

THE UTILIZATION AND MANAGEMENT OF
INFORMATION PROCESSING TECHNOLOGY
IN CALIFORNIA STATE GOVERNMENT

APRIL 1983

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PREFACE

The Conference Committee on the 1982 Budget Bill added language to Section 4.00 requiring the Legislative Analyst and the California Information Technology Advisory Board to perform independent reviews of electronic data processing (EDP) control and uses in California state government, and to submit separate reports to the Legislature in January 1983. A copy of the specific language adopted by the Legislature is included in this report as Appendix A.

The chaptered version of the 1982 Budget Act inadvertently omitted the language added by the conference committee. This omission was brought to the attention of the Joint Legislative Budget Committee in a letter dated July 8, 1982, and co-signed by the Legislative Analyst and the Director of Finance. This letter also expressed the intent of both the Legislative Analyst and the board to comply with the conference committee's directive.

The language added by the conference committee declares that a review of data processing is warranted by the numerous problems that the state has encountered in controlling and using EDP technology. It cites the Statewide Public Assistance Network (SPAN) project launched by the Department of Social Services as an example of these problems. Clearly, the SPAN project, which was replete with examples of inadequate control measures, incomplete system design and confusion regarding the role of data centers, provided ample reason for the Legislature to ask whether there is

something fundamentally wrong in the manner in which the state manages its utilization of EDP technology.

This is not to say, however, that effective uses of EDP technology by state agencies cannot be found. In fact, there are more examples of efficient EDP applications than of those, such as SPAN, which have experienced major problems. Consequently, in responding to the Legislature's directive, it is our intent to place the SPAN project within the context of the state's total involvement in the use and control of EDP technology. We also intend to make recommendations which should have both an immediate and long-range beneficial effect with respect to the use of this technology, and at the same time reduce the likelihood of another "SPAN".

A discussion of SPAN is included in Chapter III of this report.

REPORT OBJECTIVES

The goals of this report are to (1) identify the major problems inhibiting the cost-effective application of electronic data processing technology in California State Government, and (2) recommend measures to eliminate or minimize these problems.

The language adopted by the conference committee specifies that we review the following eight options and issues:

- (1) Further consolidation of data processing service centers.
- (2) Establishment of a central data processing system development capability to be employed in the design and development of large systems whenever it is decided that a system is to be designed and developed by state personnel.

(3) Consolidation of data communications systems and management.

(4) Establishment of a central data processing organization encompassing (a) computer support, (b) large system development support, (c) data communications, (d) equipment, supplies and services procurement, and (e) any other function which may be suitable for centralization.

(5) Recruitment and retention of an adequate number of qualified managerial and technical staff.

(6) Methods of resolving problems created by the migration of skilled managerial and technical staff from one system development project to another.

(7) Difficulties experienced by agencies in their initial efforts to implement electronic data processing systems.

(8) The adequacy, role and placement of the State Office of Information Technology.

Our report addresses each of these issues, as well as the following issues which were not specified in the budget language: (1) office automation, (2) computing in higher education, (3) microcomputers, (4) legislative oversight, (5) security of information management systems, and (6) the management of information processing technology on a statewide basis.

Appendix B presents background information on the control and use of EDP technology. It includes a review of (1) past studies of EDP usage by the state, (2) the development of consolidated data centers, (3) the evolution of electronic data processing technology, and (4) the various organizational approaches which have been used to manage and control this technology.

METHODOLOGY

Information used to develop this report was obtained from a variety of sources. First, we participated with the California Information Technology Advisory Board in the development and distribution of an extensive survey questionnaire which was sent to each entity of state government in September 1982. The survey is referred to throughout this report as the "September EDP Survey." This survey is, to our knowledge, the only comprehensive survey ever conducted to gather information relative to the state's use of information processing technology. Topics covered in the survey include the amount of funds expended for electronic data processing, the development of systems, data processing personnel, other services, telecommunications, planning, and consolidation of computer resources. The information obtained from the 112 completed surveys was useful in the preparation of this document, and it should also be valuable as a basis for further study directed toward improving the state's utilization of information processing technology.

Other sources of information which we relied on in preparing this report include technical books, periodicals, trade publications, previous reports and studies, interviews with key EDP personnel and the accumulated experience of the Legislative Analyst's office in monitoring the use of computing technology by the executive branch over the past 15 years.

This report was prepared by Robert Del Agostino with the assistance of Jay Schenirer (who prepared that portion of the report which addresses telecommunications), under the supervision of William Behnk.

SUMMARY OF FINDINGS

The use of computers in California state government is becoming increasingly pervasive. In many instances, the use of these devices is essential to the successful delivery of various program services. In 1982-83, total state expenditures for the support of computing equipment, facilities and personnel is expected to reach approximately \$325 million.

The term electronic data processing, once synonymous with the use of computer systems, has been replaced by the term information management. This term encompasses a host of computing devices, ranging from the relatively inexpensive desktop computer to the most powerful general purpose computer available on the commercial market. As computer technology has evolved over the past several years, so has the state's ability to use the technology in a cost-effective manner.

The advent of "office automation" and "personal" computers, and a trend toward more decentralized computing resources, offer the state the promise of significant additional improvements in information management and a more effective use of personnel resources. These trends also present the state with a significant challenge in terms of managing these new resources effectively.

At the present time, this challenge is not being met. The state's current policies remain oriented toward large, central computing facilities which, in some cases, are unable to provide the capability inherent in many

COMPUTING IN HIGHER EDUCATION

16. We recommend that the Legislature direct the California State University to:

- Review the role of the Division of Information Systems, with the aim of placing more emphasis on systemwide coordination and policy development. (Page 114)
- Reevaluate the continued development and installation of systemwide administrative systems in order to determine the extent to which these systems are likely to meet individual campus requirements in a cost-effective manner. (Page 117)
- Provide the Legislature with an analysis of alternative methods for allocating computer resources. (Page 118).
- Identify methods for improving the sharing of computer applications among the campuses. (Page 119)

OFFICE AUTOMATION AND OTHER ISSUES

17. We recommend that the Department of Finance report to the Legislature on its progress toward implementing an office automation policy as required by the Budget Act of 1982. (Page 126)

18. We recommend that the Legislature direct the new state authority to:

- Adopt a policy prohibiting the awarding of any contract for office automation equipment which would limit the state's ability to take advantage of more cost-effective systems. (Page 127)
- Assess the health, safety and ergonomic aspects of office automation in state government and develop appropriate policies,

- standards and guidelines to protect employees and enable the maximum productive use of office automation systems. (Page 129)
- Evaluate the effectiveness of the federal Paperwork Reduction Act of 1980 to determine whether a similar measure should be enacted in California. (Page 130)
 - Establish a central information service to provide: (a) information pertaining to automated information systems maintained by the state, and (b) examples of documentation required of departments in the development of information systems. (Page 132)
19. We recommend that the Department of Finance inform the Legislature as to the status of its efforts to develop a statewide policy and standards regarding the acquisition and use of microcomputers. (Page 134)
20. We recommend that the Legislature reassess the need for the joint legislative/executive branch California Information Systems Implementation Committee and reestablish the committee as a legislative oversight committee if it is determined that such a committee is still warranted. (Page 135)
21. We recommend that the Legislature direct the new state authority to: (a) review and modify, as necessary, policies and requirements contained in the State Administrative Manual regarding the physical and electronic security of state information systems, (b) determine the extent to which state agencies comply with these policies and requirements, and (c) develop a plan to bring high-risk state agencies into compliance. (Page 139)

Note: Many of these recommendations refer to a new state authority which we believe should be established to assume the responsibilities currently assigned to the State Office of Information Technology in the Department of Finance. If, however, the Legislature chooses not to create a new authority, the State Office of Information Technology would be the logical agency to be assigned the responsibilities contemplated by our recommendations.

CHAPTER I

INFORMATION TECHNOLOGY: TRENDS AND IMPLICATIONS

EVOLUTION OF THE TECHNOLOGY

The state began processing data using automated equipment in 1928, following the installation of punched-card machines in the California State Insurance Compensation Fund. The state's first electronic computer was installed in the Department of Employment in 1956.

Subsequently, the use of computing equipment increased relatively rapidly to the point where, in 1967, there were 54 computers operating within the executive branch, excluding the state colleges and the University of California. This growth in independent, department-managed computing facilities came to a halt with the advent of large-scale computers. These computers made possible the establishment of more cost-effective consolidated data centers in 1972.

Since 1972, the computing industry has continued to increase the power of large computers. In addition, it has introduced and perfected small and relatively powerful minicomputers and, more recently, desktop microcomputers. These products have again changed the way in which computing technology is used, resulting in a mix of decentralized, or "distributed," computing operations and central data centers.

IMPROVEMENTS IN EDP TECHNOLOGY HAVE BEEN REMARKABLE

A recent article in Scientific American highlights the improvements in EDP technology since the state's first electronic computer was

installed. According to this article, "If the aircraft industry had evolved as spectacularly as the computer industry over the past 25 years, a Boeing 767 would cost \$500 today, and it would circle the globe in 20 minutes on five gallons of fuel."

Only 36 years ago, the world's first large-scale computer--the ENIAC (Electronic Numerical Integrator and Calculator)--was built. The ENIAC weighed 30 tons, required 1,500 square feet of space and used over 18 thousand vacuum tubes. Today, it is possible to buy from a retail outlet a desktop computer capable of solving ordinary arithmetic problems 18 times faster than ENIAC, for a price below \$400. Further, because there is an annual price-performance improvement in equipment of about 25 percent to 30 percent, relatively powerful desktop computers will be available in the near future for less than \$100.

In the State of California's data centers today, there are computers which operate at speeds measured in billionths of seconds, and which are capable of performing in excess of 10 million operations each second. These computers run hundreds of programs simultaneously for users scattered throughout the state. Yet, these computers are, in a sense, technologically obsolete the moment they are installed, so fast is the pace of development.

According to experts, the next 10 years will produce staggering changes in EDP technology, such as video disks capable of storing up to 22 billion bits of information. The Japanese reportedly are working on a combination laser/magnetic bubble technology with a theoretical ability to

store on 11 disks everything ever written. In this country, the federal government is considering the use of "smart" cards, similar to plastic credit cards, as a means of achieving significant reductions in fraud and errors associated with the issuance of food stamps and certain other welfare programs. Under this concept, recipients would be issued a plastic card containing a memory chip capable of storing information pertaining to the cardholder and also a record of transactions as the card is used. The card is technologically feasible; the only question is whether there would be sufficient savings in the areas of paperwork reduction and reduced losses from fraud and error to offset the costs of developing the cards and the systems necessary to support their use.

From digital watches to video games to unseen microprocessors controlling automobile carburetors, the products of microelectronics are indeed pervasive. The trend is clear, and has been for some time: more computing power in less physical space at less cost.

EFFECTS OF THIS TREND

Since the early 1970s, there has been a steady increase in the acquisition of smaller computers by state governments. According to the National Association for State Information Systems, minicomputers accounted for 9 percent of the 50 states' computer inventories in 1974. By 1981, their share of the total had increased to 26 percent. Information developed from the September EDP Survey revealed that small computers in California State government--that is, those costing less than \$5,000--accounted for about 38 percent of the total state inventory. This

percentage is still increasing, and will continue to increase as a result of office automation, which is now in the early stages of development throughout California State government.

The impact of the trend toward smaller, more powerful and less costly computers would not be as great were it not for the development of "user-friendly" software. Such software makes it relatively easy for a nontechnical person to use a computer effectively, with little or no training. The concept of user-friendly software is not new--it has been touted for years. It was only recently, however, that such software actually became available. Further, this software is also available on a variety of small computers.

The mix of large computer centers that can be accessed by remote terminals and small computers with user-friendly software has created a situation where, for the first time in 27 years of computing in California State government, we are entering an era in which users will be able to manage many of their own information requirements. The ability to link these small computers to larger systems will bring to a worker's desk an amazing amount of computer power.

IMPLICATIONS

Obviously, this trend poses a number of implications for state government. What will be the role of the large data center as computing power becomes decentralized? How best can the proliferation of small computing systems be managed? Does the state have an adequate planning mechanism to ensure that technological trends are exploited in the most

cost-effective manner, and not just accepted as a matter-of-course? Given the rapid change in technology, should lease/purchase criteria be revised? Will these systems provide a means for state government to meet program service requirements in an era of fiscal constraints?



CHAPTER II
INFORMATION PROCESSING ACTIVITIES

Currently, the state maintains two large general purpose data processing service centers: the Stephen P. Teale Data Center and the Health and Welfare Agency Data Center. Together, these two facilities provide a variety of computer-related services to 120 state agencies. Each of these centers is a consolidated computing facility which replaced independent computing systems operated by numerous departments. The authorized expenditure levels for these centers in 1982-83 are as follows: (1) Teale--\$35 million, and (2) Health and Welfare--\$22 million.

In addition to these service centers, separate and relatively large computing centers are maintained by the Franchise Tax Board, the Department of Water Resources, the Board of Equalization, the Department of Justice and the Department of Motor Vehicles. There are also smaller but relatively powerful computer installations in a number of other departments, including the Public Utilities Commission, the California Highway Patrol and the Department of Rehabilitation.

TREND TOWARD CONSOLIDATION

In the late 1960s and early 1970s, both government and the private sector were faced with the issue of whether to consolidate computing. In 1972, the Department of Finance developed a plan for resolving this issue in state government. The department's plan called for consolidation of EDP capacity in a limited number of "data centers."

At the time the department proposed its plan, computing equipment was expensive, and cost was the primary concern in setting policy toward data processing in state government. Moreover, there was a decided absence of both statewide planning for, and standards governing the use of, EDP. As a result, 25 separate computing systems had developed within state government, and the number of independent systems was increasing rapidly. There was little if any sharing of automated information, and very few common or integrated systems had been developed.

The administration maintained that the consolidation of computing resources would provide an immediate savings to the state by reducing the number of expensive computer systems. It also maintained that the development of common systems and increased information sharing would result in other benefits as well. Centralization of the planning and control responsibility within the Department of Finance was viewed as a means to ensure that the equipment consolidation plans would be effective.

The Department of Finance plan, while significant in terms of its impact on the state's use of computers, was not as comprehensive as some advocates of consolidation had proposed. For example, a May 1969 report prepared for the Joint Committee on Legislative Organization recommended a more comprehensive consolidation that would bring together research, planning, training, systems analysis, computer programming and computer operations.

Finance's plan, though narrower in scope than the one recommended in the 1969 report, did accomplish the department's primary goal--the

establishment of consolidated data centers and a reduction in the number of computer systems in state government. However, by not providing for the centralization of systems or applications development, the plan allowed departments to maintain separate systems analysis and programming staffs. Departments which could not attract the necessary staff were able to obtain such services through either the private sector or other state agencies, primarily the Department of General Services. Similarly, data preparation remained under individual department control, with services provided in-house or acquired from the Department of General Services, other departments or the private sector. Planning with respect to data communications was, to a degree, placed under the control of the Department of General Services' Communications Division.

