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Technology is Not Enough

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This should be the best of times for computer departments: installed capacity is increasing at better than 30% per year in the U.S. and even more in the largest and most advanced companies.[1] Demand for new applications is rising even faster. Pressures for increased productivity in ours manufacturing, distribution, services, and especially the office together with renewed emphasis on improved quality for American products can only place even greater demands on computing organizations in the future. Indeed, the overall picture reads like a technologist's dream: huge backlogs, increasing demand, increasing price-performance of computers, new technology including that for the office, the plant and probably the home promising even greater potential, and inflation enabling the justification of more and more applications. It sounds almost too good to be true--and it is! In spite of these glowing prospects, many businesses today face problems so serious in their use of our wonderful technology that they threaten to jeopardize not only the bright futures of many of those computer professionals, but also that of the firms which employ them. Matters are at a crisis point in computing for many corporations. Technology, by itself, is not enough. Businesses face a tough set of computer problems today and in the future where the solutions are largely managerial in nature, and most are beyond the scope of the executive charged with managing the computing function. Key to these solutions is the formulation of a comprehensive strategy for the deployment of information resources with the firm, something that can only be done by senior management. Unfortunately, many of these people do not understand the problem.

THE BIGGEST PROBLEMS

Computer users today face a common set of problems and challenges:

<u>The economics of computing have turned around--total costs for an application are now rising</u>. The costs of computing have dropped steadily since business use began some thirty years ago, driven primarily by the dramatic improvements in the performance/price of processors and memory. And continuing improvements in this tech-

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[1] Throughout this paper the terms DP, computer, information resources, and information systems have been used interchangeably. "Information resources" is the more descriptive as it encompasses functions ranging from traditional data processing and information reporting to the technologies of office automation, networking, and process control in manufacturing as well as non-traditional applications such as Decision Support Systems and the Information Center concept. The author wishes to acknowledge the contributions of Professor Warren F. McFarlan of the Harvard Business School, Mr. Phil Grannon of the IBM Company, and Professor Louis T. Rader of the University of Virginia for the development of certain concepts in this paper.

nology on the order of 25% per year can be expected for the rest of this decade, but these changes are nowhere near great enough to offset the rising cost of people necessary to support it all. The total cost of most applications today, including hardware, communications, software maintenance, and operations support has stopped declining and is about to rise even without considering the cost of development. An historic turning point in computing has been reached: the biggest cost element for an application today, or all applications together for that matter, is for people. The cost of the hardware will continue to drop steadily as a percentage of total costs; but the increasing cost of people will raise total costs of an application almost as rapidly as the underlying rate of inflation!

The shortage of applications and systems programmers is the major constraint for computer users today--it will become more severe in the years to come. The enormous demand for computing, even at increasing cost levels, requires growing numbers of new, entry-level employees; for example the Department of Labor has forecast that the employment for new programmers and systems analysts will increase 20% in the U.S. throughout the 1980's (Occupational Outlook Handbook). Other forecasts from the Bureau of Labor Statistics place the estimated jobs for new entry-level computer programmers in 1990 43% higher than that in 1980. In spite of these rosy forecasts, the supply of such people will probably decline over this same time period due to changing demographics in the U.S. Between 1981 and 1988 the number of young people (aged 20) entering the workforce will fall 20% (U.S. Department of Commerce). Along with this decline one can also expect a serious and depressing drop in aptitude for computer programming and systems work, at least insofar as can be measured by standardized tests. For example, math SAT scores of college-bound high school seniors dropped from 493 to 467 from 1968/69 to 1978/79 (College Entrance Examinations Board). Verbal scores dropped even more, from 463 to 427 for the same years. Compounding the problems of the present shortage of people as well as the shortfall to come is the alarming dropout or loss rate of employees from computing. For whatever reason, and there are many theories, the exodus of gifted employees from the ranks of application and systems programmers and systems analysts is very high. The shortage of people, not money or equipment or demand, will be the biggest constraint for computer users in the decade.

