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PLANNING YOUR FUTURE INFORMATION SYSTEMS

Computer-using organizations are entering a rapidly changing, high risk period that will require careful planning and close supervision. The changes include shifting to distributed data processing, installing automated office systems, and putting in integrated tele-communications. Perhaps not since the big conversion days of the 1960s has there been such a need for well-considered strategic plans, showing what the information systems should look like five to eight years hence and how organizations will use them. How can you do this? Here are some suggestions. (See page 16 for an executive summary.)

Einar Stefferud of Network Management Associates, Inc., (Huntington Beach, California), Professor David Farber of the University of Delaware, and Ralph Dement of Digital Equipment Corporation (Maynard, Massachusetts), in Reference 1, describe briefly a strategic conceptual framework that they have worked on. This framework is for future acquisition and use of computers and data communications in support of workplace automation.

Variations of this conceptual framework have been used to date by two government agencies—the Federal Communications Commission (whose plans we discussed in our July 1982 report) and the U.S. Army's Armament Research and Development Command.

To get a more complete picture of this conceptual framework than is found in Reference 1, we had a lengthy discussion with Stefferud.

Some years hence, large and small computers will be "everywhere" and, to a great extent, they will be inter-connected via networks. The big questions are: (1) what will be the structure(s) of these future information systems, and (2) how will organizations get from their present computer environments to these new ones? Stefferud, Farber and Dement provide a view of one such structure and a plan of action for getting there.

The conceptual framework is based on the premise that the migration of computer power to end users will be the driving force for network-based information systems.

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What is needed, say the authors, is a coherent plan for guiding this migration of computer power to end users. The components of their plan include processors, networks, services, and standards.

Processors. The authors see three levels of processors, usually with associated information storage.

Single user systems (SU) can operate in a stand-alone mode but also will be connected to local networks. Conceptually, they are much like today's personal office computers.

Multiple user systems (MU) will serve limited, relatively local groups of users via terminals, as today's mainframes and minis do. These MU's also will provide (1) backup facilities for the SU's, (2) heavier duty computation than can be done on an SU, (3) program libraries for themselves and for the SU's, and (4) database management for any central files.

Ideally, says Stefferud, the SU's will be scaled-down versions of the MU's—able to run the same software (to reduce software development and maintenance) but without all the features needed for shared operation on an MU.

Remote utility systems (RU) will provide the heavy duty computing, corporate database management, remote batch processing, and backup for the MU's. For most organizations, these RU's are represented by today's centralized mainframes. In addition, though, they are also represented by the computers used in commercial network services, such as databank services.

As an acronym, the authors have chosen SU/MU/RU (or SUMURU) for this conceptual framework.

Networks. The authors see a network architecture consisting of two levels.

Local networks (LN) will provide high speed information transfer, as in today's Ethernet, as well as close coupling between several SU's and a single MU. The SU's probably should not have their own removable files on floppy disks or cassettes, says Stefferud, but instead should have non-removable hard disk storage, plus access to hard disk storage at the MU's for personal files, shared files, and main program libraries.

An MU will perform other functions as well. It could provide the gateway function between the local network and any remote networks. And, using terminals in a time-sharing mode, it can serve in place of the network of SU's until that network has been installed.

Remote networks (RN) will provide connections among MU's and connection to both in-house and commercial remote computer services. The RN's probably will have lower transfer speeds than the LN's, but still should have enough bandwidth to provide file transfers within reasonable time limits.

Services. The authors see three main types of services that the LN/RN network architecture should provide.

Terminal access. Either a terminal tied to an MU, or an SU, must be able to access any MU, RU or SU, subject only to management constraints (not technical barriers). The terminal or SU might well act like a 'dumb' terminal in this instance.

File transfer. Users must have the ability to send and receive files. To do this, a user must have both read and write privileges at both ends of the transfer.

Computer mail. For this service, the originator of a message needs read and write privileges only at the point of origin, not at both ends (as in file transfers).

Standards. At the outset, the term 'standards' is perhaps a bit too strong; 'corporate preferences' might be a better term. But when practical, these preferences should be converted into corporate standards.

The plans of the U.S. Army's Armament Research and Development Command for workplace automation articulate the need for standardization in two areas—operating systems and communication protocols.

Operating systems. The corporate standards (or preferences) on operating systems should be designed to minimize the barriers to the transfer and use of programs and data. Ideally, a selected operating system should run on more than one vendor's equipment.

As examples of this kind of standard, CP/M and UNIX are identified in the plans as the preferred operating systems for the SU's, and UNIX and perhaps MVS (for IBM and plug-compatible computers) for the MU's.

Communication protocols. Standard protocols will be needed for terminal access, file transfers, and computer mail. In the federal government, the Department of Defense's TCP/IP protocol might be chosen. In private industry, as the ISO 7-level protocols are developed, they probably should be adopted as corporate standards.