Under the Department of Finance's plan, planning and control over EDP expenditures, together with the responsibility for developing statewide EDP standards were, however, consolidated in the department. Upon receiving these responsibilities, the department became very active in the development of control and standards policy, and it prepared some planning guidelines. It was not able, however, to develop a comprehensive statewide master plan for the use of EDP, as required by the Government Code. This planning requirement subsequently was eliminated from the code by Chapter 643/80.

Advantages of Consolidation

A major objective of equipment consolidation was to reduce the number of costly, independent computing systems, and establish large, consolidated computer facilities which could achieve economies of scale. A secondary benefit anticipated from consolidation was that small users, which ordinarily would not have access to sophisticated equipment, would be given an opportunity to take advantage of large-scale computing capabilities. Other advantages anticipated from consolidation included the opportunities for increased application of standards and uniform processes, development and use of common systems, improved control over EDP expenditures, more cost-effective computing, and the conservation of scarce resources (for example, technical personnel).

Disadvantages of Consolidation.

Consolidation also brought with it some disadvantages, such as the potential for (1) lack of effective control by individual departments over the computer resource on which they depend to meet program requirements, (2) inadequate service, (3) insufficient responsiveness on the part of data centers to the needs of users, (4) increased costs on the part of consolidated data centers, (5) delays in the implementation of departmental systems, and (6) a lack of accountability for program performance.

How Much Consolidation is "Enough"?

At one time or other, the state has experienced each of these advantages and disadvantages. Consolidation has reduced the amount of funds expended for computing systems, but in some instances it has resulted

in inadequate service to users. It is possible that service deficiencies have negated some of the cost savings from consolidation. This may have occurred, for example, when inadequate service provided by central facilities impaired the development of a system or increased the nonproductive time of computer terminal operators. Conversely, a departmental system may be unsatisfactory even when it offers the fastest response time, if the department cannot manage the resource effectively. Obviously, weighing only the potential advantages and disadvantages of EDP consolidation will not necessarily point the way toward the most cost-effective method of organizing and managing computing resources. This is because a number of other factors will determine the effectiveness of a given method. These factors include the soundness of policies, standards and organization, and staff and management expertise.

There is no universally accepted solution to the issue of centralized versus decentralized EDP operations. Private corporations, including those listed in the "Fortune 500," manage information processing technology in a multitude of ways. While most do so on a decentralized basis, others are managed centrally, while still others employ a mix of methods. Other states also use a variety of methods to manage EDP resources. If there is one widely accepted truth, it is that there is no one answer to the question: what degree of consolidation is appropriate?

There are those who believe that centralization versus decentralization no longer is the primary issue in information management, and that the more important question is: how can organizations structure

their systems and programs to meet, simultaneously, the needs of top management and operating units alike? These individuals argue that who manages the new technology is not as important as how the technology is applied. This view, however, is not universally held. For example, a recent Brookings Institution publication stated that ". . . the question of centralization or distribution of computer resources represents a policy issue of the highest importance."

In view of the conflicting expert opinions on the appropriate level of consolidation, we do not have any basis for recommending in this report whether there should be more or fewer data centers in California state government. We do, however, make recommendations which, if implemented, would ensure that state government is in a better position to assess alternatives that would provide for greater or lesser consolidation.

DECENTRALIZATION IS OCCURRING WITHOUT ADEQUATE PLANNING

As noted earlier, there were many separate computing installations in the executive branch prior to the consolidation of computing facilities in 1972. While some of these installations were eliminated through consolidation, the establishment of the two consolidated data centers did not bring a halt to the growing number of computers located in the line departments. In fact, there are now some 900 computers in the executive branch (excluding those owned by the two data centers), and the number continues to grow. Officially, however, the state still is committed to centralization. As a result, the proliferation of computing resources is occurring without the benefit of statewide planning or even a statement of policy that can guide the departments.

The absence of statewide standards and guidelines has proven to be costly in a number of cases. For example, desktop computers have been acquired by some departments without regard to the compatibility of the equipment with other departmental or data center systems. When department staff subsequently identify a need to have a communications link with a central computer, they learn that their desktop computer is incompatible with the central computer, and additional costs must be incurred to establish the link.

The problem of compatibility has been addressed by individual state departments, but it has not been addressed on a statewide basis. Recognizing this, the Legislature required that standards and guidelines be placed in the State Administrative Manual governing the acquisition and use of office automation equipment, mini- and microcomputers. The Departments of Finance and General Services are in the process of developing a policy to ensure greater compatibility of equipment. Meanwhile, equipment continues to be acquired in the absence of appropriate state standards and guidelines.

The development of policies governing acquisition and usage will not, by itself, assure that decentralization proceeds on a rational basis. Standards and guidelines can ensure only that acquisitions and usage occur within some sort of framework. The mere existence of such a framework, however, will not encourage acquisition of equipment where it is warranted, and may not discourage it where it is not warranted. That requires planning, as well as guidelines. At the present time, no plan for

decentralization of computing capability exists, nor is there any requirement that such planning be undertaken.

In at least two instances, efforts by departments to establish an independent computing capability have failed, at significant cost to the state. As discussed elsewhere in this report, the Department of Social Services wasted approximately \$700,000 in acquiring a computer for the ill-fated SPAN project. In addition, the Department of Consumer Affairs cost the state approximately \$200,000 in 1981 when it decided to abandon a computer system it had acquired and instead purchase services from the Franchise Tax Board computing center. Had there been guidelines in place capable of helping these departments understand and evaluate fully the ramifications of decentralization, we believe the outcomes would have been different.

The Department of Consumer Affairs' unfortunate experience was due primarily to the fact that the department simply was not prepared to operate an independent computer facility. This was not detected at an early stage in the acquisition process because there are no established criteria or procedures for evaluating a department's capability in this regard. If an evaluation process had been in place, this failure might have been avoided.

Although decentralization is likely to continue, large centralized facilities are not going to disappear, at least in the near term. Consequently, a plan is needed which addresses the appropriate blend of centralized and decentralized information processing capabilities.

Accordingly, we recommend that the Legislature direct the executive branch to develop plans and policies governing the decentralization of computing resources.

ROLE OF CONSOLIDATED DATA CENTERS IN THE FUTURE

In the Analysis of the 1977-78 Budget Bill, we recommended that the Department of Finance ". . . assume leadership responsibility for the development of consolidated data center plans which will recognize a practical limit on the size and scope of each consolidated data center." The department argued against developing these plans. It advised the committees that it preferred to make these determinations at the time when a data center requested a significant increase in computing capacity.

Since then, several significant increases in computing capacity have occurred. The Teale Data Center, for example, has grown from two computers and 34 customer departments to eight computers, located in two separate computing facilities, and 105 customers. Furthermore, the Health and Welfare Agency Data Center will, in 1983, relocate to a substantially larger facility in order to house its two computers and provide direct on-line service to more than 1,000 terminal locations.

At the same time that these and other large centers continue to increase in size and capacity, some experts are questioning the role of large computing facilities in the future. According to a recent Brookings Institution publication, ". . . some experts feel that the days of the large-scale computer are numbered . . .". We foresee a continuing role for large computers, at least for the next decade. Such computers will have to

be retained for certain tasks because the alternatives are not cost-effective. For example, the smaller departmental computers simply do not have the capacity to replicate the capabilities of large data centers. Nor is it always cost-effective to "load" departmental computer systems with the extensive array of software products that have already been acquired for the central facilities. In addition, information systems based on very large data bases cannot be transferred to a departmental computer system, unless the system itself has substantial capacity, in which case some of the perceived advantages of a decentralization would be forfeited.

In addition to operational considerations, a very important factor in assessing the future for large centralized facilities is the effect on the data center's economic base of shifting workload from the central data center to a customer department's computer. If a major customer department decides to drop out of the Teale Data Center and install an in-house computer, the impact of withdrawal on the data center's remaining customers could be substantial. For example, if the amount of work performed by the data center for one customer represented 20 percent of the center's budget, and that customer withdrew its workload, the cost to all remaining customers would increase because the Teale Data Center must recover its costs through its billings. Often, a decrease in customer usage does not permit a proportionate reduction in overall data center operating costs.

We cannot say how long the state's central computing facilities will be cost-effective, or what they will look like five or ten years from now.

It is apparent, however, that new concepts such as decentralized facilities, office automation and the continued decrease in the cost of computing equipment suggest the need to consider how big the central facilities should be allowed to become. In fact, some state managers already believe that the Teale Data Center is too large in terms of its ability to provide responsive and cost-effective services.

In summary, we believe that current trends in information management argue for a planning process which will better define the role of the state's large computing facilities. Accordingly, we recommend that the Legislature direct the executive branch to include in the statewide planning process an evaluation of the optimum size and scope of large data centers.

"CATCH 22" SHOULD BE AVOIDED

There has been a number of instances over the years where a department requesting an independent computing capability has been turned down by the Department of Finance on the basis that it would be less costly to the state if the work were performed at a central facility, even though this would be more costly to the department. Typically, the rationale for the Department of Finance's action has been the availability of surplus computing capacity at a central facility. Because the state was already paying for this surplus capacity, requiring a department to use it in lieu of establishing an in-house computing capability did not appear to result in any net increase in state costs.

This rationale, however, is flawed. During their years of operation, the state's central computing facilities have experienced numerous capacity increases. The Teale Data Center, for example, has undergone at least ten major system upgrades since 1973. Each of these upgrades has been justified on the basis that the data center's capacity had been or was about to be exceeded. Thus, the extensive cost of these upgrades was made necessary by the fact that the data center was simply out of surplus computing capacity. Consequently, these costs can be attributed in part to the decisions made by the Department of Finance that required departments wishing to establish their own capacity to, instead, use the services of a central facility. These decisions generally were based on an analysis that failed to take into account future central facility upgrades.

Once a major upgrade at a central facility occurs, the process begins anew. Surplus computing capacity once again is generated, leading Finance to steer business toward the facility so as to utilize this "already paid for" capacity. In this regard, the Department of Finance's policy has a built-in bias toward larger central facilities, and is likely to result in higher state costs, even though the objective of the policy is to avoid higher costs--a true "catch 22".

Further, central site upgrades increase not only equipment costs; they also increase the number of support personnel needed and make necessary structural modifications to accommodate the additional computing facilities. There are, therefore, "hidden" costs in decisions to have customers use "surplus" capacity. These costs should be considered

explicitly in evaluating departmental requests for internal computing systems.

In summary, a more comprehensive approach to the evaluation of independent computing requests should be developed as part of the overall evaluation of the size and scope of central computing facilities.

Accordingly, we recommend that the Legislature direct the executive branch to assure that any policy governing the establishment of independent computing capability avoid automatically favoring the expansion of the central EDP facilities.

MAJOR UPGRADES SHOULD BE DEFERRED WHERE POSSIBLE

As noted above, both the Teale Data Center and the Health and Welfare Agency Data Center have experienced numerous major capacity upgrades since they were created. Several of these upgrades have caused temporary interruptions in service to customers, some of which have been of a serious nature. These interruptions result from a variety of factors, including computer program "bugs", faulty equipment components and the physical relocation of equipment or cabling (computer centers literally sit on top of miles of power and communications cabling). Consequently, there is a "cost" associated with significant upgrades of data center capacity that must be considered in determining whether to proceed with a proposed upgrade.

One means of avoiding or deferring a major capacity upgrade would be to place additional workload on a facility which has sufficient surplus capacity. Often, however, this is not feasible within state government,

primarily because the state's two largest data centers--the Teale Center and the Health and Welfare Data Center--are not fully compatible, even though they both operate IBM-oriented systems. This lack of compatibility discourages the temporary use of capacity available at the other facility because of the conversion costs associated with moving the workload back to the original facility.

When surplus state capacity is not available, we believe consideration should be given to the temporary use of computer capacity in the private sector. A careful evaluation of all the costs associated with state upgrades, including the "Catch 22" aspect discussed above, may result in a determination that on a temporary basis, it is more cost-effective to use capacity available in the private sector than to upgrade capacity in state government.

Accordingly, we recommend that the Legislature direct the executive branch to assure that planning for state data centers consider the temporary use of commercial computing capacity when such use would be cost-effective and defer the need for a major system upgrade at a state data center.

COMPATIBILITY OF COMPUTER SYSTEMS

The "heart" of any computer system is its software operating system, a collection of computer programs provided by the manufacturer which are necessary to operate the computer. Operating systems for the large computers which form the nucleus of the data centers are unique to a vendor's hardware "architecture". That is, IBM-compatible computers have

operating systems that are different from those used by Honeywell, Sperry Univac, Control Data and others. Operating systems can also vary within the line of computers offered by a single manufacturer.

The uniqueness of operating systems requires that computer programs written for data center customers--for example, an accounting system--be converted before the programs can be processed by a computer with a different operating system. As a result, it often is not economically feasible to replace a computer system of one type of hardware architecture with one of a different type, even when the competitor's equipment is less expensive to lease or purchase. Similarly, operating system differences within one manufacturer's product line can inhibit the transferability of customer programs from one facility to another when the facilities maintain identical computing equipment but different versions of the operating system.

As a consequence, the state's ability to achieve workload leveling among its data centers is restricted to computers of similar manufacture which have common operating systems. Even where a common operating system exists, additional factors, such as the identification scheme employed by each data center to label automated files, can inhibit the efficient transferring of workload.

Currently, the state does not have guidelines or policies for ensuring that its computing facilities can be used efficiently for workload leveling purposes. This should be corrected. We recommend that, as a first step, policies and guidelines be developed which will ensure that computing systems of similar architecture are made more compatible.

Improved compatibility could also permit data centers to share operating system support staff. Currently, each data center maintains its own software support staff. The Teale Center has an authorized staff of 49, while the Health and Welfare Agency Data Center has 22 authorized positions--just for system software support. Operating systems, because of their critical nature and complexity, require highly skilled staff. At present, however, such individuals are in relatively short supply. This problem will become even more critical as additional private sector computing centers are established in the Sacramento area, because these new facilities will have a competitive salary edge in terms of offering positions to state data center system support personnel. The use of common operating systems would enable scarce personnel resources to be better utilized.

Accordingly, we recommend that the Legislature direct the executive branch to develop policies and guidelines which will facilitate the state's sharing of computer systems of like manufacture.

DATA CENTER SHOULD MODIFY RATE STRUCTURE

By law, the state's primary computing centers--the Teale Data Center and the Health and Welfare Data Center--are required to operate on a fully reimbursable basis. Consequently, each center has developed a comprehensive billing system based on various cost "centers", such as central computer time, number of lines of output printed, and amount of disk space used. The rates for like cost centers vary between the two data centers because each center has a different complement of equipment, computer

programs, personnel and overhead costs for such items as space and energy consumption. The rates also differ between the two centers for another reason: the Teale Data Center offers substantial discounts for work processed at times other than during the day shift, while the Health and Welfare Data Center does not.