The pace of technological change exceeds the ability of many organizations to keep up--many today are falling behind, some are technologically obsolete. That we live in an age of rapid change is without doubt; that computers, communications systems, and office automation technology are some of the fastest changing parts of the business is also unquestioned. However, many managers seem unaware of the costs and dangers of such rapid change. First, this fast pace is a threat to employees. Many computer system personnel and their managers live in fear of the technology passing them by; too many have already fallen behind. To keep up requires a degree of training and education that many organizations are unable or unwilling to provide. Second, not only are individuals falling behind, but entire companies do as well. Businesses and government agencies with obsolete computers, old and outdated applications, and antiquated management practices based on late 1960's and early 1970's environments risk the continued existence of the firm itself in certain industries. As time goes by the best people leave and they fall farther and farther behind to the point where they cannot benefit from technology without taking great risks. Increasingly, one's business cannot incorporate the most modern and efficient manufacturing technology without up-to-date computer systems in place.

Those who let their DP organization fall behind risk losing the entire company as well.

Senior managers do not have confidence in their ability to manage information resources--and they do not have confidence in DP management either. The crisis in computer systems starts at the top. Of all the important functions of a business, information systems is the one area where senior management lacks real experience and understanding. There are several explanations: for many executives, the computer is still a new technology that has been always treated as a specialized function in which their participation was minimal. Even today, an assignment in information systems is not on the career paths of general managers in most firms. Technology has changed so fast that what little managers do learn is quickly obsolete. Finally, few senior managers have come from the computing field. As a consequence, we find senior executives managing information resources either defensively (minimize budgets and risks, go slow, do not innovate, use strict controls) or by remote control (lots of consultants, heavy turnover of senior DP staff, frequent changes of direction), always looking for some piece of magic that will suddenly make all the problems go away. The situation is made worse by the lack of comprehensive measures of performance and results that typify most DP shops.

Backlogs of applications awaiting development are large and growing--trends in development productivity are disappointing. While there is little agreement as to what a three year backlog actually is or what it means, most companies think they have such a situation or worse, and for most it is a big problem. Today some firms claim their backlogs are measured in man-centuries! Businesses are creating and approving new computer projects at a rate faster than their ability to actually develop and install those applications. In many companies the delay in getting projects even begun is indeed measured in years, especially if the applications have to be programmed by conventional methods. If the problems caused by big backlogs and increasing demand were not enough they have been compounded by the dismal record of productivity improvements many companies have realized in programming. Indeed, too often there has been no improvement at all. Today medium-sized computers cost about as much per hour as does a programmer, tomorrow it will be the programmers alone causing the bottlenecks because we shall surely get increased productivity from the technology. If means cannot be found to dramatically improve development productivity, backlogs will grow and grow. This tends to drive users to outside vendors, service bureaus, and software packages, or they respond by pushing for their own systems or for higher priority on their own pet projects--thus, putting great pressure on the DP organization, computer-steering committees, or both. These alternatives to the traditional company developed and operated computer applications are not necessarily ill-advised, but often users turn to them for the wrong reasons. Sometimes users simply give up and blame their failure to meet their business plans on lack of computer support.

Applications and data collections prove inflexible and difficult to change--a large part of the "computer problem" in most organizations stems from the poor products developed in the past. "Every change request gets to be a giant project that takes forever to complete and costs a fortune," is a universal complaint. Some blame it on programming languages, others claim it is because of their database system or even the database concept itself, while others say it is due to the short-sightedness of the original users and designers. Whatever the reasons, there is general dissatisfaction with the adaptability of information systems to changing requirements. Yet it is just this flexibility that is the crucial element of information systems, especially when one considers their high cost, and long development time and economic life--typically ten years or more. "Overall, they're just not doing the job," is a common judgment one hears everywhere.

Many core systems now need replacement--at a time when all resources are needed to whittle away at the backlogs. On top of large and growing backlogs, a great many companies now find many of their most basic core applications sadly out of date and in need of replacement. The replacement projects, reflecting expanded requirements, more advanced technology, and more stringent controls, often are considerably larger than the applications they replace. These replacement projects now loom as big, costly, high risk endeavors which will further delay work on the backlogs of totally new projects, and yet will only marginally improve the results of delivered products as perceived by the users. The U.S. Social Security Administration is a good case in point. Their benefits payment system is quite old, primarily batch, with large tape files and programs mostly written in assembly language. Their rewrite will be five years in the planning, seven in development and conversion, and when completed will then be expected to last late into the 1990's. The effort will require thousands of man years. While few businesses face conversions and rewrites of this magnitude, countless firms will be surprised at the burdens and risks of these big replacement projects.