A road map

The authors have given considerable thought to the problem of how to get from 'here' to 'there,' where 'there' means their SU/MU/RU framework. Here are some of their main points.

As an early step, select the preferred operating systems and communications protocols, as just discussed. Then encourage compliance with these standards (or preferences) by the operating units of the organization by offering more support to those users who do comply.

Then begin developing or acquiring the network interfaces—for communicating from MU's to the RU's, or to remote MU's, via the remote network. These interfaces should provide for both terminal access (for terminals tied to the MU) and file transfer.

Then select appropriate computer mail services. These selected services will determine whether mail transfer facilities are to be located on the MU's, on an in-house RU, or on a commercial network service. In any case, user interfaces for mail services should be available on all SU, MU and RU systems. Once the computer mail service has been selected, expand the number of sites that it serves as rapidly as is practical. For more discussion of computer mail services, see Reference 5.

As a practical first step, especially until local networks of SU's can be installed, install MU's that serve a number of local terminals. Later, as the SU's are installed, they can replace some of the local terminals, and the MU workload can shift more to its gateway, backup, and librarian functions.

These, then, are some of the highlights of an interesting approach to the structure of future information systems. It is an approach, moreover, that is being tested in at least two government agencies. It represents, we think, the type of forward thinking that most computer-using organizations should undertake, if they have not already done so.

Information Sciences Institute

We talked with Keith Uncapher, Executive Director of the Information Sciences Institute, part of the University of Southern California, located in Marina del Rey, California, near Los Angeles. ISI was founded in mid-1972, and from the first, has made extensive use of office automation. They have almost a paperless office, as we discussed in our September 1978 issue. In addition to serving the ISI research and development staff, they provide computational, word processing, text processing, calendar, and electronic mail services to some 3,500 other people throughout the U.S. via the ARPANET network.

We wanted to get ISI's views on what the structure of future information systems is likely to be, based on their extensive experience with computing, data processing, and automated office functions.

Many external users of the office functions make use only of calendar and electronic mail services, said Uncapher, even though ISI provides a good deal of user support and documentation. The reason for this limited usage, he feels, is the variations in response times that any time-shared computer service encounters; when demand is heavy, response time gets longer. So these users tend to lose interest when they encounter slow responses, he said, and then begin to want their own computers.

But that is not the whole story about users wanting their own computers. Even the internal-to-ISI researchers need a better level of service, which ISI is finding hard to support with centralized computers. Not only do the researchers need good response times but also ISI would like to provide a minimum of 10 to 20 times more CPU cycles per researcher than the present mainframes supply. Upgrading to later mainframe models might provide five times more cycles—which isn't sufficient. And ISI would like to provide each researcher with the equivalent of about 4 million 36-bit words of address space.

Finally, these parameters imply a high speed delivery service. For users internal to ISI, this means access to local computing capability on megabits-per-second local networks. External users should have at least 56 kbps of bandwidth at a low cost. Until these conditions can be met, Uncapher sees 'personal work stations' as being favored.

How can 'personal work stations' meet these needs? The new generation of micros, such as those based on the Motorola MC68000, can do it.

So, says Uncapher, for the foreseeable future, it looks like information systems—involving computing, data and word processing, office functions, and so on—will use computationally rich work stations which can operate not only in stand-alone fashion but also can access a wide variety of network 'servers' (to be described). Also, such work stations must be able to access *all* network functions, and should have the software to accomplish this.

These work stations ideally will have high resolution bit-mapped graphics capabilities, in the order of 1000 by 1000 point resolution. Even for secretarial use, it is desirable for the work station to follow the dictum of "what you see is what you get." Thus, a page of text displayed on the screen should look just like it will when it is printed out, including different character fonts and sizes, proportional spacing, graphics, and so on, he said.

What will be the role of central processors in such an environment? Uncapher sees them providing three main types of services. One is server services, for providing file storage, information retrieval, electronic mail services—as well as access to specialized computers—for *many* users (thousands, tens of thousands, even hundreds of thousands in some cases). Another is high volume batch data processing and 'number crunching' services. And the third is the specialized processing computers which might be (say) high performance LISP machines for providing orders of magnitude capability improvement over work stations, for that particular language, for artificial intelligence applications. Most of these services would be accessed via networks. The specialized processing services, in addition, probably would have to be on a shared basis, where users are assigned time slots in which they can use the service.

But, said Uncapher, if the time comes that each user can have a megabit or more of bandwidth at low cost, and the mainframes can provide sufficient CPU cycles and memory space per user, the balance may shift back toward the centralized systems. At present, though, he does not see centralized systems being able to meet these needs as well as the new generation of work stations can meet them.

The need for strategic plans

It is evident, with the rapid and widespread progress that is being made in the micro-computer arena, that the computer field will be undergoing a radical change during the 1980s. Clearly, micro-computers and their associated software represent the most dramatic (and, some say, meaningful) developments in the field.