As noted in our Analysis of the 1982-83 Budget Bill, most large commercial and governmental data centers operate on a continuous, around-the-clock basis to maximize the use of available computing capacity and defer costly and potentially disruptive capacity increases to meet workload growth. In order to encourage the distribution of workload across all shifts, most data centers charge more for day shift processing because this is the period during which demand is the greatest. The Health and Welfare Agency Data Center, by not offering service at differential rates, is failing to take advantage of an important means for avoiding or reducing the number of capacity upgrades made necessary by increased demand for day shift computing capacity. The lack of discounts for off-hours processing provides no incentive to customer departments to schedule work for processing at times other than the prime time period--the day shift.

For these reasons, we recommended in the 1982 Analysis that the Legislature direct the Health and Welfare Data Center to evaluate alternatives to its current rate structure which would optimize use of the data center's computer processing capacity, and report its findings and recommendations by November 1, 1982. This requirement was included in the Supplemental Language Report of the 1982 Budget Act.

In its report, the data center states that use of a differential rate system would not be practical for the following reasons:

- Existing data center management practices have been effective in controlling day shift workload.
- Rate differentials would generate no new work, but would merely require discounts offered on one shift to be offset by a surcharge on another.
- The administration of different rate structures results in additional overhead costs.
- Different rate structures result in different charges for the same work, depending on the shift.
- The data center operates on the weekends on a part-time basis only, because sufficient resources generally are available during the week when the center operates on a continuous basis.

In lieu of adopting a differential rate structure, the report recommends adjustments in three specific cost centers. These adjustments appear to be appropriate, regardless of whether a rate differential system is adopted.

We do not find the report's conclusion regarding a differential rate structure to be warranted by the analysis contained in the report. In fact, none of the reasons given by the center even address the primary rationale for such a rate structure. For example:

- Even if existing data center management practices are adequate to control workload, this is no reason for not instituting a system which should result in improved control.

- The report's observation that a differential rate system would result in discounts for some processing and surcharges for other processing is not an argument against a rate differential system; it is merely a description of how a rate differential system works.
- The report's assertion that additional data center overhead would result from administration of different rate structures is not documented. Instead of estimating the fiscal effect of such a rate structure, the report merely states that the center would incur additional overhead costs "to manage the various rate schedules and to produce the bills each month."
- The observation that a differential rate structure would result in different charges for similar work if processed during different shifts is accurate, but is not a reason for not adopting a differential rate structure.
- Finally, while the data center is not staffed for full weekend operation at the present time, the added cost to extend operations might be more than offset by the savings that would result from diverting workload to the off-hours.

For these reasons, we conclude that the data center has not completed a meaningful evaluation of alternatives to the current method of charging for services.

Accordingly, we recommend that the Legislature direct the Health and Welfare Agency Data Center to establish a differential rate system for processing work at different times of the day.

NEED FOR A POLICY ON USER FEES

Some experts maintain that an effective charging system is the most valuable management tool available to an executive responsible for computer operations. Under such a system, costs for EDP services are charged to those who receive the benefits of the services.

According to the results obtained from the September EDP Survey, most state agencies that have computers do not have charging systems. The primary reason for this is that many computer facilities are relatively small, or are dedicated primarily to one user. In such cases, it may not be practical to impose user fees. For other departments, however, particularly those with a large computing facility, such as the Board of Equalization and the Department of Motor Vehicles, a charging system may be appropriate. Yet, there is no policy in the State Administrative Manual which addresses computer center fees, nor are there guidelines to assist departments in evaluating the potential benefits of a fee system.

This omission should be corrected. Accordingly, we recommend that the Legislature direct the executive branch to develop for the State Administrative Manual policies and guidelines regarding charging for computer center resources.

NEED TO IMPROVE MANAGEMENT COORDINATION

In the course of developing information for this report, we met with various data center directors. It became apparent from these meetings that the exchange of ideas and sharing of experiences among data centers occur in a rather haphazard manner, and often result from the initiative of individual directors.

A closer working relationship between center directors can have a beneficial impact on state information management practices. This was illustrated recently when one data center director became aware that another data center was preparing to go to bid to secure additional disk storage devices. The director informed the other center that the required equipment could be obtained under an existing contract, avoiding the cost and delay associated with an unnecessary procurement.

It would appear that all data centers--and, ultimately, customer agencies--would benefit from more frequent staff contact and information sharing. Among the alternatives for improving communications among centers are (1) periodic meetings, (2) information bulletins discussing significant developments, (3) joint training sessions for data center personnel, (4) rotation of personnel to assist data centers in problem resolution and (5) the development of standards to promote the sharing of data center resources among the centers.

Accordingly, we recommend that the Legislature direct the executive branch to establish a data center management coordinating process.

PROCUREMENT OF EQUIPMENT, SUPPLIES AND SERVICES

Chapter 761/80 established within the Department of General Services a separate procurement authority for EDP equipment, supplies and services. Since July 1, 1981, the department has processed over 160 original procurement contracts, with a total value of \$142 million.

Both the results of the September EDP Survey and interviews with computer center management indicate that the central procurement authority

is being managed at an acceptable level. Further, a report issued by the department in January 1982 indicated that there were no significant problems in implementing the new procurement act.

Chapter 761 authorizes the department to delegate procurement authority to other departments which have demonstrated an ability to effectively manage EDP-related procurements. Pursuant to this provision, the department has delegated procurement authority to several agencies, including the California State University. This authority is limited to procurements not exceeding \$100,000.

TREND IS TO PURCHASE

Section 5207 of the State Administrative Manual requires that, prior to acquiring computing equipment, a determination be made by the department proposing the acquisition as to the most cost-effective means of acquisition. This determination must take into account the intended useful life of the equipment, its salvage value, and a comparison of the relative advantage of leasing versus purchasing, using a methodology prescribed in Section 3700 of the manual.

Under normal circumstances, the methodology set forth in the manual is appropriate. Recent developments in computing technology, however, suggest the need to reevaluate this approach.

Computer pricing is difficult to predict, and is subject to sudden fluctuations, particularly when new technological developments occur. For example, in its feasibility study report recommending the acquisition of three new and very large computing systems, the Teale Data Center offered

as one reason for an accelerated procurement effort the need to acquire the new computers before any price increases. The Teale Data Center, upon receiving authorization to acquire the first of the three computers, entered into a procurement which resulted in the purchase of an IBM 3081 computer, one of the largest available on the market at that time, at a total cost of approximately \$5.5 million. Shortly thereafter, IBM reduced the purchase price of the 3081 by \$460,000.

In addition, the potential impact of office automation on computing equipment requirements, a trend toward smaller, distributed computing systems, and the question of the optimum size of state data centers all argue for reconsideration of the current policy which results in the purchase of large computers. Review of this policy may allow the state to avoid being locked into an installment plan purchase of large computers which have become prematurely obsolete and are no longer cost-effective. Until the state has developed a better understanding of where it should be relative to computing resources in the mid-1980s, and for the other reasons discussed above, the best policy may be one of leasing.

Accordingly, we recommend that the Legislature direct the executive branch to reevaluate State Administrative Manual provisions governing the analysis of whether to lease or purchase computing equipment.



CHAPTER III
THE DEVELOPMENT OF SYSTEMS

The difficulties experienced by the state in attempting to implement the SPAN project have raised the question of whether EDP analysts and programmers should be centralized on a statewide basis. There is no ready answer to this question. Historically, within California state government, these personnel resources have been deployed on a decentralized basis--that is, in individual departments. Within departments, however, these resources typically are deployed on a centralized basis. Today, there are in excess of 1,700 systems analysts and programmers dispersed throughout state agencies. Obviously, any effort to centralize the functions performed by these personnel would have significant implications for both state government and the individual departments, and benefits could easily be outweighed by the cost of disrupting the delivery of these services.

LIMITED CENTRALIZATION

For several years, the Department of General Services, through its Data Processing Services Section (DPSS), has maintained a central pool of analysts and programmers whose services are available to other state agencies on a contract basis. The quality of expertise available through this pool, however, has varied widely, and there have been some serious failures. For example, a licensing system developed for the Department of Insurance was so ineffective that it had to be replaced. Further, the DPSS has not been structured to provide comprehensive staffing for major

projects such as SPAN, which required substantial staff resources. The DPSS would have to undergo a major transformation if it were to develop a staff capability to design and implement large systems.

Assuming, for the sake of argument, that there would be value in establishing a central EDP development staff large enough to handle major projects, it would be difficult to determine the proper amount of staff resources to allocate to this function. Resolution of this question is complicated by the fact that departmental information systems are developed independently, as the need arises, and are not coordinated on a statewide basis. Consequently, the total statewide demand for systems development personnel--which will vary according to the number of projects in progress--either could exceed the staff's capability or, conversely, could be so low as to make it extremely difficult to keep staff occupied productively. It is doubtful, therefore, whether even a modified version of the centralized approach would be more effective than the current method which allows agencies to meet their technical staff requirements through a variety of means, including the acquisition of assistance from a central authority.

Centralization of system development personnel--whether total or partial--raises another important issue: that of program understanding. Opponents of centralization argue that the success of systems development personnel, particularly systems analysts, is dependent on their understanding of the individual programs of various user agencies. In order to achieve this expertise, a central staff would have to receive

additional training. The full potential of such a training effort might not be realized, however, because the centralized agency could ultimately reassign the trained analyst to other projects which, from the central agency's perspective, are of a higher priority.

If we accept the premise that the state's current organization for systems development is generally working satisfactorily, as seems to be the case, there does not appear to be a compelling reason to seek further centralization of personnel resources. In fact, the existing structure is not unlike that of any number of major U. S. corporations which have large, independent operating divisions. Moreover, various writers on this subject predict that technological advances in computing will lead to increased emphasis on the management of data, with an expanded role for the users of information, and less reliance on traditional, highly technical EDP personnel. Certainly, recent developments in office automation systems and "user-friendly" software provide the means to allow such a shift in emphasis. This shift will have implications for the role of technical personnel in the future. It would appear, therefore, that until that role can be defined more accurately, the most practical approach would be to maintain the current organizational structure, modifying it as required by technological advancements and operating experience.

PROBLEMS IN DEVELOPING LARGE INFORMATION SYSTEMS

In our 1973 report on the state's uses of EDP technology, we identified several major information system projects which were either outright failures or had experienced significant problems while being

implemented. Similar problems have arisen in the intervening years. For example, the state's centralized personnel and payroll system--the Personnel Information Management System--became fully operational only after significant cost overruns and schedule extensions. Moreover, a project intended to develop a state-operated centralized welfare information system--the third attempt of its kind--was abandoned in 1976, at a cost of several hundred thousand dollars.

Information system project failures can be attributed to several factors. These include (1) poor project control, (2) mismanagement, (3) inadequate or inexperienced staffing, (4) unrealistic schedules (5) insufficient involvement of the ultimate users in the design or implementation of the system, and (6) incomplete feasibility studies.

In addition, because of their inherent complexity, it is difficult to estimate accurately the costs and time schedules for information system projects. This is because an information system project manager begins with a conceptual design, which gradually is transformed into a more detailed description as the project progresses. Consequently, it is possible to spend hundreds of thousands--or even millions--of dollars before it is possible to assess the accuracy of the original project estimates. The larger and more complex the information system project becomes, the more difficult the task of developing accurate time and cost estimates.

Well-managed projects that are based on good feasibility studies and staffed with experienced personnel tend to yield systems which are

reasonably close to schedule and cost estimates. On the other hand, periodic progress reports prepared for projects which are poorly managed or encountering serious problems generally are not reliable, even though they may appear to be reliable.

How can the Legislature, which authorizes projects through budget appropriations, or a department director who is concerned with the effective expenditure of resources, be assured that important information system projects are founded on appropriate feasibility studies, well-managed and staffed with the adequate personnel resources? The current control process does not provide that assurance.

Clearly, this situation needs to be improved, and it can be improved. While there is no way to ensure consistent success, there are methods which could be used to enhance the opportunity for success. These methods are discussed in the sections of this chapter which follow our discussion of the SPAN project, the most recent information system project to experience serious implementation problems.

STATEWIDE PUBLIC ASSISTANCE NETWORK (SPAN): STUDY OF A FAILURE

Chapter 282, Statutes of 1979, requires the Department of Social Services to implement a centralized welfare delivery system in all counties by July 1, 1984. According to Chapter 282, the purpose of the system is to improve the delivery of benefits to eligible recipients for specified welfare programs, such as Aid to Families with Dependent Children and Food Stamps. In addition, the centralized system was expected to save millions of dollars annually through equipment and personnel reductions in the counties.

At present, each county is responsible for its own welfare delivery system, although several counties containing approximately 35 percent of the state's welfare caseload have cooperated in the development of a Case Data System. Los Angeles County, with approximately 36 percent of the state's caseload, has developed its own system, the Welfare Case Management Information System (WCMIS).

In response to Chapter 282, the department established a separate division to define, design, develop and implement the centralized system. It also established administratively 89 positions to begin work on the project in 1979-80. The department's original schedule anticipated that an additional 43 positions would be added in 1980-81.

The SPAN project was the largest and certainly one of the most complex information system projects ever undertaken by the State of California. Consequently, the department's efforts at carrying out the project were followed closely by the Legislature, private vendors, and state control agencies. The private firms were interested because of the millions of dollars worth of computing equipment that would be necessary to link hundreds of field offices in 58 counties with one or more new large computing complexes managed by the state.

Difficulty of Task

In the Analysis of the 1980-81 Budget Bill, we highlighted three areas of concern with respect to the SPAN project. Our concerns were grounded in the complex nature of the project, as well as in the "very demanding" time frame for completion of the project that was imposed by the statute.

First, we were concerned over the department's interpretation that Chapter 282 required a highly complex automated system to be made operational within five years. The state's past experience indicated that the initial estimates of the time required to implement systems of this magnitude typically were too optimistic. Consequently, we suggested that the department reassess the reasonableness of the required implementation date.

Second, we were concerned that, because there was a serious shortage of qualified EDP professional staff in state government, the department would experience some difficulty in acquiring an adequate number of sufficiently skilled personnel. This was a particularly important concern because the cost-effectiveness of an information system as complicated as SPAN would be determined by the skill and thoroughness with which project personnel designed the system.

Finally, we expressed our concern that the department had not had enough time to define all of the system's requirements, and thus was not in a position to know how much time actually would be required to implement the centralized system.