Instead of establishing administrative procedures and tactical systems to manage information resources, steering committees have been formed to fill the gap--and they are not working well in many companies. Steering committees of one kind or another are widely used to review computer projects, set priorities, allocate scarce resources, propose budgets, and coordinate planning activities. Too often these committees are failures. Membership on such committees is often the most frustrating and time consuming assignment the manager has. Usually these failures result from a committee being used as a substitute for much needed administration practices, managerial systems, an overall structure, and a comprehensive information resources strategy.

The related technologies of telecommunications, office automation, and computer controlled manufacturing technology pose integration challenges almost overwhelming to many firms. While a few businesses have made great strides toward integrating not only their plans for this technology, but major pieces of it as well, the majority of firms still have not sorted out what they should do or how to go about it. It is quite common, even in large businesses, for computing and information systems to be under one head, word processing and other office automation projects under another, voice and message communications under a third, and for there to be no thought given to how, if at all, the various computer controlled equipments and processes of manufacturing or distribution are to be related, even though those machines are all information collecting and processing devices.

DP managers themselves are in trouble. Many DP managers today hold classic "no-win" jobs. They are caught in a squeeze between users who want more and more computer services and senior management concerned with costs and control. Many are trying to fight off outside service bureaus, mini- and micro-computer vendors who are courting their users, and even inside managers wishing to establish their own information systems groups. Unhappy users are the norm; irate users are common. In spite of increased budgets for development and new development tools, backlogs keep growing. There seems to be an invisible backlog at least as large as the visible one. Purchased packages prove difficult to implement to the user's satisfaction. Even with continued improvements in price/performance of processing and memory and bigger budgets for equipment, capacity problems never go away. The squeeze is most apparent in the budget process: user budgets grow and flex with departmental and divisional requirements, but the DP or computer department budget is normally fixed or capped. Information resources becomes the battleground between growth-oriented users and defensive, reactive senior managers. Overriding all of these concerns is the realization on the part of many of the senior DP managers, if not the majority, that they are in dead-end jobs; there is no next, higher job for them in their company. As an example, the person to whom they report, Executive Vice President, Vice President Administration, or Chief Financial Officer almost always holds a position they are not equipped to assume.

THE NEED FOR STRATEGY

Each of these problems is serious in its own right. Taken together they present a challenge so great as to jeopardize not only the computer systems of many firms but increasingly the very existence of the business itself. The 1980's will witness businesses in many industries which go on to succeed over their competitors due largely to their ability to manage the new technology and develop information systems of strategic importance to the company. Competitors will suffer and decline because they lack this ability. Obvious examples of organizations where information resources will become the key strategic factor are American Express, Master Card, and Merrill Lynch, but there are a great many others where the products and services that the firm can design and produce, the quality and cost structures of those products and services, and speed and responsiveness to changing market conditions will depend in large part on the quality, creativity, and flexibility of their information systems.

If there was ever a time for senior executives to be closely involved with information systems this is it, yet too often we find such managers active with matters of secondary importance: approving new projects, allocating scarce budget dollars to competing departments, reviewing the status of development projects, selecting vendors, approving software packages and the like. No doubt these activities are important and need to be decided with care, but they are largely operational or tactical in nature and are not the most important issues for top management attention. These topics are frequently forced onto the agendas of steering committees because senior management has failed to perform its primary task: to establish an overall strategy for information resources. Senior executives should spend their time addressing just four key strategic questions:

- How should information resources be organized and deployed within the firm?
- Where and how are information resources to be controlled?
- What overall architecture should one have for applications and data?
- What overall architecture should one employ for technology?

ORGANIZATION DESIGN

The key strategic planning question for information systems today is: how should we be organized?

- How many data centers should there be and to whom should they report?

- How should the development groups be organized, where should they be located within the business?

- What role should the corporate information department play vis-a-vis the various users?

- Should computing be brought together with office systems and communications and in what type of structure?

- Should planning be an activity separate from development and operations?

- How should the traditional data processing and basic business systems be organized relative to information reporting systems and decision support activites?

None of these questions can be answered until the company sorts out what responsibility for information resources each organizational participant (user department, systems developer, data center, planner) is to assume. Each must have a clear and comprehensive statement of mission and responsibility. Few companies have such a strategy.

Almost all organizations must decentralize increasing amounts of responsibility for information systems than was necessary in the past. Computers and their related technologies have become so pervasive that the simple organizational solutions of the past are no longer practical. No central group can hope to manage all this technology in a large or even medium-sized business. Even companies that have decentralized computing to a divisional or group level now find that they must go even further. End-user facilities, Decision Support Systms, Information Centers, and many of the new non-procedural programming systems all require more decision responsibility be given to users, yet to be successful they all depend upon databases and other centrally-managed technology for their effectiveness.