If this is the case, and we believe that it is, what will today's information systems evolve into by the end of this decade? For instance, at many organizations, the main data processing system structure is that of mainframes that perform a combination of batch and on-line workloads, the latter being accomplished via many terminals communicating with the mainframes. In a good number of organizations, minicomputers and micro-computers are also being installed, often on a stand-alone basis, for reasons that we discussed in our June and July 1982 reports. What system *structures* will replace these?

In our study of this question, we reviewed the studies we have made for our monthly reports for the past several years. We have reported how organizations are installing distributed data processing, office systems, application-independent data networks, energy management systems, and so on. Also, we have attended a good number of conferences and seminars in the past two years on most of these subjects, and have talked with a number of specialists in these areas. Within this body of material, we looked for ideas dealing with the likely structure of future information systems.

Why should a user organization worry about the structure of future information systems, and spend the time and money to develop plans for achieving that structure? Why not just let the suppliers come up with solutions? The answer to these questions is—because of the real possibility of the user organization making serious and costly mistakes.

Serious mistakes

One point that has stood out strongly during our review is that some organizations are making serious mistakes in their move to the new environment. For instance, Maskovsky (Reference 2) briefly describes the experiences of six companies in their installation of new automated office systems. Five of the six had done little or no strategic planning for these office systems, he says, and each of those five companies experienced project failures.

In the first case, the company jumped into the implementation too quickly; the system design that resulted was too superficial, and the department managers could (and did) easily 'shoot it down.' When the company ran into profit problems, the project was scrapped.

In the second case, the executive in charge of information systems was given the responsibility to control the proliferation of a variety of word processing systems. He brought in a consultant, but failed to communicate the real objectives of the project—which turned into a typing study. No one else in the company was involved with the project, and when the executive was absent for several weeks, the project was terminated.

The third case, too, dealt with establishing coordinated procurement of word processing systems. The information systems executive set up a 'targets of opportunity' study, which identified some cost avoidance patterns involving professionals and managers (with potential savings of $30 million per year). Top management enthusiastically approved a pilot project, which included the use of computer mail. An elaborate network was designed for the computer mail system, and desired equipment was identified. But computer mail by itself could not justify the cost of the network, and the project team neglected to tie it in with an overall strategy which *could* justify it. At this point, top management vetoed the whole project because the network was not cost justified.

In Maskovsky's fourth case, the company had many office automation projects either completed or underway. The realized benefits to date had been disappointing, so a team was set up to investigate. The team saw a need for a long range plan, and developed one. But the company had already invested so much in equipment and methods that it became difficult to make much progress toward the goals of the long range plan.

And in his fifth case, a strategic plan was developed for moving into advanced information systems, including office systems. And, by following this plan, early results were good. But the plan was "organizationally parochial," says Maskovsky, and depended on a specific management style. When the company re-organized and its leadership changed, the whole approach had to be replanned and restructured.

In each of these five cases, strategic plans either were missing (as was typically the case) or had essential flaws, says Maskovsky. That is the primary reason, he feels, for the failures that resulted. In his sixth case, the company did a good job of developing a strategic plan—and has been successful in implementing the integrated systems that they had planned.

Tucker (Reference 4a) describes a project, for installing a pilot computer mail system, which failed. A company wished to install such a system to serve over 2000 employees at the headquarters site. The expected benefits were to reduce the amount of 'telephone tag' (several tries to reach the other person on the phone) and the amount of time spent creating and filing interoffice messages. But after a few weeks of trial, the pilot system was terminated because of low usage.

There were several reasons for the failure, Tucker says, based on post-project interviews with the participants. Many participants did not have their own terminals, so terminal access was not convenient. Much of the participants' communications were with people not on the network. The log-on time, to find out if there were any messages, was longer than just making a phone call. And it was not clear to the participants that management had any real commitment to the system.

Conrath (Reference 3a) describes how an early 'word processing center' project in Canada failed; we have heard of similar experiences elsewhere. To cost justify expensive word processing equipment, most of the secretaries were taken from managers (except for the secretaries of senior executives) and moved into a word processing center. These secretaries felt that they had been moved into a segregated, low status unit—and turnover increased. Managers found that trying to get their typing done to their satisfaction was a much lengthier process than it had been. And it seemed to them, too, that they no longer could control the priority and quality of the work done. When the situation became sufficiently intolerable, the company disbanded the center and returned to the old methods.

These cases are just a sampling of the unsatisfactory experiences that many organizations have had, as they have tried to move into the new computing environment. In fact, in the literature and in the conferences, one reads and hears much more about the unsuccessful cases than about successful ones.

Contributing factors

It may not be surprising that failed projects receive more notice than successful ones, because they are perceived to be 'more interesting' and 'more newsworthy.' But, at the same time, one would expect to read about or hear about *some* cases where expected benefits actually materialized. But this kind of information is sparse indeed in the office automation field. The same is true for distributed database systems and local networks.

Why? Some researchers in this area assign blame for the lack of achieved benefits to users, not just to the suppliers of the new systems.

