter, starting with the things that will involve the least upheaval.

As we discussed in our last two reports, on the automated office, the least upheaval occurs with straight-forward equipment replacements. Such replacements involve no changes in procedures or other human activities. The compatibility module of the new systems would be an equipment replacement of this type. It will be an important element of these new systems; the mainframers *must* provide an easy way to run existing programs and data files.

However, we suspect that many users will want to begin exploiting the features of these new systems as soon as they can, and will not want to run just in a compatibility mode. They will want to begin using the interactive modules and the database management module, in all likelihood, and possibly even the batch processing modules. So the mainframe manufacturers are likely to offer automated conversion aids, to help convert existing programs and data files to run in native mode on the new modules. As we described in our May 1978 issue on database

conversions, such aids are available. However, they are limited in what they can do, and users still will probably need a non-trivial amount of programmer and other staff time, for making the conversions. So the upheaval factor here will apply mainly to the development staff.

Moving up the upheaval spectrum, other users will want to take this opportunity to move to distributed systems, since supposedly these will be better supported by the new systems. Such users will have largely completed their efforts to centralize data processing and will feel that things are fairly well under control. Now, they may say, is the proper time to move into distributed systems. Such a move will require significant reprogramming efforts. The mainframe manufacturers will probably try to make this seem less of a challenge by means of the new system development modules.

It is likely that the new systems *will* make the installation of distributed systems and distributed databases easier to accomplish than is true of today's products. They probably will be designed to do just that. Partially completed projects for installing distributed systems may be stopped upon the announcement of the new systems, in order to re-design and re-work as needed. This will be an upheaval factor to consider.

Also, it should be recognized that the impact of distributed systems and distributed databases upon the organization is not yet well understood. They may involve procedural changes, and hence resistance, on the part of the organization. Of course, many managers want their own computers, and this should help gain acceptance of these systems.

The biggest expected impact on the organization would seem likely to come from the end user modules, because they will require changes in the behavior of many people in the organization.

For example, an office work station will handle most information in electronic form, rather than in paper form. This includes such functions as creating and receiving messages, filing messages, and so on. Based on pioneer users of these functions, secretaries may resist the work stations at first because they seem so 'mysterious.' But after a few months of use, the acceptance may be good.

The system development modules, while they sound attractive, may generate quite a bit of resistance on the part of the development staff. The reason we think this resistance should be expected is that these modules will impose a discipline upon the development people—a discipline that is still the exception more than the rule, for most staffs. If this resistance does, in fact, come to pass, the benefits of these modules will not be realized as fast as the mainframers' salesmen might imply.

But the biggest impact will be on management.

### Impact on management

The major gains from the new systems almost surely will come from increasing the productivity and effectiveness of managers, as we discussed in our last two reports. But these gains will come from a change in management work habits. And this, we expect, will lead to a good amount of resistance on the part of some managers.

Today, most of management's communication is verbal—by conversations, telephone calls, meetings, dictation, and so on. The new systems will want to supplant some of this verbal communication by keying in input and by reading output on a display. As we mentioned last month, one study showed that one-half of a typical manager's activities were completed in less than nine minutes. So managers do lots of things for short periods of time, and mostly by verbal communications. How readily will they take to work stations? Someone who has been accustomed to the verbal ways for twenty or thirty years may choose to use a management work station very sparingly.

*A management query system* probably will be the service where acceptance is easiest to gain. If a manager is unwilling to use a work station himself or herself, the secretary or a staff member can be asked to make the queries.

*Alerting services* also might be well accepted but they will involve behavior changes. Instead of relying on the common sense and/or experience of other employees, the manager will have to carefully define the criteria for all alerting messages that he wants to receive.

*Message services*, too, might be well accepted by some managers, especially those who are willing to use a keyboard terminal. The early users will be those managers who are annoyed with the interruptions they now get and who would like to

handle their messages at times of their choosing. Other managers seem to thrive on interruptions and they probably will not take to these systems.

*Decision support systems* probably represent the largest potential gains in effective management but they also will be the most difficult for managers to accept, we suspect. They involve basic changes in the way most managers make decisions. When tough problems arise, managers will want to fall back on familiar decision-making processes. They may prefer to use decision support systems only for less critical or less important problems.

So this is the new computer environment we foresee. We think it will come into being in the next few years. Most of the push will come from the mainframe manufacturers as they attempt to 'sell the sizzle, rather than the steak' of their new systems. And the new systems are imminent because of the on-rush of micro-computer technology. At least, that is the way we see the next few years.

We will have accomplished our purpose with this report if we can persuade readers to take the new micro-computer technology very seriously indeed, investigate it, and make up your own mind as to what will happen. Then, if you agree that the types of changes that we have forecast are likely, investigate the probable impact of those changes on your organization. In short, be prepared for the decisions on your course of action before the 'sizzle' of the new systems becomes too enticing.

To help you with these decisions, our next few issues will discuss some developments that are sure to be part of the computer environment of the 1980s. Next month, we will discuss data encryption—which will probably play a much larger role in data processing than most users presently realize.

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ADDITIONAL READING

1. For background information on how the micro-computer technology is developing, we suggest the following two IEEE Computer Society publications; the address is: 5855 Naples Plaza, Suite 301, Long Beach, California 90803:
   a) *Computer*, a monthly magazine of the Society; annual subscription is included in membership dues, or write for non-member price. We suggest that you start at least with the 1976 issues.
   b) *Proceedings of Compcon Conferences*; two conferences are held each year, and most of the recent ones have papers dealing with the front edge of microprocessor technology. The non-member price of each proceedings is $20.
2. Good quality tutorial papers on micro technology often appear in the IEEE *Spectrum* magazine (IEEE, 345 East 47th Street, New York, N.Y. 10017). Annual subscription is included in IEEE member dues. Write for non-member price.
3. A new newsletter, *Computer and Data Processing Technology*, is just being introduced by L. C. Hobbs, whose articles on technology developments have often appeared in *Datamation*. The newsletter will deal with various aspects of new technology. Subjects such as magnetic bubble and CCD memories, large semi-conductor RAMs, and 16-bit micro-computers will be covered in near-future issues. The address is: Hobbs Associates, P. O. Box 686, Corona del Mar, Calif. 92625; price $85 per year.

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