The key organizational question today for many large companies is that of segmentation: what information resources should be structured centrally, what should be located elsewhere but managed and designed centrally, what should be managed locally, and how and where should the activities be linked? Difficult tradeoffs are required to properly balance the advantages of integration with costs of that integration. The costs are typically those of flexibility, adaptability, and the money and time required to respond to change. For example:

> Electronics Company--This large multinational firm is organized in a traditional decentralized profit center fashion with several dozen divisions. Data collections at corporate include only those needed to support contracting, external financial reporting, and the legal function. Applications related to that information are the responsibility of the corporate information systems group. All other data collections and supporting applications are by division except for the order entry function which spans the divisions and performs the billing and collections. Their segmentation is on three levels: corporate, distributed (linking the divisions for order entry), and divisional.

CONTROL

The second element of computer strategy is that of control: who is to control which aspects of information resources, how is control to be effected, and how is performance to be assessed, and by whom? Key issues include:

- Who approves applications and sets priority? According to what basis or criteria?
- Who selects and approves new technology and on what basis?
- How are budgets set and who determines spending levels and constraints?
- How are outside sourcing decisions (and all "make or buy" decisions) made and by whom?
- Where and how are costs collected and charges rendered?
- What financial control structure is used for the data centers and development groups?
- How is performance measured?
- What is the role of audit?

The primary options or choices are illustrated in Figure I (Allen, 1981). As depicted in the first column, responsibility for applications, budgets, and priorities is typically either vested in the information services department or function; shared between that department and the end users, but coordinated by a steering committee or several committees; or a user responsibility, either departmental or divisonal (but not information services). The key control question is simply: who is responsible for assuring that this company's information systems are effective? The answer tells a lot about a company. Many firms do not have an answer, or responsibilities are overlapping or conflicting.[2]

[2] For additional perspective on the issue of responsibility assignment for information resources, see Buchanan, J. R. and Linowes, R. G., "Understanding Distributed Data Processing," Harvard Business Review, July-August, 1980.

A few examples may help to illustrate these options. A DP manager of a large firm came up to me at a conference recently and said, "I don't know why everyone here is so anxious to have steering committees. I'm the Director of Information Systems in my company and the title means just what it says. I'm responsible for seeing that we have the information systems that we need, just as the Director of Accounting has that responsibility for accounting systems. He doesn't have a steering committee for accounting and I'll be damned if we're gonna have one in my department." This is obviously an example of centralized control. At the other end of the spectrum are those companies where that same manager is called Director of Information Services and operates what amounts to an internal service bureau. Responsibility for identifying potential applications, evaluating and justifying them, and then funding or budgeting these applications is strictly a user responsibility.

With decentralized control, corporate systems are simply the responsibility of some corporate department, the so-called system "owner." In this situation, the corporate information services organization is not resonsible for these key decisions on applications, priorities, and budgeting; they are not application owners. And there are a wide variety of organizations falling somewhere in between (bureaucratic) where a centralized DP function shares responsibility with various users for these key decisions. Such an approach to control is typically effected through the use of steering committees.

As depicted in the second column, the approach to budgeting reflects another important control choice for information services. In many firms the information services budget, once approved, remains fixed for the year, while in others it is variable or flexible depending upon user demand. In the latter situation, informa-

	Decision Responsibility for Applications Budgets, and Priorities	Type of Budget	Financial Structure for Information Resources	Objective of Charge-Out	Use of Outside Services
Centralized	Information Services	Fixed	Cost Center	Cost Awareness	Decision of Information Services
Bureaucratic	Steering Committee		Service Center	Cost Allocation	Approval of Information Services
Decentralized	Divisional or Departmental User	Flexible	Profit Center	Pricing	Local Option

Figure 1. Elements of Control Strategy

tion services management is delegated the authority to increase expenditures if demand increases over what was originally budgeted, and they must also cut back if the reverse is true, although this rarely happens today. For most businesses the key question is how fast capacity will grow. The type of budget employed is really a question of whether budgetary control for DP rests with a corporate information services function or the users.