Panko and Sprague (Reference 4b) say that the evolution of the 'office of the past' involved four largely independent product specializations in user organizations. These were data processing products, specialized office products (such as mailing equipment and duplicators), general office products (such as copiers and typewriters), and tele-communications products. Typically, corporate authority for these resided under different people.

These traditional bailiwicks are part of the cause of the problem, say the authors. The new environment involves using networks to interconnect many of these types of products. But each bailiwick has a parochial view. For instance, people oriented toward data processing see these networks as just extensions of distributed data processing networks. These networks have been successful for transaction *data* processing but perhaps will not be as appropriate for non-transaction, non-data office work.

At the same time, people concerned with office automation view these networks as local networks that inter-connect many co-operating work stations. They are concentrating on communications functions and tools for supporting individual workers and small groups, say Panko and Sprague. The views of the different bailiwicks do not mesh.

Moreover, the problems associated with local networks for office systems seem to be of little concern to the people dealing with networks for distributed data processing, and vice versa.

So, say Panko and Sprague, these two network-based approaches as yet have shown few signs of merging, although in time they are almost certain to merge. Users are not yet thinking of this kind of integration and suppliers are not yet providing it.

Also, says Coggshall (Reference 3b), system integration via local networks is likely to be slower, less complete, and more problem ridden than is widely perceived today. Most of today's usage is accounted for by a short list of applications—including data entry, inquiry, accessing multiple processors, and document preparation and distribution. One expected large use of local networks—computer messaging—as yet has not received widespread acceptance, possibly because too many keystrokes are required to get on a system. In addition, few local networks are being used (in any meaningful way) for a combination of data processing, word processing, computer mail, and other applications. One reason for this, Coggshall believes, is that most user companies have not trained work station operators to use the network for a variety of uses.

As just noted, today's local networks may not handle both data processing and office functions well, and there are some definite difficulties with numerous computer mail systems. So part of the cause of slow acceptance mentioned by Coggshall may well be product shortcomings.

There is still another point to make. No one is yet sure just where in an organization the processing and data storage functions will be best located. For instance, six possible levels of processing and data storage are: (1) work stations, (2) work groups, (3) departments, (4) sites, (5) regions or countries, and (6) corporate headquarters. Should processing and data storage be decentralized all the way down to the work station level, or centralized at the corporate headquarters level, or centralized at some intermediate point such as the site? This decision is far from simple.

Another big reason for possible serious mistakes is that the future working environment may be quite different from today's. It could be costly to base future plans on today's environment, only to find later that significant changes in work styles invalidate the plans. Let's consider the question of work environment.

What will office work be like?

Panko and Sprague (in Reference 4b) say that most 'technological' revolutions (such as office automation) are really 'organizational engineering' revolutions. They illustrate this point by referring to World War II.

At the beginning of the war, German U-boats were relatively ineffective against British shipping. Then the U-boats shifted to 'wolf pack' tactics by attacking in co-ordinated groups. Without any change in technology, they became very effective. The Allies eventually countered this move by adopting 'hunter killer' teams of destroyers. It was the new way of organizing work that was successful in both cases, not a change in either the submarines or destroyers. So, say the authors, the keys to success are new ways of performing work, as opposed to just inserting new technology into existing work environments.

To get an idea of what types of work styles future systems might have to support, we contacted several people who have been heavily involved with the planning of future systems, to get their ideas.

Einar Stefferud, of Network Management Associates, Inc., Huntington Beach, California, who was mentioned at the beginning of this report, when asked about the possible changes in work styles in the automated office, responded, "This is a really big question, like asking (years ago) how the automobile will change our work styles."

Networks will allow widely separated people to work together, he said. And 'widely separated' includes not only geographic separation but time differences as well. People can be 'in their offices' in the evenings or on weekends, or while on trips, or at other offices. Networks will allow workers to literally take their 'entire' offices with them.

Walter Ulrich, of Walter E. Ulrich Consulting Inc., Houston, Texas, has been helping companies implement office automation projects for several years. He sees automated office systems having two major effects on how people will actually work in the office.

The first effect will be to reduce the number of 'bottlenecks' that office employees now encounter. For example, progress may now stop on a piece of work because someone who has to be contacted is tied up at the moment. This is a bottleneck. An electronic message system or voice mail system would allow a message to be waiting for that person, to be handled when he/she is free. A reduction in such bottlenecks will permit employees to handle more work without having to work harder, because of less wasted time, says Ulrich. Thus the tempo of work will speed up.

The second effect is that office support tools will make work more technical. Today there are sophisticated computer-based decision support tools available, for instance, but these are used by relatively few decision makers. In the office of the future, these tools will be used by many more people. However, to use the tools properly, these decision makers will need more technical knowledge. So decision making will become more technical.

James Norton of Tymshare Inc., Cupertino, California, has used Augment, their office support system, for the past 13 years, logging about 10,000 hours during that time. He uses it about three to four hours a day.