So that the concerns raised in the Analysis could be addressed, we recommended that the department's feasibility study report include information on resource requirements, implementation schedules, and the phase-in of the existing Los Angeles County WCMIS and the multi-county Case Data System into the statewide system.

By the end of 1980, the department had expended \$1.5 million on the Statewide Public Assistance Network project. The department estimated that expenditures would approximate \$4.1 million in 1980-81, and \$6.3 million in 1981-82. During 1980-81, project staffing reached 136.

1981: A Year of Disappointment

In January 1981, the department issued its feasibility study report on the SPAN project. The report recommended that SPAN be patterned after the automated welfare information system that was then being developed in Los Angeles County. Four months later, in May 1981, the department informed the Legislature that, because of difficulties involving the development of the Los Angeles system, the SPAN design was being modified to implement a different alternative, one involving aspects of both the Los Angeles system--WCMIS--and the Case Data System employed by 14 counties. Seven months after this revision, in December 1981, yet another alternative was selected for the SPAN project--one based on the Case Data System only.

Each of these modifications represented significant change in direction for the project. In each case, however, the proposed change was not backed up by adequate supporting information, and the supporting information that was provided appeared to have been developed after the fact. Consequently, we concluded that critical decisions were being made on the SPAN project in the absence of a careful analysis of all relevant factors.

The department's acquisition of a computer from the Department of Justice illustrated the problems that plagued the project as a result of

inadequate management. When the decision was made to abandon the WCMIS-based SPAN and implement an alternative using the WCMIS central index capability with Case Data System application programs, the department contracted with the Department of Justice to acquire a computer system that had been installed at the Department of Justice, but was not being used at the time. Once agreement had been reached, SPAN efforts were redirected to preparing computer programs, including the WCMIS central index, for the Department of Justice computer.

At about the time the system was ready for operation, SPAN management elected to abandon that approach and implement SPAN based on the Case Data System only, using computing equipment from a different manufacturer. This decision cost the state approximately \$700,000 (for the Justice computer), and delayed the project. The department defended its decision on the basis that the new approach would save money by using a surplus computer available from the Teale Data Center for SPAN-related processing. In fact, however, there was no surplus computer at the Teale Center.

Credibility Declines as Project Cost Increases

By early 1982, the department's management of the SPAN project was recognized as inadequate, and the department had little credibility with the Legislature when it came to SPAN. Expenditures in 1981-82, originally proposed at \$6.3 million, were estimated at \$8.3 million. Project staffing had ballooned to 215 positions, significantly more than the 140 projected in the 1981-82 budget. The budget for 1982-83 proposed expenditures of \$21.3 million for the SPAN project, and requested a nearly 25 percent increase in staffing (to 266.5 positions).

In our analysis of this request, we noted that there had been (1) three different approaches to SPAN proposed by the department during a 12-month period, each supposedly the most cost-effective alternative, (2) no meaningful progress on the project in 1981, (3) a 14-month delay in starting up the pilot project, (4) increased expenditures, (5) growing uncertainty over the prospective savings, (6) erratic equipment acquisitions, and (7) inadequate responses by the department to specific requests of the Legislature for information pertaining to the SPAN project. An independent consulting firm hired by the Department of Social Services through the Health and Welfare Agency Data Center to review the SPAN project confirmed that the original feasibility study report and the department's management of the project were seriously deficient.

The problems associated with the project had by this time become so apparent that the legislative fiscal committees held several lengthy hearings on the department's budget request for SPAN in 1982-83, including a special joint session of the subcommittees of the Senate Finance Committee and the Assembly Committee on Ways and Means. Moreover, private sector computing interests, which had consistently maintained a "low profile" with respect to the development of the project, assumed a more aggressive role, attempting to demonstrate what was wrong with those SPAN alternatives that did not favor their approach or computing equipment.

The Legislature, having already authorized the investment of some \$14 million, and having been assured by the department that the system would be operational at the time called for by the original schedule, was placed in

a very difficult position. After extensive deliberations, the Legislature decided to defer further implementation of the project, pending revisions to the original feasibility study report by a private consulting firm to be retained by the Auditor General (rather than the Department of Social Services). As a result, the SPAN project was not funded in 1982-83, and project staff has been released to other state activities.

Project implications. We do not believe it is possible to develop a control mechanism capable of providing absolute assurances that there will be no more "SPANs". Nevertheless, we conclude that several actions could be taken which would minimize the possibility that other projects will experience the serious problems of the type that undermined the SPAN project. These measures are discussed in the remainder of this chapter.

MAJOR PROJECTS NEED PROPER OVERSIGHT

The experience gained from SPAN demonstrates clearly the need for better oversight of major information system projects. To assist both the Legislature and the responsible department in overseeing such projects, we believe assistance should be sought from an outside consulting firm that has no stake in the project. While the Department of Social Services' secured the services of such a firm to evaluate specific aspects of the project, it did so more than two years after the project had been initiated, and after several million dollars had been expended. Further, the scope of the consultant's work was limited, and, thus, did not permit the kind of comprehensive evaluation which was needed.

The responsibilities of the independent consultant should include evaluation of (1) the feasibility study report, (2) the capability of the project team to implement the project successfully, (3) project management procedures, and (4) project progress. Consultants should be brought in before system development occurs, and should be required to provide periodic reports to the Legislature, state control agencies and the department responsible for the project. These reports should contain findings and recommendations, as well as typical progress reporting.

Consultants could be obtained either from other state agencies or the private sector. Competitive bidding should be encouraged with respect to the acquisition of services from the private sector in most instances. We believe that the use of such consulting expertise would also be appropriate for projects managed for the state by other private sector firms, as well as for those managed by state agencies. This technique has been employed occasionally in the past for some state information system projects. To ensure maximum objectivity in the review of major information system projects, independent consulting services should be obtained by an agency other than the one responsible for the project. The cost of these services, however, should be borne by the department which is responsible for the project.

We believe the added cost to the state of providing independent project oversight would be more than offset by the savings achieved through the avoidance of major problems or expenditures that would otherwise result from undetected or uncorrected problems in the project development cycle.

Further, the better informed the Legislature and departmental management are, the less confusion there will be regarding the status or progress of a major project.

Accordingly, we recommend that the Legislature direct the executive branch to develop policies and guidelines capable of ensuring that major EDP information system projects will be overseen by independent qualified personnel who will provide periodic evaluation reports to the Legislature and the executive branch.

TARGET VERSUS FIXED COMPLETION DATES

A major difficulty experienced by the SPAN project stemmed from a requirement in Ch 282/79 that the SPAN be made operational on a statewide basis by July 1, 1984. This requirement had the effect of compelling the Department of Social Services to fit all system development activities into a schedule that would allow the completion date to be met, without regard for the time needed to perform the work in an adequate manner.

Complex projects such as SPAN require months of analysis just to define all of the required activities in sufficient detail to develop a comprehensive and meaningful development schedule. For this reason, we believe the target completion date should be determined by the project schedule, rather than the reverse (that is, having a specified completion date determine the project schedule).

An additional drawback to statutory implementation dates is that they tend to weaken accountability. Project management can characterize these dates as "unreasonable", and thereby use them to "excuse" project

difficulties. For example, when slippages in a project schedule occur or problems develop because not enough time was spent on critical project components, management seeks to avoid responsibility for the slippage or problems by claiming that the tight schedule was necessary because of the mandated completion date.

Consequently, we conclude that statutes authorizing information system projects should specify a target date for completion, instead of requiring completion by a specific date. Further, we believe that such statutes should include a requirement that the responsible state agency submit to the Legislature a schedule indicating when the task can be completed. This will permit the Legislature to assess the costs and risks associated with alternative project implementation plans.

Accordingly, we recommend that the Legislature specify target, rather than mandatory, completion dates for the information system projects it authorizes.

EMPHASIS SHOULD BE ON PILOT PROJECTS

At the time the Legislature deferred further implementation of the SPAN project, the state's total investment in the project was approximately \$14 million, and the number of staff allocated to the project exceeded 200 positions.

At the same time that the SPAN project was under development, two other major state information systems were also in progress. These projects required substantially less personnel resources than SPAN, were far less costly, and have been implemented successfully. The other

projects--the Medi-Cal Eligibility Determination System (MEDS) in the Department of Health Services and the California Automation of Services Team (CAST) in the Employment Development Department (EDD)--while not fully comparable to SPAN, are comparable to the extent that each is a complex system involving central computing facilities linked through communication facilities with distributed offices. The MEDS system is tied to county offices, as SPAN was intended to be. CAST is being developed to serve ultimately over 200 EDD field offices throughout the state.

An important aspect of both MEDS and CAST that contributed to the success of these projects is that each sought to develop a comprehensive pilot program before the project was expanded. Further, the expansion of these systems on a statewide basis will be gradual and carefully monitored.

The development of pilot programs prior to implementation statewide allowed each of the projects to be staffed with considerably fewer personnel than would have been required otherwise. For this reason, the cost to develop CAST was only \$3.6 million, of which \$482,000 was for evaluation of the pilot program. CAST staffing never exceeded 15 positions. The MEDS project cost approximately \$5 million for development, and required a maximum staffing level of 30 positions.

In both cases, the pilot approach provided workload information which made it possible to develop a realistic assessment of computing equipment requirements and other resource needs for a statewide system. In contrast, the SPAN's project management estimated total statewide computing system requirements prior to any pilot operation.

The successes of the MEDS and CAST projects, relative to SPAN, suggest that a pilot approach should be used in other large information system projects.

Accordingly, we recommend that the Legislature require mandated statewide systems to be implemented only after completion of a successful pilot program. We further recommend that the Legislature direct the executive branch to include policies and guidelines in the State Administrative Manual requiring the use of pilot programs prior to the development of large-scale information systems.

NEED FOR A PEOPLE POLICY

The implementation of a modern information system based on computer technology carries with it significant implications for the people who must make the system work. There is often a resistance to change and a concern about job security on the part of those affected by the project. Some managers believe that workforce reductions resulting from a new system will have an impact on their status within the organization (which may be based on the number of employees supervised). Power centers sometime shift as the result of a new information management system. Essentially, these new systems often have an unsettling effect on the people they affect. Yet, these are the very people who will play a key role in achieving the anticipated benefits of the project, for which millions of dollars may have been expended.

In practice, the "people" aspect of modern information systems is often overlooked or given insufficient attention. Some experts believe

that the failure of information system projects may be traced, at least in part, to the failure to address this aspect of such systems. The State Administrative Manual, which contains an extensive section on EDP activities, does not provide any guidance in this critical area. Consequently, departments which implement major information system projects must rely on their own experience or initiative. This "hit or miss" approach is not in the best interests of the state.

Many of these difficulties arise because sufficient consideration was not given to the needs of the people who will be affected by the new automation system. The problem could be minimized by the development of "personnel impact" guidelines to assist those responsible for implementing the new systems. Training programs for systems analysts could be redesigned to incorporate methods of ensuring smoother transitions from manual to computer-based operations by achieving higher levels of acceptance among affected persons.

Accordingly, we recommend that the Legislature direct the executive branch to develop for the State Administrative Manual policies and guidelines capable of ensuring that consideration is given to the personnel implications of information systems implementation.



CHAPTER IV
PERSONNEL-RELATED ISSUES

In 1979, there was a serious shortage of qualified EDP personnel in the state, and a task force was formed to assess the extent of the problem and determine possible remedies. At that time, employee turnover was relatively high, and the vacancy rate for programmers, analysts and software specialists ranged from 23 percent to 30 percent. As a result, one-half of all programmers and computer operators, almost one-third of all analysts and one-fourth of all software specialists in 44 departments had fewer than two years of experience in their classifications.

The task force released a report in March 1980 containing ten specific recommendations for improving EDP personnel recruitment and retention. Several of these recommendations subsequently were adopted.

Current State Situation

At present, state personnel in EDP analytical, programming and management capacities number approximately two thousand. Turnover, a major problem in 1979 and 1980, does not appear to be as serious a concern today among the state agencies responding to the September EDP Survey. According to the survey, only six out of 61 departments indicated that the retention of experienced staff was a problem. The turnover rate, however, is not known because no agency of state government tracks it.

State EDP managers indicate that the problem of retaining experienced personnel could surface again because a number of new, non-state computer

facilities are being located in the Sacramento area. At least one private sector firm has attempted to hire highly-skilled personnel from the Teale Data Center.

While turnover has subsided, at least temporarily, the survey indicated that the state continues to experience serious problems with respect to hiring qualified candidates for technical positions. For example, 40 percent of the departments indicated that the availability of qualified personnel was not satisfactory, while 30 percent felt that the overall quality of those candidates that are available was unsatisfactory. The availability of qualified technical personnel is the statewide EDP problem identified most frequently by respondents to the September EDP Survey. The problem is perceived to be most critical with respect to non-managerial technical positions.

Technical Staff Shortage has Cost Implications

State agencies increasingly are looking to the computer as a means of improving the cost-effectiveness of the programs they administer. In automating their programs and processes, agencies usually confront two main problems. The first is the lack of "up-front" money needed to sustain the project until savings from automation begin to accrue.

Even when departments are able to resolve the funding problem, however, they are immediately faced with a second problem--the lack of skilled technical staff. This shortage often delays cost-effective projects, resulting in a large and growing backlog of such projects. According to the September EDP Survey, there is a statewide backlog of 104

potential projects, each with a cost of \$100,000 or more and supported by an approved feasibility study report demonstrating the necessity of the project and identifying the most cost-effective means of accomplishing it. According to the September survey, 65 percent of the departments reporting a backlog of projects indicated that the problem was attributable largely to unavailability of technical staff.

To the extent that projects are backlogged, any savings or improved program effectiveness anticipated from these projects will be deferred. Consequently, the lack of a sufficient number of technical staff imposes a heavy cost on state programs.

Significance of the Personnel Problem

California's experience in seeking to attract qualified technical personnel is not unique. For example, a recent survey of employers in the New York metropolitan area (which supposedly has the greatest concentration of computer users in the country) revealed that finding and retaining qualified EDP personnel was one of the biggest day-to-day problems these employers faced. A 1982 report on information systems technology in state government issued by the National Association for State Information Systems (NASIS) stated, "The problems associated with recruiting qualified employees . . . are worse than last year, and may well worsen." According to the NASIS report, more state administrators cited the recruitment problem than any of 11 other major problem areas.

The shortage of applications and systems programmers is viewed by many observers as the major constraint on computer users today, and this

constraint is likely to become more severe in the years to come as the demand for analysts and programmers increases. The Department of Labor predicts that employment opportunities for new programmers and analysts will increase by 20 percent in the 1980s. Yet, census data indicate that between 1981 and 1988, the number of young people entering the workforce will decline by 20 percent. Further, these young people may not have as high an aptitude for computer programming and systems work as past entrants had, given the decline in mathematical and verbal Scholastic Aptitude Test (SAT) scores during the 1970s. Although there has been some improvement in SAT scores recently, it is too early to say whether the upward trend will continue.