An example of a company with a flexible DP budget is illustrated below:

> Manufacturing Company--A large industrial products company provides information products and services to both divisions and corporate departments from a central tele-computer center in New York. Each division is a profit center; corporate staff departments are cost centers. Tele-computer charges these users for services provided and has no upper limit on their gross or total DP expenditures. However, they do have a limit or cap on the net or unrecovered portion of their budget for those activities that cannot be charged out. In effect they have a flexible budget. Budgetary control over computing in this company is a function of the budgeting and decision activities of the divisions and corporate staffs.

Closely related to the type of budget is the type of management control or financial control structure used for information services (Column 3). Centralized control is typically achieved by operating information services as a cost center with a fixed budget; in decentralized control structures it is more likely to be an internal profit center with a flexible budget. Charge-out practices are another key control device. As reflected in Column 4, the objective of charge-out under centralized control is to provide cost information to various parties short of actually charging out costs. There is either no charge-out at all for development or operations, or it is of the "memo-record" variety. Bureaucratic control structures typically use cost allocation charge-out mechanisms either by monthly charge-backs of costs incurred or by budgeting machine rates and collecting job accounting statistics for billing. Charge-out in a decentralized control structure is more often a type of transfer pricing accomplished either by adding a margin to costs or in some way reflecting standard costs or market prices. Pricing here is usually monitored or reviewed by some function other than computer services, such as the controller.

Lastly, another key control issue is that of sourcing: in centralized structures the decision to purchase outside or to provide services from within is made by information services or DP, in bureaucratic structures it is frequently a steering committee decision with advice or approval from DP, while in decentralized control forms it is a user's option, frequently within previously established guidelines or standards.

It is essential that these various options be selected consistently. Decentralized control over applications, budgets, and priority-setting is best accomplished when Information Services has budget flexibility, is run more like a profit center than a cost center, and has an advanced pricing-oriented charge-out system. It makes little sense and could lead to very serious problems if an organization were, for example, to delegate applications, budgeting, and priority decisions to users, but attempt to use a fixed budget for information services while trying to structure it as a cost center with a break-even charge-out system. The result would be chaos.

THE ARCHITECTURE OF APPLICATIONS AND DATA

Closely related to the issues of organization and control is the question of overall architecture for applications and data. Although the concept of a Total Information System or Total Database has been long ago dismissed and with good reason because most of those efforts bogged down in detail, the need for a master plan has never been greater. This grand design must answer these questions:

- What will be the major data collections?
- How, if at all, should they be related?
- What types of application systems will feed them and draw on them; how are these to be related?

Data flows and information requirements typically mirror the organizational structure of the firm. Most large American businesses are organized on a decentralized or divisional basis, yet corporate and often group, or strategic business unit staffs, are significant and growing in both size and involvement in both planning and coordination activities.[3] The grand design for applications and data is not merely an extension of the basic corporate structure and way of operating the business day-to-day, it must be a key element of the way in which the business structure is defined and operations proscribed.

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[3]Richard Vancil in Decentralization: Managerial Ambiguity by Design, Dow Jones-Irwin, 1978, documents the apparent ambiguity of increasing decentralization of operational responsibility and increasing centralization of staff activities in large U.S. firms.

The data architecture, for example, must address issues as whether plant data such as inventory, orders, scheduling, shipping, billing, and purchasing should be located at the plant, or grouped together with other plants at the division or group level, or be at corporate, or how much should be where, and how the major elements should be linked, and why it should be done that way. This architecture must specify the core data processing applications, how they should tie together, and how they are to be integrated with the data collections. Other key issues in planning the applications architecture include which functions to automate (or the scope of applications), the use of shared systems and the mix of traditional data processing, information reporting, and decision support applications. Another strategic issue exerting a strong influence on applications and data architecture is the determination of what to attempt inhouse through the use of traditional, custom-tailored programming, what to contract out, what to purchase in package form, and what to implement through information-center or non-traditional programming means.

Too often DP managers mistake their current applications portfolio and databases for the grand design which they attempt to guard jealously. Unfortunately such rigidity is often painful because the requirements for new applications and data change rapidly. Business segments change quickly as markets and products evolve, as organizational units change and as managers come and go. Indeed, many vital aspects of the firm change must faster than do information systems. It takes months to construct a database, or to redo a major core application, or to convert DP operations from one type of technology to another. It takes years to restructure the applications and data architecture of a business.