Based on his experience, he says that new users usually do basic word processing and message sending for the first year or two. After that, some move on to the more sophisticated uses. So it takes some time before users are comfortable about changing to a new work style.

Average users spend one to two hours a day on the system. When their use pattern settles down, they become efficient at the terminal and split their use into several sessions a day. Much of their daily communication with people and groups is diverted into the electronic medium—reducing telephone and travel to some extent.

Using electronic information retrieval and communications, employees can receive responses to their questions in minutes, rather than hours or days. Norton believes that people will develop different working styles to cope with this increased tempo of interaction.

Norton also believes that face-to-face communication will still be important, because of the emotional satisfaction it provides, and because it will be many years before most of one's 'contacts' will be available via computer.

At Lincoln National Life Insurance Company, Ft. Wayne, Indiana, James Coen and James Tunis have been deeply involved with installing the company's advanced office system (AOS). They say that today in their company, employees typically use their AOS terminals four to eight times a day. Sessions average eight to twelve minutes in length, but this varies quite a bit.

The AOS system is used much like the telephone—it is always available, but it is not used continually. Employees treat the electronic mail service as a new level of communication—generally more urgent and less formal than a memo but less urgent than a telephone call. Users actually learn how often others look at their electronic in-trays. And if they think that their message will not be read by the time they need an answer, they will use the telephone instead.

At first, a new user uses the message system mainly for one-way communication—giving out information. But as use matures, it changes to more non-simultaneous two-way communication, such as dialogs and asking for information, we were told.

The system has led to some gradual, subtle changes in the attitudes of executives at subsidiary companies which are located some distance from corporate headquarters. For example, one corporate officer periodically sends out general information bulletins describing some of his future plans, using the computer mail system. These bulletins are not important enough for telephone calls and are not formal enough for inter-office memos; previously he had no proper vehicle for this type of communication. This informal 'advance notice system' has led some subsidiary executives to feel that they now know more about future plans and are being asked for their comments in advance. As a result, their attitude about headquarters has improved. They can see that they are now more involved in the decision making.

The system also allows short-term projects involving many people to operate more efficiently—say, to discuss the feasibility of the company offering a new type of insurance product. And since the people all are on the system, they do not really care where the others are located geographically until they must physically meet with other members of the project. So more communication among more employees is taking place because of the message system.

The system is also allowing about 60 people (almost 5% of the current total number of users) to work at home occasionally. The company's chief executive officer and his staff all have home terminals, at their requests, which they use to extend their work days. For example, when the CEO returns from a business trip, he uses his home terminal over the weekend to catch up on his office work, so that he can be prepared for Monday morning.

The upshot

What conclusions can be derived from this discussion?

As we see it, the message is that now is not the time to make large financial (and hence practically irreversible) commitments to the structure of your future information systems. Today's situation is just too fluid. User needs cannot be treated as 'obvious,' or even determinable by short studies by data processing system analysts. Pilot projects and research studies are starting to uncover unexpected basic requirements. Suppliers today are offering office system products that are mainly adaptations of their existing data processing products—and they are working madly behind the scenes to determine just what is really needed for the new generation of information systems.

So what *can* be done? Our view is that this is the time for pilot projects and for developing your strategic plans for future information systems.

Develop strategic plans

As has been discussed, there is a potential for large investments in 'wrong' systems—unsatisfactory distributed data processing, poorly accepted office automation and such. Large sunken costs make it difficult to change things in the future.

While the present situations in office systems and distributed systems are fluid, they *are* starting to crystallize. Micro-computers, local networks, database technology (including relational database management)—all these and more show signs of convergence toward standard approaches.

For 1983, we suggest that you conduct pilot projects and develop your strategic plans—plans that apply to the remainder of the 1980s—concentrating on important technical and sociological issues.

A number of our reports during this year, therefore, will address various aspects of strategic planning for future information systems.

Important technical issues

The technical issues that we would single out for your strategic plans to address are: (1) the overall structure of future information systems, (2) network issues, (3) data issues, and (4) work stations.

Overall structure. The main point here is whether your future information systems are to be centralized or, if not, to what extent they will be distributed.

Many organizations are making this structure decision almost by default, it seems to us. For instance, some have installed IBM's SNA data network—and they see office systems using extensions of the data network. While there are some ways in which SNA is not centralized, in the main it is.

On the other hand, those organizations that have installed (say) DEC's DECNET have selected a distributed structure. And the SU/MU/RU structure discussed earlier in this report is another example of a distributed system.

The point being made here is that the structure of your future information systems should be selected explicitly, after due consideration, and not by default.

Network issues. Two of the main problem areas in networks are (1) open versus proprietary networks, and (2) how office system networks will be handled. In addition, there are some other important considerations.

Open versus proprietary networks. Actually, there seems to be three types, not just two: open, semi-proprietary, and proprietary.