The shortage of technical personnel ultimately may be alleviated as a result of the increased use of desktop computers and office automation systems by nontechnical employees. As noted earlier, some experts believe that advances in small computer technology will reduce the need for highly skilled personnel. The state's experience with the use of small computers, office automation and user-friendly software, however, is too limited to provide a basis for assessing the impact of this technology on the need for additional technical staff.

EFFORTS TO ADDRESS PROBLEM

Two efforts currently are underway within the state to alleviate the shortage of qualified technical personnel.

Apprenticeship Program. First, the Department of Industrial Relations (DIR) has developed an apprenticeship program for the purpose of

training programmers for state agencies. The program began in November 1982 with nine apprentice trainees. (The number of trainees is relatively small because many departments that otherwise would have participated in the apprenticeship program were able to secure the personnel they needed by hiring experienced personnel made available by the Legislature's action to defer the SPAN project.) A second group of trainees is contemplated in late 1983.

The initial apprentice group will receive training in four departments. After completing the two-year program and passing an examination, the trainees will be classified as Programmer IIs.

Change in Minimum Qualifications. The second effort to improve the quality of technical personnel available to state agencies is directed toward an increase in the minimum qualifications for the Programmer I position.

In July 1982, the Department of Finance expressed to the State Personnel Board its concerns regarding the recruitment of candidates for the Programmer I classification. Among the department's concerns was the fact that during the first four months following publication of a 1982 list containing the names of 700 candidates for that classification, only 24 appointments were made, despite numerous vacancies in this classification. According to Finance, the minimum qualifications for admission to the testing program were too low, allowing too many unqualified people to apply. This, in turn, led to an excessive number of applicants who had to be interviewed. Finance concluded that this forced the state to spend more

for recruitment than was necessary, and the department recommended that the board establish more realistic minimum qualifications.

We understand that, instead of raising the minimum qualifications, the board is considering reducing them so that even more applicants will qualify for the examination. Not only would this further increase the state's recruitment costs; it could also result in a disservice to those persons made eligible for the examination, since they would be unlikely to obtain employment.

Accordingly, we recommend that the Legislature direct the State Personnel Board to adopt minimum qualifications for the Programmer I classification which are consistent with the employing departments' requirements for qualified technical personnel.

OTHER SOLUTIONS

In addition to the efforts designed to rectify the shortage of qualified technical personnel that currently are underway, the state has other options for addressing the problem which should be considered. One option involves the use of commercially-available computer programs known as "application generators." Essentially, an application generator provides a shortcut method for developing computer application programs which minimizes systems analysis requirements and eliminates conventional programming. The use of application generators by the Santa Fe Railroad reportedly has resulted in a savings of \$4 for each \$1 invested in implementing the system. Furthermore, Westchester County, New York, which employs approximately 10,000 persons, is in the process of installing an

extensive office automation and application generator system for the purpose of improving productivity. The county believes that the new system will more than pay for itself, and will make it possible to avoid costly staff increases to meet increasing workload.

In California, there is no centrally-managed or coordinated effort to determine the potential of application generators to alleviate personnel shortages and reduce state program costs. We believe that the concept has sufficient merit to warrant investigation by the state. This could be carried out through a pilot or demonstration program conducted under the auspices of the California Information Technology Advisory Board (CITAB). A pilot program of this type would be an appropriate means for proving the effectiveness of the concept, and would also provide a forum for the dissemination of results and the development of policies and guidelines for the use of application generators.

Accordingly, we recommend that the Legislature direct the executive branch to evaluate the effectiveness of application generator software as a means of addressing the shortage of qualified technical personnel and reducing system development costs. If the evaluation verifies the cost-effectiveness of this option, the executive branch should include in the State Administrative Manual policies and guidelines employing the concept.

Master Service Agreements for Technical Services Needed

The use of contract services provides another means for addressing the shortage of skilled technical EDP personnel. The primary provider of

these services within state government is the Data Processing Services Section in the Department of General Services. On many occasions, however, the department does not have sufficient staff to meet service requests on a timely basis or provide the specific skills required. In such instances, the requesting agency has had to obtain assistance from the private sector. Doing so, however, often requires the agency to follow a competitive bid process, which delays the provision of services which may be needed quickly.

Several months ago, CITAB began a project that seeks to arrange a master service agreement with one or more private sector companies specializing in the provision of highly-skilled technical personnel on a contract basis. This technique has been used successfully by Sacramento County and other governmental jurisdictions.

Subsequently, the Department of General Services, which will negotiate the master service agreements, decided to survey state agencies as to what types of skills should be available under these agreements. It is not clear why the survey was not undertaken earlier, when the CITAB launched its effort to arrange a master service agreement. Had this been done, state agencies could look forward to acquiring from the private sector skilled personnel not available within the state at an earlier point in time.

In any case, there clearly is a need for the type of master service agreements now being considered by the CITAB. In fact, such agreements are needed with more than one firm, because it is doubtful that any single firm

could provide all of the skills required by the state at the time when they are needed. The scope of the agreements should be relatively broad so that a technical skill requirement which may not be reflected in the results of the Department of General Services' survey could still be obtained through the master agreements.

Accordingly, we recommend that the Legislature direct the Department of General Services to (1) expedite the execution of master service agreements for technical EDP personnel, (2) establish agreements with more than one firm, and (3) assure that the agreements are sufficiently flexible to enable departments to acquire any technical support service necessary for the successful implementation of an information system project.

PERSONNEL PROBLEMS REQUIRE CLOSER MONITORING

In developing information for this report, it became apparent that, despite general agreement as to the seriousness of the problem of recruiting and retaining technical personnel, the information available on the problem is very limited. For example, we were not able to obtain accurate information on either the rate of turnover of EDP personnel or the reasons for turnover. Further, no agency of state government compiles information on the total number of state EDP positions, by classification, or the vacancy rate for these positions, and salary comparisons also are very limited. The only recent salary information available through the Department of Personnel Administration was for selected classifications in the San Francisco Bay Area.

In summary, sufficient information is not available to permit a complete evaluation of the EDP personnel recruitment and retention problem.

Accordingly, we recommend that the Legislature direct the executive branch to monitor more closely the recruitment/retention problem regarding technical personnel so as to provide the state with better information upon which to develop more effective strategies for addressing the problem.

SHOULD MANAGERS BE TESTED?

Four data processing manager classifications have been established in state government to provide a management structure to supervise EDP technical staff, data centers and other EDP operations. The four classifications range from data processing manager I through data processing manager IV. The monthly salary for these classifications ranges from \$2,278 to a maximum of \$3,650. Individuals qualifying for these positions come primarily from the computer programming and systems analysis ranks.

Under current policy, applicants for the data processing manager classifications are not required to take a written examination. Appraisals by the applicants' supervisors are required in the case of those applying for the data processing manager I and II classifications, and an oral interview with a qualifications appraisal panel is required for all four classifications.

Some state EDP managers believe that there also should be a written examination to assist in determining an applicant's aptitude for management responsibilities. Such a requirement may be particularly appropriate for

the entry level data processing manager I classification. Further, to the extent that a written examination could be devised so as to provide a good indication of management aptitude, it would also add an element of consistency to the examination process, because oral examinations tend to vary according to the oral panel's membership.

Accordingly, we recommend that the Legislature direct the executive branch to consider requiring a written examination for all candidates for data processing manager classifications.

MIGRATION OF SKILLED STAFF

One of the problems that this report is required to address involves the movement of skilled staff from one system development project to another within state government. Our ability to determine the extent of this problem, however, was hampered by the absence of data. The March 1980 report issued by the task force on data processing recruitment and retention indicates that the movement of EDP personnel among various agencies, at that time, was substantial, accounting for 69 percent of the total number of transfers and separations. The SPAN project, for example, drew a number of skilled personnel from other state agencies. The most significant loss of highly skilled employees, however, occurred as a result of these employees leaving for better paying jobs in the private sector.

In the September EDP Survey--which provides the most current information on this matter--respondents did not identify the movement of EDP personnel among departments as a significant problem. Moreover, it can be argued that there is value to some movement of skilled personnel among

projects because it is through such movement that valuable experience can be shared among all state agencies.

The Department of Finance advises that a Management Memo is being developed on human resources planning which will address the EDP personnel migration issue.

Planning to Avoid the Problem

The absence of any data documenting a problem in this area is not a basis for complacency. If one or more highly-skilled technical personnel leaves a project at a critical time, the impact on an organization can be very serious.

Current state policy on interdepartmental migration is set forth in State Personnel Board Rule No. 425. This rule allows a department to defer a lateral transfer (that is, a transfer within the same classification) for up to 30 days. It does not, however, apply to transfers for promotional purposes. As a result, it does not prevent the untimely movement of key staff when a promotion is involved.

One method of avoiding the disruptive effects of interdepartmental transfers without penalizing state personnel might be to allow the employing agency to promote an individual who has been offered a promotion by another department, and retain his or her services on a temporary or part-time basis until a major project dependent on the skills of the individual has been successfully implemented or until a suitable replacement can be found.

Accordingly, we recommend that the Legislature direct the executive branch to evaluate methods for alleviating problems caused by the movement of critically-needed skilled technical personnel among state agencies.

DIFFICULTIES FOR FIRST-TIME USERS

Our experience indicates that first-time users of information technology are faced with a number of obstacles in seeking to obtain the benefits of an information management system. For example, the department must develop a feasibility study report, as required by Section 4 of the Budget Act and the State Administrative Manual. While a feasibility study report is necessary if a project is to be designed and implemented successfully, it puts an inexperienced user in a bind because such departments generally do not employ persons with a technical understanding of information technology. Consequently, the expertise just to do the feasibility study report must be acquired. If the department attempts to hire its own staff, it is faced with the difficulty of assessing the technical skills of applicants. The ability to select qualified technical personnel is especially critical to a department which has no technical expertise, since the effectiveness of a major information system is likely to depend on the capability of those individuals selected by the department.

The same problem may confront a department if it elects to acquire the expertise needed to design and implement an information system project from another source. Acquiring technical personnel from other state sources, such as the Data Processing Services Section in the Department of

General Services, is difficult for the inexperienced department because it may not have personnel in-house who can describe adequately the department's information requirements. This problem is amplified when the contract technical staff are not fully qualified. For these reasons, a number of departments have expended a significant amount of money on the development of systems designed and implemented by contract personnel, only to find the system did not meet their requirements.

Another difficulty that the inexperienced department may encounter in acquiring technical services from the private sector results from the requirement that these services be obtained on a competitive bid basis. Where competitive bidding is necessary, the adequacy of the bid specifications and the selection of the method that will be used to evaluate the bids are extremely critical. As one might expect, the quality of bid documents prepared by state agencies has varied widely.

Even after this problem has been overcome and a contractor has been selected, the inexperienced department confronts yet another difficulty: recognizing problems and performing adequate management and oversight of the contractor, once the information system project is under way.

Clearly, it is vital that first-time users of information technology be able to obtain qualified assistance to ensure the success of their projects.

Control Processes Frustrate Users

The complex EDP control process is another obstacle encountered by users inexperienced in information technology. For some projects, it may be necessary to obtain approval from three or more separate agencies for different aspects of a project. Departments implementing projects for the first time often are frustrated by the control process. A good example of these frustrations can be found in the Health and Welfare Agency's experience in implementing the Multipurpose Senior Services Project (MSSP).

The MSSP was established by Ch 1199/77. The legislation required the Health and Welfare Agency to set up pilot projects to develop specified information regarding services to senior citizens. Chapter 1199 required two annual reports on the pilot project results--one in 1979 and one in 1980--and provided for termination of the projects on January 1, 1981. Overall, the project appeared to involve a relatively straightforward application of computing technology, and was not costly.

The MSSP did not become fully operational until October 1981. A December 1981 report submitted by the Secretary of the Health and Welfare Agency, in response to a directive contained in the Supplemental Report of the 1980 Budget Act, describes in detail the chronology of events which caused the delay. In essence, the delay resulted from two factors: (1) the inexperience of agency staff in implementing information system projects, and (2) the workload resulting from reviews by and requests for information from the various control agencies, including the State Office of Information Technology, the State Personnel Board and the Department of General Services.

In theory, the efforts of these agencies were directed toward ensuring that the Multipurpose Senior Services Project was accomplished in the most cost-effective manner. Yet, as documented in the agency's report, several control functions were carried out by these agencies in such an inflexible and "bureaucratic" manner that they had the opposite effect. For example, the Department of Finance required the agency to prepare a five-year data communication plan, even though the project was scheduled to terminate in two and one-half years.

We question whether such a protracted development process resulted in the cost-effective implementation of the project. Clearly, the delay in attaining full operation of the system prevented the Legislature from obtaining the information it sought on a timely basis.

In transmitting the report on the MSSP to the Legislature, the agency secretary expressed his hope that the experiences gained from the project, along with the recommendations made in the report, could assist other agencies in planning for projects in the future. We believe one recommendation in particular merits consideration--the recommendation that an oversight agency be designated to assist a department throughout the process of developing an information system. The agency report recommends that the oversight agency be familiar with all state EDP requirements, and that it be authorized to modify or waive requirements when it believes such action is warranted.

We believe that this type of assistance could help ensure that funds appropriated by the Legislature for information system projects are

expended in a cost-effective manner, and that the Legislature's information requirements are met on a timely basis. Such a program could be developed through CITAB. It would not have to be limited to "first-time" users, although this should be the program's primary focus.

Accordingly, we recommend that the Legislature direct the executive branch to establish a specific program within the executive branch to provide assistance to inexperienced users of information technology during the development of an information system.

CLASSIFICATION LEVEL

In the past, departments lacking the EDP staff needed to plan an information system project often found that they were unable to hire a highly-experienced EDP professional, due to difficulties created by Department of Finance and State Personnel Board policies. These policies tended to restrict the use of senior-level personnel to situations where there would be additional EDP staff for the senior person to supervise. As a result, departments requiring only one position initially were forced to rely on a mid-level professional to guide their initial ventures into the use of computers. Given the complexities of information systems technology, this was not always desirable.

Recent discussions with State Personnel Board staff indicate that the present policy toward hiring EDP personnel is more flexible than it has been in past years. Currently, the level of the position for which a department may be authorized to hire is based on several factors, including the size of the project, on-going requirements and the placement of the

position in the organization. In effect, it appears that the level at which new positions can be filled is negotiable.

We believe that a policy is needed to ensure that those departments making their first attempts to use modern information technology have access to technical support personnel having experience commensurate with their needs. While the current policy appears to be an improvement over the policies that prevailed in the past, a careful review of current practice may disclose the need for further improvement.

Accordingly, we recommend that the Legislature direct the executive branch to review policies and practices governing the employment of EDP personnel by departments which lack experience in technology implementation.