Two brief cases illustrate what is meant by strategic architectural planning:

The Bank Holding Company--This bank is expanding by acquiring during the 1980's. Each bank has been run as an autonomous profit center. In the past each bank's DP operations were distinct, although they frequently shared application packages when convenient. Such a decentralized approach had been quite satisfactory during the 1970's and was largely the outgrowth of the holding company's acquisition program and method of operation, but that strategy has now changed. In the future, operations of the banks will be consolidated so as to offer common services on a state-wide and probably a regional basis. What was once a customer of one of the member banks will in the future be a customer of the integrated bank company. As a consequence, the new architcture envisions central collections of integrated customer information, probably segmented by type of customer, and integrated applications, bank-wide, linking formerly quite separate applications such as the deposit accounting, consumer loans, and cash management services.

An Energy Company--The situation at one of the large energy companies is considerably different. In the past all major applications were planned to support company-wide needs, and all data collections were centrally managed and tightly integrated to avoid redundancies and to insure commonality and accuracy. But the business structure is changing and the firm, now organized into operating companies, finds their various business activities and information requirements increasingly diverse. As a consequence they have changed their architecture to one based upon operating company and divisional data collections for operational information leaving corporate systems and databases only to support staff and corporate office needs. In time, even such core systems as general accounting and payroll will be broken up along divisional lines.

As these examples illustrate, the applications and data architecture of a firm is the primary determiner of the firm's future information services and products. In the words of Tregoe and Zimmerman, it is "the driving force" for information systems planning (1980).

THE ARCHITECTURE FOR TECHNOLOGY

In the past most firms provided data processing services from a central site, primarily for reasons of economy of scale (for both computing technology and staff) and to maintain control. If the firm was quite large, or operations geographically dispersed, or the firm operationally decentralized, one often found multiple data centers again with large host machines centrally managed within a designated segment of the business. Technology planning was basically a process of determining the number of central sites, their size and how, if at all, they were to be linked together, usually through some collection of dial-up and leased telephone lines. Today we still face these same issues, but the technological options are so much richer and the scope of architectural planning so much broader that firms today face the same requirement for an overall architecture or grand design within which technology planning can occur, the integration of computing, communications, office automation technology, and process control, as they do for applications. Key issues today include:

- The general mixture of large host computers, minis and micro computers best for the firm. Everyone requires some mixture of this technology, the question is what mix is best?

- The geographical siting of the technology.

- The technological plan for office systems. Again there is a question of mix: how much office system should be done on computers, how much on traditional office machines, and how much on the new technology just emerging from the laboratories.

- The technological plan for manufacturing, distribution, and services with respect to computer controlled processes. The role of Computer-Aided Design and Manufacturing Technology.

- How and where processing devices should be linked, how many networks there will be, and the mix of company and public carrier networking facilities to be used.

- Which software concepts to employ for operating systems, communications, databases, and programming.

This type of architecture requires a level of planning without resort to the details and specifications of specific equipments, operating systems, or communication protocols. For example:

A University has decided to continue to operate three primary data centers (research and academic computing, administration, and hospital/medical center) each with its own separate network, with a fourth and also separate network for voice and electronic mail, based on Rolm technology, and finally a mixture of stand alone word processors, micros, and minis for certain designated types of applications. This strategy was conceived and approved without specifying vendors, machines, operating systems, or database packages; indeed, they really do not know what the specifics will be, but there is considerable confidence in the architecture itself.

A U.S. Government Agency is about to choose one of three options for a technological strategy: a single large multiprocessor host configuration with nation-wide communications network, several regional host machines with regional networks and a central switching center, and the third option based on dozens of localized minis and a hostless interlinking network, probably employing satellite-based data transmission.

DETERMINANTS OF STRATEGY

As depicted in Figure 2, the determinants of strategy for the information resources function include not only the business strategy, goals and objectives, and basic organizational structure of the firm, but also the environment external to the firm, the technological environment, and certain key constraints. The determinants are different for each organization. Examples of factors in the technical environment that could be key to strategy and especially the architectural issues include satellite data transmission capability, the home computer/terminal, the growth of the software industry and the availability of software packages, mass storage technology including optical stores, mini and micro processor developments, networking systems, and advanced programming languages, to mention just a few. External environmental factors important to the development of strategy could be the changing business environment of the firm such as the predicted restructuring of the U.S. banking environment, deregulation of the airlines, or possibly the trucking industry and legislation governing transnational data flows and privacy. Internal environmental considerations might include the existing portfolio of applications and data structures, and the expertise and experience of users and user managers. Constraints could include financial considerations, personnel limitations, and availabilities, and corporate policies governing personnel management.