Open networks have standard interfaces and protocols, so that the hardware and software products of many suppliers can be connected to them. This is a highly desirable feature, from a user's point of view. The open network is exemplified by the International Standards Organization's 7-level 'reference model' that is being supported by more and more suppliers. Standard interfaces and protocols have been established for the lowest three levels; the fourth level is close to standardization, and much work is still needed on the top three levels.

A semi-proprietary network architecture is represented by SNA, in our opinion. IBM might take issue with this opinion and say that SNA is their proprietary architecture. But so many other suppliers are making SNA-compatible products that IBM will find it politically difficult, we believe, to make basic changes in SNA without due notice to the other suppliers. In any case, SNA has something close to the seven levels of the ISO reference model—and (a big advantage) SNA is a thing of the present, not something still in the future.

An example of a proprietary network architecture has been, until fairly recently, Datapoint's ARCnet.

Type of office system network. Several questions arise in this area. One is, should the work stations of office workers be served by extensions to the data network (for instance, SNA), or by a local network? Mainframe suppliers tend to favor the former, while office system suppliers favor the latter. So far, integration of the two approaches has not occurred.

Where local networks are to be used, the question of type arises. One type is the PABX, using advanced telephone technology. A few of the newer PABX's offer data bandwidths of 56 kbps for a work station that shares a line with a voice telephone. In addition, a speaker at a recent conference predicted a data bandwidth for work stations of up to 2 *megabits* per second in the not-distant future. Add to these points the fact that telephones are ubiquitous and the PABX approach becomes a powerful one.

Highly competitive with the PABX are the baseband and broadband local networks. (We discussed some of the pros and cons of these two types in our November 1981 report.) William Zachmann of International Data Corporation, Framingham, Massachusetts, at his company's 1982 Fall Executive Seminar, made the point that broadband networks will allow several generations of computing devices to be attached to the network, since each can have its own assigned channel bandwidth. Hence, adjusting to new technology may be easier with this type of network.

Then, too, there is the access method debate—primarily carrier sense multiple access with collision detection (CSMA/CD) versus token passing. CSMA/CD is currently more popular, but token passing (favored by IBM, we are told) probably will gain ground during this year.

Other network considerations include: (a) what will be attached to the network (mainframes, minis, micros); (b) where will these computers be located (in same building, in nearby buildings, at remote locations, or in other countries); and (c) what gateways will be needed among dissimilar networks (local, remote private networks, remote public networks, and commercial networks)?

The question for user organizations is—"Which of the several approaches will we base our plans on, for our future information systems?" For too many of these issues, this decision is often being made by default—and it shouldn't be.

Our opinion is that most users will gain a large advantage by selecting an approach based on open networks or (not quite as good) semi-proprietary networks. Such an approach makes it possible to use hardware and software products from multiple vendors.

If you select a single-vendor approach and if something goes wrong, it can be very expensive (and embarrassing) to have to redo everything so as to change vendors. Open networks make this event unlikely.

All in all, there is a lot of progress being made in communication technology which will affect the plans of your future information systems. Which path do you want to follow?

Data issues. This title probably should be 'information issues' rather than 'data issues.' The reason is that users will be concerned with the transmission, processing, and storage of not just data but other types of information as well. The other types include text, graphics, images, and digitized voice (perhaps for annotating data, text, or graphics).

These various types of information will have to be managed—stored, retrieved, protected, changed, etc.—in an integrated fashion. We have already come across, for instance, a relational database system that provides a 'note field' capability; an explanatory note, up to thousands of bytes long, can be attached to any record.

And then there is the question of where the information will be stored. Will storage be central, as in many of today's data systems? Or will the information be stored close to the primary users, as is occurring with some distributed systems?

It is worth repeating—these choices should be made explicitly, after due consideration, and not on a default basis.

Work stations. One main issue with respect to work stations is—should they be dumb terminals tied to minis or mainframes, or should they be personal business computers? There is an apparent economic advantage to using inexpensive dumb terminals tied (say) to minis. But there are many advantages offered by personal business computers that have not yet been widely recognized.

Zachmann of IDC, at the Executive Conference mentioned earlier, listed some user needs that will require a large amount of CPU cycles and memory space. Powerful work stations will have an advantage over minis and mainframes in meeting these needs, he said. These needs include bit-mapped displays for showing dynamic, high resolution images and color graphics, as well as processing voice recognition and voice output, and extensive manipulation of information aggregates such as whole pages or whole documents. So CPU cycles and memory space may be demanded on a scale that minis and mainframes will be hard pressed to meet for numerous simultaneous users—but that the new generations of micros can handle on a work station basis.

In the near future, though, whatever the type of work station, it should be able to handle all of the functions that the user employee needs. These functions can include transaction processing, word processing, graphics, and even video.

Next month, we will address the role of work stations in more detail.

These technical issues, important as they are, make up only part of the plans for future information systems. There are some equally important sociological issues.