INFORMATION RESOURCE CENTERS

During 1982, the Employment Development Department established a Data Processing Information Center with the following responsibilities (in priority order):

1. Training users.
2. Defining automated files for easy access by users.
3. Providing advice and consulting in response to user requests.
4. Reviewing service requests and user areas for opportunities for the cost-effective transfer of activities from the department's data processing division to the user.
5. Performing work for users, under certain circumstances.

According to the department, the Data Processing Information Center was established because (1) the department was unable to recruit and retain an adequate number of programmers to meet user requests, (2) the independent use of computers by users was increasing, and (3) the number of requests for information from automated files was increasing at an exponential rate. The department's decision to establish this center is consistent with modern information management concepts.

At first glance, the establishment of an information center may appear to be applicable primarily to a department which already is experienced in the use of EDP. We believe, however, that the concept is equally applicable to the inexperienced department, because the planning for this type of facility should occur simultaneously with the planning for the department's initial computer-based information system, where it is determined that an information center would improve the system's usefulness.

At present, the policy on information system development set forth in the State Administrative Manual does not mention information centers. We believe that the development of policies to encourage the establishment of information resource centers would be consistent with modern information management practices, and would afford both experienced and inexperienced departments an important series of aids in the use of information systems. In addition, these centers could play a substantial role in reducing the backlog of EDP applications. Organizations which have established information centers have, according to a recent trade journal article, reduced their backlogs by an average of 30 percent.

Accordingly, we recommend that the Legislature direct the executive branch to encourage the establishment, where practical, of departmental information resource centers to improve the utility of existing information systems and the development of new systems.

REQUIREMENT FOR EDUCATION OF MANAGEMENT

Historically, the use of computer-based technology has had to overcome a persistent problem: how to make top management sufficiently aware of the value of computing systems to ensure that the technology is used in an appropriate and effective manner. In recent years, however, there appears to be a growing awareness on the part of state managers at all levels that a manager needs to be well-informed regarding modern information systems technology. Some of this awareness may stem from a fear that managers lacking this understanding will be left behind by a younger generation that feels at ease with computer terminals and computer jargon. It also stems from a recognition that computers offer the only means of effectively controlling expenditures or meeting program requirements with limited resources. Finally, increased access to computing power through terminals and personal computers, and the so-called "user-friendly" software programs which facilitate the use of computers by persons who are not technically trained, are compelling reasons for managers to want additional training.

The result, whatever the motivation, is an increased interest on the part of many managers in information management technology. The state's ability to satisfy this interest, however, needs to be improved. There is

no strong central education program, for example, to meet the needs of interested managers, or to spark the interest of managers who may not realize that they should be more aware of information technology. In the September EDP Survey, 58 percent of the respondents indicated an interest in attending a seminar on office automation. Almost 61 percent of the departments indicated that top management did not even have a clear understanding of what the term "office automation" means.

EDP education is available through the State EDP Education Program in the Department of General Services. This program, however, is dependent on customer requests for programs, and is not able to meet the needs of all who desire training. Educational programs are also available through the state's system of higher education and from private sources. "Free" education can often be obtained from computer manufacturers or software companies, although this education is generally tied to specific product lines. Nevertheless, product-specific free education often serves to demonstrate uses of computer technology which can be accomplished by other manufacturers or software suppliers.

We believe that one of the ways to help departments which are inexperienced in the uses of information technology or to upgrade the skills and awareness of managers in experienced departments is to develop a strong, centrally directed information systems technology education program. With appropriate policy direction, such a program could become a routine part of management training. This program would result in increased costs, but the cost to the state of failing to increase the overall "computer literacy" of its managers may be substantially higher.

Accordingly, we recommend that the Legislature direct the executive branch to develop an educational program designed to increase the awareness of managers with respect to the application of modern information management technology.

CHAPTER V

TELECOMMUNICATIONS

OVERVIEW

Telecommunications, which encompasses a wide range of communications technologies including the transmission of voice, data and video images, recently has come to the forefront as an important issue in California state government. Where wire was once the only means by which communication could occur, a wide range of communication options now exists, including the use of coaxial cable, microwave, and satellite. The nature and flexibility of today's technologies are such that the distinctions between the transmission of voice, data, and video images have blurred. Modern systems are sufficiently flexible to handle all types of communications. For example, one can receive a phone call or watch a television transmission originating from across the world that is brought to its final destination through the use of satellites, microwave dishes, coaxial cables, fiberoptics, and cellular radio networks, among others.

Existing technology also will allow the consumer to communicate with his/her bank, police or college by means of a two-way interactive cable attached to a television screen. In fact, technological barriers to the provision of services have been lifted, leaving only cost as the primary consideration. For this reason, we believe it is essential that the state develop a unified approach to telecommunications--one that retains flexibility with respect to planning for the state's telecommunications future.

In this chapter we discuss briefly the roles of state agencies involved in telecommunications and examine specific telecommunications policies. Our objective is to describe how state policy is formulated in this area, and to identify the changes that are needed if the state is to take full advantage of the new technologies.

STATE AGENCIES

Department of General Services

The Department of General Services' Communications Division has basic responsibility for state communications, primarily of the telephone and radio type. As a means of identifying and fulfilling statewide data communication user needs, the department has contracted with ConTel Information Systems (formerly Network Analysis Corporation) to produce a report containing six components:

1. Requirements Analysis
2. Evaluation Criteria
3. Alternative Solutions
4. Alternative Evaluations
5. Best Solutions
6. Detailed Network Design and Implementation (to be based on phases 1 through 5, plus administrative approval to proceed).

Components 1 through 5 have been completed.

The ConTel report, which will cost an estimated \$158,000 to produce, was designed to include a feasibility assessment of alternative statewide network approaches, along with alternative solutions, to meet user needs. The report, however, concentrates on statewide data communications.

The California Public Broadcasting Commission (CPBC)

Over the last three years, the CPBC has sought to make itself a leader in the telecommunications field in California state government. Accordingly, it has undertaken planning and demonstration projects in the use of teleconferencing specifically, and telecommunications generally. It also has contracted for a telecommunications user needs study, the State Telecommunications Project. The study will attempt to encompass all potential state government users, including the educational system, library systems, and hospitals, among others.

State Office of Information Technology (SOIT)

The SOIT regularly communicates with the Department of General Services on communications needs, and is participating in the CPBC State Telecommunications Project. SOIT, however, has taken little role in policy planning for the use of telecommunications in California state government.

Others

There have been other attempts to bring users or potential users together for discussion of telecommunications issues. In early 1982, the Office of Planning and Research held two one-day conferences. These conferences were intended primarily to provide a forum where state agencies and industry could gather to discuss uses of telecommunications.

In addition, an ad hoc committee of users was convened on at least four occasions by representatives of California State University, Chico. The purpose of these meetings was to provide for a general discussion of the telecommunications plans of each participant, so that each could learn

from the experiences of others, while at the same time discover what services or facilities may be shared. Represented at these meetings were the state police, state library, University of California, California State University, California Public Broadcasting Commission, and Department of General Services, among others. Because these same groups are represented in the State Telecommunications Project being conducted by the CPBC, this ad hoc group has been disbanded.

Legislative Interest

Work on telecommunications is now being done by at least four legislative entities. In 1982, the Assembly created the Subcommittee on Cable, Public Broadcasting, and Telecommunications. The Senate Committee on Governmental Organization, partially as a result of Senate Resolution 49, has held a preliminary hearing on the divestiture of AT&T and its subsequent effect on the state. The Assembly Office of Research has also been involved in cable regulation, computer literacy, and telecommunications generally. Finally, the Legislative Analyst's Office recommended in its Analysis of the 1982-83 Budget Bill that the Legislature hold hearings on the state of telecommunications activity in California state government.

STATE MICROWAVE SYSTEMS

The state maintains at least three distinct microwave systems which are used for varying purposes and operated by different agencies. Basically, microwave communications utilize radio-type signals having a very high frequency. These signals are transmitted point-to-point from one

site to the next. Each site must have a clear pathway to the next site in order for the signal to be received. This requirement tends to limit the location of microwave sites in California to mountain tops or along the central valley. Receiving and transmitting sites within populated areas must be placed on buildings that have uninterrupted line-of-sight to the next site. As a result, finding microwave sites in congested cities such as Los Angeles is becoming increasingly difficult.

Because different microwave systems will most likely utilize pathways in close proximity to one another, the economics of these systems are such as to encourage common use of the systems by diverse institutions. The shortage of microwave sites in populated areas reinforces this incentive.

State System

The primary statewide microwave system in California is operated by the Department of General Services (DGS). This system has 200 sites throughout the state, and is used mostly for data transmission. The state system relies on an electric signal of a continuous nature to transmit information. Thus, it is an analog system, in contrast to a digital system, which uses signals of a discrete nature, with each signal representing information.

The DGS system was planned as the backbone of the state communications system. At the present time, however, it is severely underutilized. Estimates of system utilization range from a low of 10-15 percent of capacity to a high of 35-40 percent of capacity.

The reasons for the system's under-utilization are primarily related to pricing policies, but do involve some technical considerations.

Technical Considerations. The Department of General Services' microwave system was built primarily for the transport of data. According to department representatives, however, a pilot project has been proposed to test the viability of using the system to carry state telephone communications. The pilot project would utilize microwave transmission for state telephone communications between Sacramento and Chico. If the pilot project is successful, the state could achieve significant reductions in telephone charges by transferring major portions of its statewide telephone traffic to the microwave system. Whether the project will be successful, however, is unclear. In addition, the lack of video capability of the state system precludes the possibility of utilizing the state system for video teleconferencing.

Pricing Policy. The primary reason for the underutilization of the state microwave system is the pricing policy followed by the Department of General Services. In effect, the department does not base its rates on the cost of providing specific services to different groups of customers. As a result, the department's policy requires some of the system's users to subsidize heavily other users--and has precipitated numerous complaints by state agencies.

Accordingly, we recommend that the Program Evaluation Unit of the Department of Finance examine the Department of General Services' pricing policies regarding the use of the state microwave system, and report its findings to the Legislature.

Higher Education Systems

In the early 1970s, California State University (CSU) at Chico undertook a feasibility study to determine the viability of constructing its own microwave system. The results of this study demonstrated that for what it would cost to use either the Department of General Services' microwave system or to lease lines from Pacific Telephone and Telegraph for 18 months, the State University could construct its own system. Based on these findings, the CSU constructed an analog system having video, data, and audio capability. This system is operated primarily by CSU Chico. The system, which is based in Chico, reaches south to Livermore, north to Yreka and Susanville and west to Weaverville.

The CSU is planning to extend this system to Bakersfield by 1984. Ultimately, CSU would like to connect the system to most CSU campuses so that all voice, data and video communications among the campuses would be carried on the system. The capitalized cost of the present network expanded to Bakersfield would be \$12 million over a 15-year period. Once constructed, the system should provide for stable communications costs to CSU, even as it accommodates the significant growth in data communications among campuses that is anticipated in the future.

The University of California (UC) also is in the process of planning a microwave system (digital) which would connect all of its campuses. The system, having both voice and data capabilities, would be used heavily by the UC Library system. The University of California has estimated the cost for this system at approximately \$12 million.

It is not clear that two distinct microwave systems are needed to serve the state's two university systems. It is possible that the cost-effectiveness of both systems could be increased if they were integrated at some points. At the present time, however, such integration is not required. In fact, the two systems are not even required to study the potential for integration, although informal discussions between the two segments are taking place. Nor has consideration been given to what the effect would be if the University of California pulled out of the state microwave system maintained by the Department of General Services. Conceivably, this could raise significantly the rates charged to other users, causing utilization of the state system to drop even further.

Other Communication Networks

In addition to the systems maintained by the Department of General Services and the two higher education segments, other departments operate (or plan to operate) their own systems. For example, the Department of Motor Vehicles operates its own data communications system. In addition, the Department of Water Resources indicated at a recent hearing before the Senate Committee on Governmental Organization that it will seek legislation permitting it to build its own microwave system. At the same hearing, Caltrans stated that it is studying the possibility of pulling out of the state data communications system. Caltrans estimates that it could save nearly \$500,000 annually if it contracted for communication services with the private sector.

This development of independent communication systems serving individual state agencies is taking place despite substantial excess capacity in the existing state system. Moreover, it is taking place in the absence of any state structure to facilitate overall planning of and coordination among the several projects. It is likely that effective coordination would produce significant savings to the state over time.

Accordingly, we recommend that the Legislature centralize responsibility for the planning, coordination and development of state microwave systems and other significant communications systems in a single entity.

THE STATE'S TELEPHONE SERVICE

California's state government is Pacific Telephone and Telegraph's (PT&T) largest customer in California. Currently, the state uses 200,000 telephones, which are divided into 9,400 distinct telephone networks. Ninety-five percent of these networks (8,960) cost less than \$1,000 annually. Another 10 cost between \$1,000 and \$10,000 per year, and 60 have annual bills exceeding \$10,000. For these services, the State of California pays PT&T approximately \$85 million annually. Of this amount, 72 percent, or \$61 million, results from the ongoing costs of equipment and local service, and 28 percent, or \$24 million, results from the voice and data switching systems which include Automatic Telecommunications Switching System (ATSS) and ATSS/DS (Data Service).

The Divestiture of AT&T

The American Telephone and Telegraph Company (AT&T) is required by judicial order to divest itself of its 22 operating companies. PT&T is one of those companies. A plan providing for this divestiture was submitted by AT&T in February 1983, and the actual separation is to take place approximately one year from that date. Under the plan, AT&T will retain the Bell labs, Western Electric and the Long Lines (long distance service) Division, while giving up authority over local service and the yellow pages. As a result of this divestiture, PT&T will lose a significant percentage of its revenue base, including the profits it currently derives from long distance service. Profits from this service, along with those provided from the yellow pages, have long been used to subsidize local service.

The PT&T is in the process of restructuring itself into two parts. One part, which will continue to be regulated by the California Public Utilities Commission (PUC), will support ATSS and ATSS/DS, as well as all state Centrex systems (a switchboard type system with centralized control at the local level). The other part will not be regulated, and will compete with other vendors in selling communications equipment and services.

Pacific Telephone recently testified that deregulation could cause telephone rates to increase by 10 percent in 1983-84, and by up to 250 percent between now and 1990. Other estimates of rate increases in the coming year range from 50 percent to 200 percent. No one is quite sure, however, what the precise effects of deregulation will be.

Pacific Telephone also has testified that the long distance leased line system which the company operates on behalf of the state (TELPAC) gradually will be phased out. This system, currently saves the state \$155,000 per month. The PUC has allowed PT&T, beginning in July 1983, to increase rates for this long distance service until rates are comparable to AT&T private line rates.