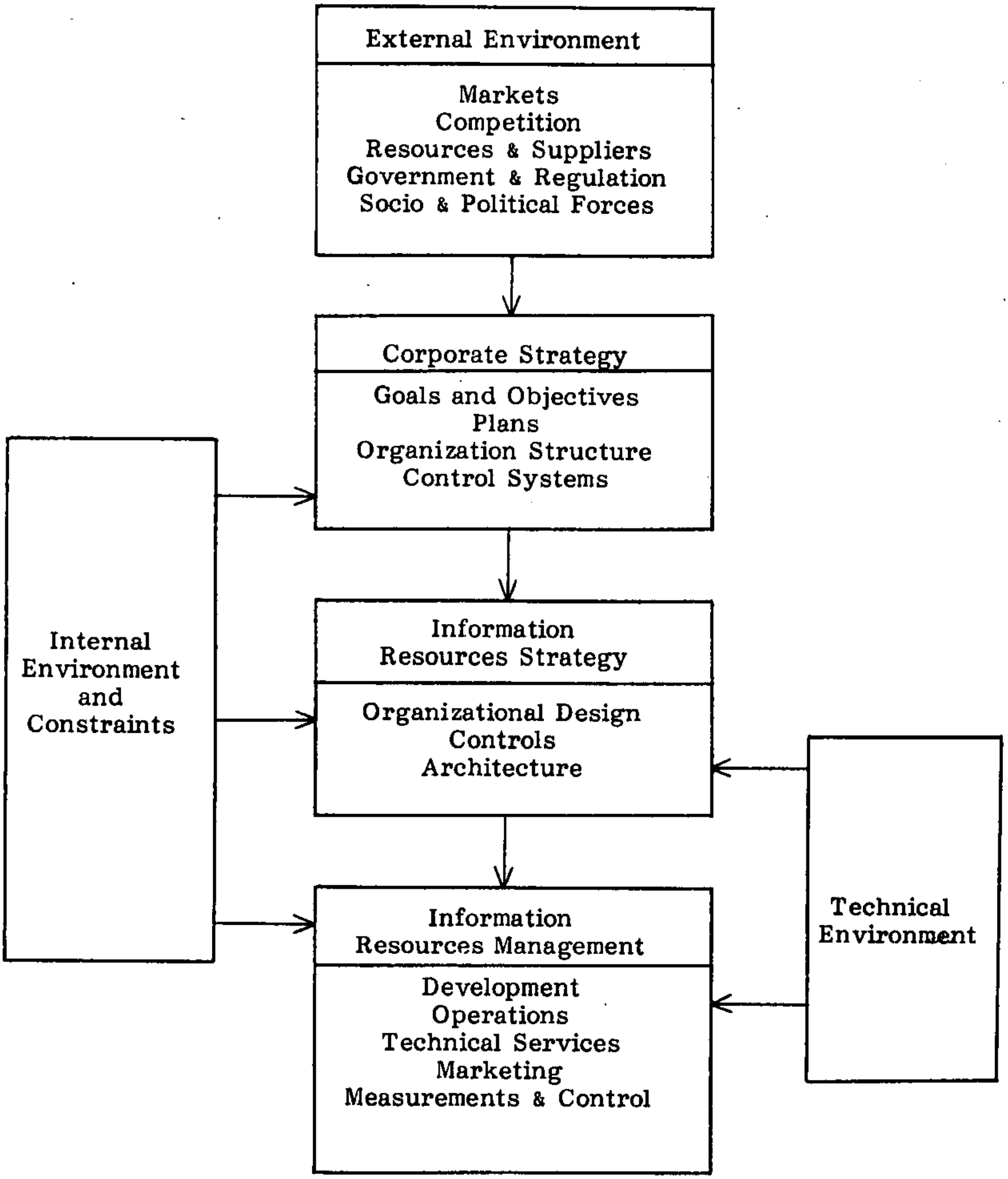

Figure 2. Determinents of Information Resources Strategy

SUMMARY

Computers and their related technology do indeed promise almost unlimited potential to businesses today, but only to those who learn to manage them. Information systems are in trouble because of inadequate management practices, attention, and direction. Many organizations lack a strategy for information resources that properly reflects their future business and technological environment. They will soon discover that computer problems have a way of quickly becoming tomorrow's business problems.

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