Important sociological issues

As far as your strategic plans are concerned, how do you want information systems to serve and support your organization by the end of this decade? In particular, how do you see your organization using the new systems?

A key factor: your company's employees. The point here is—how will the people in your organization work with these new information systems? This is central to decisions on system structure.

To be more specific, do you foresee clerical employees working at their work stations (CRT terminals, personal business computers, or whatever) for eight hours a day? In general, this is an undesirable solution, in our opinion. It is the type of solution that is developed by mechanizing an existing environment, as represented by the attitude: "Our clerical workers now spend eight hours a day working at their desks with paper documents. What is wrong with them working eight hours a day with electronic documents?" The answer is, we think, almost everything.

The way of organizing work that fits in with 'quality of work life' is to have each employee, perhaps with the help of a computer, do a complete, meaningful job. For instance, instead of a person doing one step in the preparation of vendor invoices for payment, the new way is to let that person do the whole job of getting the invoices approved for payment, for a specified group of vendors. Also, much of the control and co-ordination that was needed with the fragmented approach just is not needed with the whole-job approach, which leads to higher productivity.

Most employees like to deal with other people during their work day. So the work day probably should consist of working at the work station, plus talking on the telephone, plus making some use of paper documents, plus having some face-to-face conversations for solving problems, and so on. While the 'no interruptions, no distractions' work environment may seem to be most productive, in fact it is depressing for most people. Each employee probably *should* have some task changes during the work day.

With meaningful jobs, each employee probably will fill several roles during a work day, and each role may well involve a different group of people. This factor, too, will help determine the structure of your future information systems.

What is the possible payoff from this type of approach? As we discussed in our April 1981 and May 1982 issues, real productivity gains from the new systems can come from improved employee motivation. And motivation will come partly from more interesting, less constrained jobs.

Another key factor: your company's managers. In a discussion with us, Robert L. Patrick, an independent computer consultant from Rosamond, California, pointed out some likely problems with future information systems. Whether data is stored centrally or in a distributed manner, new systems give executives and staff members the ability to probe into the data files, to extract details.

Patrick asks: "*Should* such an ability to probe be provided? If top management has given a manager a specific responsibility—say, running a department or a division—won't probing into that manager's files rob him/her of some of that responsibility?" He cited some cases where middle managers refused to make decisions because someone above them was probing into the files and, in essence, indicating what decisions should be made.

But there is more to the problem than just undercutting the responsibility, says Patrick. Current database management technology generally does not provide for data quality indicators, to indicate the existing quality of the data. The local manager usually knows this quality—such as the fact that some important transactions have not yet been posted. Someone else, who looks at the raw data, may get an erroneous picture of the true situation. So probing might not only undercut responsibilities but it also can lead to erroneous conclusions.

User organizations should plan on a learning period, in which both employees and managers learn to live with these new systems.

All in all, the sociological issues seem to be every bit as important as the technical ones, as far as the plans for your future information systems are concerned. These issues have not received sufficient attention by information system executives, in our opinion. We plan to discuss such issues in more depth in several upcoming reports.

Conclusions

It appears to us that 1983 might best be spent in trying out ideas and deciding on what your future information systems might be like. This is not the time to make major system commitments that will be hard to undo.

Currently, much of the hardware and software that is being offered by the major computer suppliers is mainly a re-hash of what these suppliers have already developed for today's data processing. By the end of this year, we think you will be able to get a much better idea of what information system products will be like for the rest of this decade.

So use 1983 to develop your goals, consider the main issues, and select the most appropriate general structure for your future information systems.

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COMMENTARY

HOW FAST IS THE COMPUTER FIELD CHANGING?

The message of this issue has been that the computer field is entering a period of rapid change and high risk. As far as your future information systems are concerned, we are suggesting that you use 1983 mainly for developing strategic plans and for testing ideas via pilot systems.

But just how fast is the computer field changing? Two recent exhibitions and conferences help to answer this question.

COMDEX Fall '82 (Computer Dealers Exhibition) was held from November 29 to December 2 in Las Vegas, Nevada. Two COMDEXs are held in the U.S. each year — in the spring on the east coast and in November in Las Vegas. Also, one is held in Europe each year.

The Fall COMDEX is a major annual event for the announcement of important new products. The recent COMDEX had over 1,000 exhibitors and was attended by some 50,000 people — mainly people from independent sales organizations. They were looking for hardware and software products that they could assemble and package into their products and then sell.

How was this exhibition? In a word, overwhelming.

What was new since last year? Almost everything. A year ago, at COMDEX Fall '81, the IBM Personal Computer had been announced just three months earlier. It was in evidence only occasionally in the exhibits. Most of the micros were of the 8-bit variety. There was much talk about the 16-bit machines and the UNIX operating system, but not much was exhibited.