How the Divestiture Order Affects the State

In the past, the state has had to deal with only a single vendor, PT&T, making it relatively easy to coordinate state telephone communications. This has facilitated an extremely close relationship between the state and PT&T. Now, however, the state finds itself in the position of having to negotiate with a large number of suppliers, and to make complex and technical decisions for the short-term and long-term use of telecommunications. This puts a premium on unified representation of state interests and needs.

The potential vendors with which the state may wish to negotiate include not only PT&T, but a host of other private interconnect companies which provide equipment, services, and maintenance, plus specialized common carriers such as Sprint (a service provided by Southern Pacific Communications Corporation) and MCI, Inc. These specialized carriers now offer long distance rates for residential and business customers that are less expensive than those offered by AT&T. Consequently, these carriers may be able to provide less expensive telephone service to the state than AT&T can, particularly once TELPAK is no longer in operation. In addition,

Graphic Scanning, MCI Communications, and Western Union have all applied for licenses to establish cellular mobile telephone networks--a new type of radio system that will compete with local phone companies.

Missed Opportunities by the State

Our analysis indicates that the state is failing to take full advantage of the opportunities to minimize costs and improve telephone service that now or soon will exist. One such opportunity involves the purchase of telephone equipment--something that generally was not feasible prior to deregulation of the industry. The University of California's Los Angeles campus, for example, currently is studying the feasibility of purchasing a communications network of its own, including telephone receivers and Centrex. UCLA estimates that the initial investment can be completely amortized, using the resulting savings, within a short period of time.

Private industry already is making a significant effort to take advantage of the new telecommunications environment. For example, the Bank of America is planning for its own service after deregulation, and estimates a 20 percent cost reduction once the plans have been implemented.

Rather than examining these and other opportunities for improving services and reducing costs to the state over time, the Department of General Services' Communications Division is merely seeking ways to maintain current service levels at relatively stable rates over time. Our analysis indicates that this approach may cause the state to miss opportunities for increasing the efficiency of its telecommunications

network and achieving cost savings. Representatives of two interconnect companies, ROLM and Compath, for example, have testified before the state Senate Committee on Governmental Organization that they could provide specific services now being provided to the state at less cost. In light of this testimony, the Department of General Services should fully explore the costs and benefits of obtaining services from these and other interconnect companies as well as PT&T.

Accordingly, we recommend that the Legislature direct the executive branch to develop a comprehensive telecommunications plan which takes into account the fiscal and program effects of the new telecommunications environment and the deregulation of the American Telephone and Telegraph Company.

CABLE TELEVISION

Another communications area having the potential to benefit state government is cable television. Here again, however, no specific state agency has been given the lead responsibility for examining the ways in which the state could use cable television in carrying out its programs and activities. In contrast, some local governments have grown adept at incorporating the benefits of cable technology in their own operations.

State Potential

Cable television and related technology has the potential to increase the efficiency and reduce the costs of service delivery over time by the state. As the number of homes wired for cable in the state increases (approximately 50-65 percent of all California homes are anticipated to be

serviced by 1990), the potential for state use of cable increases. Some examples of potential state uses include:

- The training, in-service development, and recertification of state employees utilizing cable distributed video conferences; and
- The use of one-way or two-way interactive cable to better facilitate communication among emergency services during statewide emergencies.

Our review, however, indicates that these and other potential uses currently are not being considered by the state.

In addition, potential cost savings for the state are offered by the direct utilization of cable technology. For example, New York City has realized an annual savings of approximately \$9 million by replacing city-owned telephone lines with less expensive cable lines. New York City hopes eventually to use cable for all point-to-point communications between city offices.

The City of Sacramento and Sacramento County, whose geographic boundaries contain the largest number of state offices and state employees in California, recently underwent an extensive franchising process that resulted in the award to a cable television company of the rights to wire Sacramento County for cable. The state could have made requests to negotiate for rights to transmit its own communications on these cables, in lieu of using data lines leased from PT&T, yet, it did not do so. No formal requests by the state were made during the period when the franchise was awarded.

Some preliminary discussions between the cable company which was awarded the franchise and individual state agencies have taken place since the award was made. Because there is no single state entity with which the cable company can negotiate, however, these discussions are unlikely to result in the state's tapping the full potential of cable television.

Accordingly, we recommend that the Legislature direct the executive branch to make a significant effort to study both the economic and educational aspects of cable.

LOCAL AREA NETWORKS

A "local area network" is a telecommunications network that is confined to a specific group of circuits in a relatively small geographic area. The proliferation of independently developed local area networks within state agencies and educational facilities poses yet another obstacle to the integration of state telecommunications policy.

Currently, there are more than 40 vendors offering telephone equipment and service. Because this equipment is not standardized, the equipment used by one network may not be compatible with that used by another. This will become a serious problem as the state attempts to integrate its communications network. When this occurs, the lack of compatibility among local area networks may result in costs that are higher than necessary. As is true throughout the telecommunications area, no one state agency has been designated by the Legislature to coordinate local area networks.

Accordingly, we recommend that the Legislature assign to a single state entity the responsibility for monitoring the development of state-owned local area networks and promoting the compatibility of these networks.

EXAMPLES OF SUCCESSFUL PLANNING

Thus far, this chapter has discussed a number of areas in which policy planning and direction for telecommunications use by the state is lacking. There are, however, instances in which specific users of telecommunications have taken the initiative in using the new technology, both from a managerial and user standpoint.

California Polytechnic State University at San Luis Obispo

California Polytechnic State University at San Luis Obispo has realized benefits from the coordination of telecommunications activities. A relatively recent study of how the campus uses telecommunications found that the structure of administrative control was inadequate. In response to this finding, the campus consolidated into a single organizational structure the communications section of the Business Affairs Division, which had responsibility for all voice communications, and the Division of Information Services, which had responsibility for all data processing. This coordination has facilitated the planning of an integrated structure for a voice, data, and video communications network for the school. Ultimately, this network will facilitate environmental control, security, the use of computer terminals, and terminals for the deaf, telephone service, and other communications.

California State University, Chico

California State University, Chico, has been particularly aggressive in planning for and utilizing telecommunications in its educational process. As a result:

- The school is completely wired for an integrated telecommunications system. This system includes (1) a video player and controls in every classroom that are connected to a central media center so that tapes can be stored and played without having to physically transport them from building to building, (2) a hookup to the local public broadcasting and commercial television station and radio stations, and (3) an integrated microcomputer system. Additional equipment can be added to the system without the need for expensive rewiring.
- An extensive ITFS (Instructional Television For Students) microwave network has been installed and serves over 400 full-time students. This network offers all upper division courses taught at Chico, except laboratory work, to students living within a 33,000 square mile area. The system has a one-way video and two-way audio capability, allowing students, located in nine learning centers throughout northern California, to communicate with other students and teachers. This network makes higher education accessible to students in an area where mountains, weather, and the large amount of space between sparsely settled communities contribute to a sense of isolation. The state police

is also studying the possibility of using this system for training purposes, in order to avoid the heavy cost of in-person training.

- The library has been fitted with an automated, electronic search and tracking system for books. The system saves a great deal of staff time in connection with the handling of books, from initial cataloging to student use. Book locations may be determined easily through computer search, and computer terminals are rapidly replacing card catalogues, saving time, space, and money.

Much of what CSU Chico has accomplished stems from a feasibility study covering Chico's entire communications network, including requirements for video, audio, and data communications, and encompassing a coaxial cable network, microwave and ITFS system, telephone system, word processing, electronic mail, facsimile and off-campus communications. No such planning process is even contemplated at the state level.

CALIFORNIA IS NOT UNIQUE

Other states are grappling with the same communications problems that California faces. Some have been more successful in resolving these problems than others. The experience of two states--North Carolina and South Carolina--may be instructive in terms of the successful coordination of telecommunications planning.

North Carolina

In 1978, an executive order created the North Carolina Task Force on Public Telecommunications. The task force was given the mandate to study all aspects of telecommunications planning and development so that "North Carolinians may derive the maximum benefit at least cost from the rapid growth of telecommunications technologies." The task force reached two conclusions:

- "More cost effective and efficient use of telecommunications systems would result if personnel in various offices were systematically informed about facilities and encouraged to share them"; and
- "The emerging technologies offer fresh opportunities to improve efficiency."

Based on this report, North Carolina created the Agency for Public Telecommunications as a starting point for coordinating state use of the technology.

South Carolina

In 1981, South Carolina reorganized various groups with different responsibilities within the Department of General Services to effectuate coordinated planning and control of telecommunications. One group was assigned the responsibility for:

- Assessing the need for and use of information technology.
- Administering all government procurement and information technology contracting.

- Evaluating the use and management of information technology.
- Developing policies and standards for the management of information technology throughout the state government.

A second group, the Information Technology Planning Office (ITPO), was made responsible for:

- Initiating a state plan for the management and use of information technology.
- Providing management and technical assistance to state agencies.
- Establishing a referral service for state agencies.

Finally, ITPO was given the responsibility for creating a short range plan which would cover:

- Microwave plus ITFS
- Office automation
- Shared data network
- Technology standards and policies
- Key PBX and Centrex replacement
- Tandem switched network

In these ways, South Carolina has sought to maximize the cost-effective use of telecommunications.

Others

The states of Virginia, Kentucky, and Alaska, among others, have also taken steps to improve telecommunications planning and use. Virginia created the Virginia Telecommunications Council to manage and coordinate investments, uses, facilities and processes of telecommunications.

Kentucky created the Kentucky Emergency Warning System, integrating educational and emergency microwave systems. Finally, Alaska is purchasing its own satellite as a means of communicating efficiently within its own state.

Other countries are also taking steps to coordinate and integrate planning activities. Canada has established a Department of Communications which consolidates both the technology and the delivery of services including the arts and humanities. England, France, and Japan are making strong public investments in the industry.

Private industry also has made strong advances in the use of the technologies. In fact, telecommunications is revolutionizing the manner in which the private sector does business. Merrill Lynch contracts for a cable facility from Manhattan Cable to provide data processing and telephone communications. Many radio stations will soon be broadcasting data on their unused capacity. American General Corporation recently inaugurated a satellite teleconferencing facility which will allow the company to hold video conferences in Nashville, Baltimore and Houston. These conferences will cost \$400 to \$500 per hour, while the cost of physically sending each person to a conference, including travel, hotel and meals, is \$1,000. In Japan, it is predicted that all of that nation's 60,000 modern office buildings will be equipped for video conferencing.

CONCLUSIONS

California state government is a major user of telecommunications. The state's telephone bill is approximately \$85 million annually.

Estimates of all costs associated with state telecommunication use, including the cost of personnel time, space, and equipment, range up to \$900 million per year.

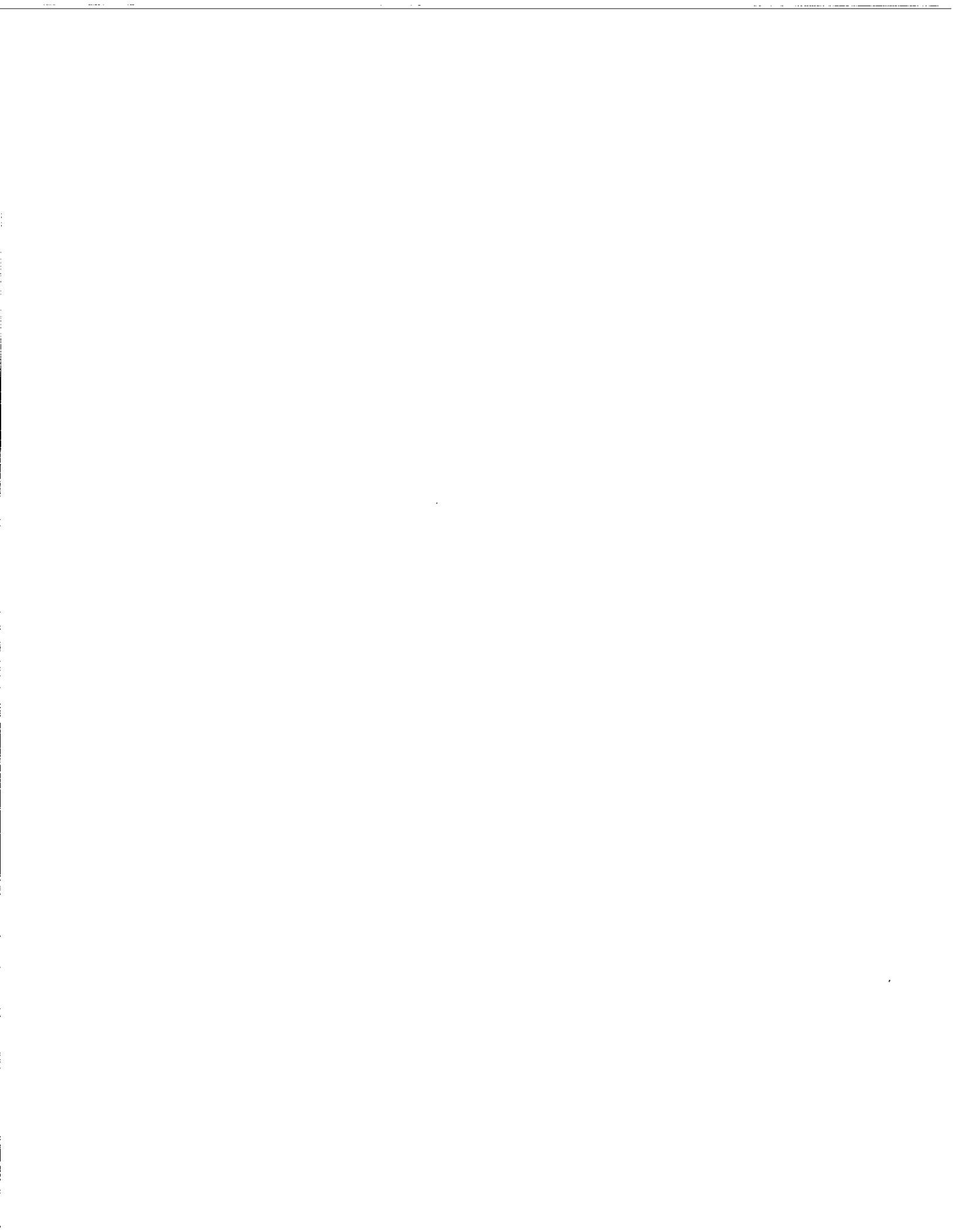
The state, however, has not undertaken telecommunications planning on a statewide basis to coordinate the uses of data, voice and video communications. Nor is a single state entity responsible for coordinating these expenditures and maximizing the benefits from them. No state entity is investing adequate funds to study how the state might best use these new technologies, or which combination of microwave, cable, or wire, for example, would best suit the state's needs. Little is being done to see how emergency services, hospitals, and the state police, among others, might best integrate their services.