This year, the 16-bit machines clearly dominated the exhibits, although there were some interesting new uses of 8-bit machines. The Intel 8086/8088 processors are the popular chips for single user personal computers; the IBM Personal Computer uses the 8088, for instance. It, by the way, apparently has become the main offering in the personal computer arena, judging from the exhibits. But there were a large number of competitive IBM/PC add-on, add-in, and plug-compatible products exhibited. CP/M is still the main multi-brand operating system for single user computers, but MS/DOS (favored by IBM) is making rapid progress, as far as available application software is concerned.

In the multi-user systems, the Motorola MC68000 has become the favored processor. Multi-user systems in the 5-user to 8-user range were most in evidence, but there were some 10-user to 16-user systems. In the operating systems exhibited, UNIX is very popular for multi-user service. Multi-user OASIS is available for the 8086/8088 processors and is expected soon for the MC68000; it offers a lot of practical features that UNIX doesn't yet have.

In portable computers, quite a bit of competition has developed for the Osborne 1. One feature that most competitors offer is a larger screen size, a definite handicap of the Osborne 1. The offerings we saw were 8-bit machines.

In the software arena, *lots* of application packages are now available for the micros, mainly running under CP/M, MS/DOS, and AppleDOS operating systems. There are now numerous spreadsheet packages on the market, as readers of the trade press recognize. What is new, though, is the integration of spreadsheet, word processing, graphics, and information management facilities. VisiCorp's new VisiOn (pronounced "Visi On"; VisiCorp sets the "ON" in superscript) is quite impressive. It provides the user with numerous "windows," where each window can be a spreadsheet, a page of text, or graphics. The user can develop a financial plan, say, using the spreadsheet, then create graphics from the spreadsheet, and then embed the graphics in a body of text.

Local computer networks for serving multi-user environments were much in evidence. These are very likely to be a part of most future information systems.

Other approaches to the multi-user situation were also shown. One, already mentioned, is the multi-user micros, both 8-bit and 16-bit. The Integrated Business Computers Cadet system was a good example of a powerful 8-bit system, giving almost mini-computer performance for up to 10 work stations. Another approach is the one followed by Molecular Computer Corp., which uses banks of centralized 8-bit and/or 16-bit processors. Users don't need personal computers with this approach; they just use terminals to access one of the centralized micros.

We could go on and on, about program and application generators for micros, about the high quality of dot matrix printing, etc. but this gives an idea of what is happening in the computer field.

Tele-Communications Association (TCA) Conference is an annual event held in late September in San Diego, California. It deals primarily with telephone technology and is mainly aimed at the tele-communications managers and executives in user organizations. While not the size of COMDEX it had almost 180 exhibitors this past September plus a complement of good technical sessions.

Much of the emphasis was on serving internal data communications needs by way of PABX technology rather than by local computer networks. Other areas included satellite transmission, fiber optics, video conferencing, and encryption.

The PABXs now on the market are mainly first and second generation system, said one speaker, and the PABXs on exhibit confirmed this. The third generation, almost here, will provide simultaneous voice and data transmission over the same wires from the user's desk to the PABX; some systems on the market offer this already. But that is only the beginning. Voice mail, voice recognition, text-to-voice output, protocol and speed conversion services, energy and security management — all of these and more will be offered via PABXs in the not-distant future.

Yes, things are changing rapidly in both the computer field and the tele-communications field. 1983 looks like a very good year for doing your planning.

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EXECUTIVE SUMMARY

All too many computer-using organizations, we suspect, are making important strategic decisions—about their future information systems—by default rather than explicitly after due consideration.

These decisions involve, for instance, (1) the overall structure of the future information systems, (2) the types of communications networks that will be used, (3) where data and other types of information will be stored and how they will be managed, and (4) which employees will be provided with personal computer work stations and which will get 'dumb' terminals tied to mainframes or minis.

One overall structure, described in the report, involves the use of *single user systems*, much like today's personal computer work stations, *multiple user systems* that serve limited, relatively local groups of users via terminals, and *remote utility systems*, like today's centralized mainframes, that provide heavy duty computing, corporate database management, and similar functions. Other aspects of this particular approach involve two types of networks (local and remote), three types of network services (terminal access, file transfer, and computer mail), and two types of corporate standards (operating systems and communication protocols). Further, a 'road map' for getting from today's situation to the new environment is presented.

Another important point to consider in planning for future systems is that some (many?) users may well need several times more CPU cycles and user address space than mainframes will be able to supply economically. And some may need a very high speed information delivery service, in the megabits-per-second range, if minis or mainframes are used. These factors argue for personal computer work stations, at least with today's technology.

Why should users worry about the structure of their future information systems? Why not let the suppliers come up with the solutions? The reason is because of the real possibility of the user organization making serious and costly mistakes. Some typical mistakes that have already occurred are discussed in the report.

One of the risk areas is the sociological considerations for future systems—and most suppliers do not yet seem to be concerned with these. These issues involve how a company's employees—from managers to clericals—will be using the new systems. Here is a chance for companies to make real improvements in 'quality of work life' by adequately considering these issues.