A recent article in Computer World listed the following seven requirements for success in using telecommunications:

1. Selecting a clear direction.
2. Designing the right systems.
3. Managing systems development.
4. Building a strong support staff.
5. Achieving high productivity and service levels.
6. Communicating with users and management.
7. Controlling the "information technology revolution "

Our analysis indicates that, given the present organizational and planning structure for statewide telecommunications, California's state government does not satisfy these criteria.

Accordingly, we discuss and recommend in Chapter VI the creation of a new state authority which would encompass the telecommunications responsibilities now assigned to COMDIV, CPBC and the State Office of Information Technology.



CHAPTER VI
COMPUTING IN HIGHER EDUCATION

The rapid advances in computer technology have affected instruction in higher education to a greater degree, perhaps, than any other segment of our society. It is these institutions that will provide the specialists of the future, and the computer will become an even more essential ingredient of the curriculum. Not surprisingly, computers are used extensively by both UC and CSU. This use can be divided into two categories--support of administrative systems (administrative computing) and support of instructional programs (instructional computing).

Section 4 of the 1982 Budget Act does not require that we address issues associated with computing in higher education as part of this study. We have elected, however, to provide background information on this topic. Because the provision of EDP service by the state's 70 public community college districts is the responsibility of locally elected boards, we have not attempted to report on data processing activities within this segment of higher education. Instead, we have confined our discussion to information processing and management within the University of California (UC) and the California State University (CSU) systems.

This chapter contains specific recommendations relative to the CSU's data processing activities because this system is subject to the EDP management requirements set forth in Section 4 of the Budget Act and the State Administrative Manual. This chapter also contains several

more-general recommendations that reflect the impact of advances in computer technology on the educational process.

THE UNIVERSITY OF CALIFORNIA

The University of California is exempt from the requirements pertaining to the management and control of EDP set forth in Section 4 of the Budget Act and the State Administrative Manual. This is because of the University's constitutional status and the fact that it is subject to the authority of an independent Board of Regents. Nevertheless, the Legislature has exercised some control over expenditures for both administrative and instructional computing in past years, in response to the University's requests for considerable General Fund support of these activities.

One example of this control is the language contained in each Budget Act from 1974 through 1978 that prohibited the University from expending funds for any new medium or large-scale computers until the report of a special task force was completed and forwarded to the Legislature. This language was adopted because of the Legislature's concern over the University's failure to adopt a master plan for acquiring and managing its computer resources. The final report issued by the task force encouraged the University to develop comprehensive long-range and annual systemwide and campus plans for computing. Such planning was completed, and the process is now an integral part of the University's management structure.

More recently, the Supplemental Report of the 1982 Budget Act contained language which required UC to report on the extent to which its

policies and guidelines relative to the use of EDP equipment conform to Section 4 of the Budget Act and the procedural requirements set forth in the State Administrative Manual. The University's response to this directive provides a detailed description of its policies and procedures, which are set forth in a series of Business and Finance Bulletins issued by the Office of the Vice President--Financial and Business Management. These policies are implemented at the campus level.

Our review of the University's policies and procedures indicates that the University does indeed have in place the policies and structure needed to manage its computing resources.

The Current Computing Environment

According to recent information provided by the University, the value of owned computers and related devices installed in the UC system, including word processing equipment, totals \$131 million. This amount does not include the costs of leased equipment and EDP personnel resources.

The administration of systemwide computing is under the direction of the Assistant Vice President for Information Systems and Computing, who reports to the Vice President for Financial and Business Management. The administrative information necessary to manage the University is contained in the systemwide "corporate" information system. Each campus is required to provide specified data to the office of the President. The implementation of this system and the development of other common administrative systems for use by the campuses is under the direction of this Assistant Vice President.

Throughout the UC system, the emphasis in recent years has been on the decentralization of both computing resources and the authority to manage these resources. As part of this trend, the University has developed communications networks to meet the requirements for office automation and provided computers to meet instructional and administrative requirements. Consequently, the control of campus computing equipment acquisitions and the development of central systems has been de-emphasized.

Part of the rationale for decentralization is that campuses have different computing requirements. The University believes that systems developed by the campuses to meet these requirements will, in general, be more effective than centrally developed and centrally imposed systems. This approach has resulted in the discontinuation of a central computing center maintained for systemwide administration. It is also reflected in a trend toward less reliance on campus computing centers, as various departments install their own computing systems. Because these centers operate on a fully reimbursable basis, some of them are experiencing an erosion in their financial base of operation. As a consequence, it is possible that regional computing centers ultimately may evolve to serve those campuses which are not able to maintain independent campus computing centers.

In the area of instructional computing, the University has increased its base of computing systems in an effort to keep up with faculty and student demand which seems always to exceed computer capacity. In some cases, additional student fees have been imposed for certain courses which

require substantial computing support, as one means to provide increased funding needed to meet faculty and student demand. The revenues from these fees, however, have been relatively insignificant. In general, students are not charged "laboratory" fees for instructional computing support.

THE CALIFORNIA STATE UNIVERSITY

The California State University provides administrative and instructional computing support to its 19 campuses and the Chancellor's office through a large central computing facility located in Los Angeles and individual computer centers located on each campus. CSU's systemwide expenditures for computing services will total approximately \$37.5 million in 1982-83.

Unlike UC, CSU's approach to systemwide computing is centralized, and relies heavily upon the Division of Information Systems (DIS). This division is responsible for the development of both systemwide computing policies and instructional and administrative systems. In addition, DIS performs a role very much like the State Office of Information Technology in the Department of Finance with respect to the EDP activities of the 19 CSU campuses. Consequently, CSU puts an emphasis on the central control of campus computing equipment acquisitions.

In general, the DIS computer facility and campus computing centers do not bill for the use of computer resources except with respect to "non-state" activities.

The CSU has satisfied its equipment requirements for computing support in what we consider to be a cost-effective manner. This is best

illustrated by the system's success in completing the procurement that replaced the central computers on each campus with new, modern equipment, at a cost of \$47.5 million over seven years. As a result of its decision to undertake a comprehensive systemwide acquisition, the CSU was able to obtain 20 computers from the Control Data Corporation at a discount of 64 percent from what it would have cost to procure the computers individually.

Review the Role of DIS

The emphasis of the CSU during the late 1970s and early 1980s was on upgrading its computing resources. This has now been accomplished. Consequently, we believe that the time has come for the system to review the role that the DIS should play during the remainder of this decade and beyond.

More and more, it appears that the traditional emphasis on controlling the use of computing technology is not going to be cost-effective in the 1980s. Instead, the emphasis will have to shift to managing information and providing adequate computing and communications resources to meet the requirements of those who must work with the information. The objective of this approach is to facilitate the use of modern information management technology, where the emphasis on control is replaced with an emphasis on standards and policies within which the technology can be used effectively. This shift in emphasis is evident in other states. For example, the National Association for State Information Systems indicates that in many states, there has been a trend away from having an all-inclusive central authority toward having a central coordinating body for EDP.

Our analysis of systemwide computing use indicates that the tendency to emphasize the control of computing technology has resulted in considerable effort being expended on protracted discussions between those who have a requirement for a computer-based system and those who have the authority to approve such systems. In many instances, it is not apparent that the cost associated with the delay in meeting user requirements has been offset by the presumed savings attained by the control function.

We believe that a more productive expenditure of state resources would occur in an environment which minimizes disputes over how information processing technology is applied, and instead facilitates the satisfaction of user requirements within generally accepted standards and reasonable policies. It is not unreasonable to assume that DIS, which operates on a traditional basis--strong central control--could be more effective were it to focus on those areas where there is a demonstrated need through the establishment of (1) standards, (2) systemwide policies, and (3) support services which respond to campus-initiated requests.

Accordingly, we recommend that the Legislature direct the CSU to review the role of the Division of Information Systems, with the aim of placing more emphasis on systemwide coordination and policy development.

Centrally Developed Administrative Systems. The Chancellor's office, through DIS, is in the process of developing major information systems for installation on the campus computing center equipment. These systems include the Student Information Management System (SIMS) and the Integrated Business Systems (IBS). Major components of SIMS, the Computer Assisted

Registration System and the Student Records System, have been installed on several campuses, with additional installations scheduled for 1983-84. The Integrated Business Systems (IBS) project was initiated based on the findings of a CSU task force that there was a critical need to improve all aspects of business operations by designing and implementing computer-based systems for accounting, budgeting, payroll, procurement, property control, general financial management, and other business functions. Phase I of IBS currently is scheduled for systemwide operation beginning July 1, 1983.

During our field visits to various campuses, it became apparent that there existed among the campuses mixed opinions as to the usefulness of centrally developed systems. In fact, three campuses have elected not to have modules of SIMS installed on their campus computing centers. Further, among campuses which are scheduled for installation, questions have been raised as to whether a system designed for all campuses, from the largest to the smallest, is going to be cost-effective for each campus. The DIS believes that systems such as SIMS and IBS will have a net benefit to the CSU system. This belief is based on the principle that it is less costly to develop and maintain a uniform system than to independently develop and maintain separate systems for each campus.

An important corollary to this principle, however, is that the presumed net benefit is dependent on the actual effectiveness of the uniform system in meeting the varying requirements of each installation. California State College, Stanislaus, a small campus in a rural location, does not have the same information processing requirements that the San

Francisco campus has. Some campus officials question the practicality of installing comprehensive information systems at campuses which they believe could operate more effectively through the use of a system tailored to the information processing requirements of the particular campus.

In addition to questions regarding the cost-effectiveness of centrally developed systems, questions have arisen regarding the effect of these systems on campus personnel and computing center resources. One campus, for example, was expected to provide a team of up to five persons, some on an 80-percent-time basis, to plan for and coordinate the installation of IBS on that campus. Due to resource constraints, the campus did not form the team or even designate a project leader, despite having been informed in late 1981 that a project leader and team would be required. This (1) raises a question as to the lack of demonstrated campus support for IBS and (2) points out that implementation of a systemwide information system of this size requires a considerable redirection of campus resources.

An additional area of concern involves the impact of these new systems on campus computing equipment resources. During the testing of the Student Information Management System at CSU, Fresno, for example, it was learned that additional disk storage capacity would be required. The adequacy of existing disk storage capacity is already an issue on campuses because of the continuous increase in demand for campus computing resources in general. Added requirements imposed by SIMS resulted in a Trustees' request for two additional disk drivers per campus. In addition, each new

system installed at a campus computing center consumes that much more computer capacity, thus accelerating the point in time when campus computers must be upgraded.

For all these reasons, we recommend that the continued development and installation of systemwide information systems be reevaluated to determine the extent to which they are likely to meet individual campus requirements in a cost-effective manner, including consideration of the effect of these systems on campus computing resources.

Accordingly, we recommend that the Legislature direct the CSU to reevaluate the continued development and installation of systemwide administrative systems in order to determine the extent to which these systems are likely to meet individual campus requirements in a cost-effective manner.

SHOULD USERS PAY FOR COMPUTING SUPPORT?

The cost of CSU's computing resources is not supported by the users of those resources through a charging system (with the exception of certain specially funded projects). There is a pseudo-charging system for some computer support, based on the redirection of positions by some users ostensibly to cover the cost of added computer support services to meet unique user requests. The extent to which these position allocations actually cover added computer support costs, however, appears to vary.

We note that other state facilities, such as the Teale Data Center and the Health and Welfare Data Center, currently charge their clients for computing services. This is done on the premise that an effective charging

system is the most valuable management tool available to the executive responsible for computer operations. Further, charging for computer service based on usage encourages the user to manage the use of the resource in a cost-effective manner.

We believe that a careful analysis of the alternative methods available for managing the CSU computing resource allocation should be completed. According to DIS, no such analysis has been made.

Accordingly, we recommend that the Legislature direct the CSU to provide it with an analysis of alternative methods for allocating computer resources.

OPPORTUNITY FOR SHARING

During our campus visits, we were made aware of relatively small-scale, but very useful, applications of computers to meet campus administrative requirements. In some instances, student interns were used to develop applications because sufficient programming staff were not available through the campus computing center. Some applications were developed for micro- or minicomputer systems which are separate from the campus computing center. Often, this productive use of the computer is known only to the campus which developed the application, even though it may have potential applicability to other campuses.

DIS, which meets periodically with all campus computing center directors and provides support for the development and installation of major systemwide information systems, should coordinate a cooperative effort directed toward an increased sharing of useful applications of

computer technology. One advantage of this type of sharing is that smaller applications are easier to install, thereby providing benefits in a relatively short amount of time. In this manner, traditional opposition to the use of computers based on the long lead-times and frustrations associated with the implementation of large systems could be mitigated.

Accordingly, we recommend that the Legislature direct the California State University, with the cooperation of campus representatives, to identify methods for improving the sharing of computer applications among the campuses.

INSTRUCTIONAL COMPUTING

Growth in Higher Education

Instructional computing represents a major growth area in both CSU and UC. Every campus we visited in the CSU system was in the process of increasing, or had recently increased, the number of computer terminals or desktop microcomputers available for student and faculty use. We were often informed, however, that even with these increases, there was insufficient capacity to meet the demand for computer access or to provide the level of support considered necessary to retain a viable educational program.

For example, several private universities recently have announced ambitious programs to provide computer "literacy" to every one of their students. Carnegie-Mellon University and Drexel University, both in Pennsylvania, and Clarkson College of Technology in New York, have announced that entering students must obtain a personal computer. These

computers, which may be linked to a campus computing facility as well as operated on a stand-alone basis, will have to be paid for by the students.

Furthermore, CSU administrators responsible for teacher preparation express concern over developing teachers who are less computer literate than their pupils. This concern may be well-founded, give a recent state Department of Education Survey which indicates that 18 percent of the state's 6th-graders have access to a home computer.

Growth in Primary and Secondary Education

The increased use of instructional computers also is occurring in the nation's primary and secondary educational systems. A recent report issued by the U. S. Department of Education indicates that although the number of microcomputers installed is still relatively insignificant--about one for every 10 classrooms--the number tripled in a two-year period. A dramatic increase may result from legislation under consideration in the Congress which would provide a tax credit for computer equipment donations to schools. One major manufacturer of personal computers has reportedly announced its intention to donate a computer to every school if the legislation is enacted. Similar legislation already has been enacted in California through Ch 1559/82.

In Minnesota, the increased availability of computers for instructional purposes across all educational systems has been encouraged through the Minnesota Educational Computing Consortium, formed in 1973 by a coalition of the state's educational systems. The consortium provides the state's 435 school districts access to a statewide computer time-sharing

system, provides discounts on the purchase of microcomputers, training and software, and underwrites software development which is then sold on a worldwide basis.

CHAPTER VII

OFFICE AUTOMATION AND OTHER ISSUES

In this chapter we discuss a variety of issues involving uses of information technology. These include office automation, microcomputers, paperwork management and the security of "sensitive" information systems, such as automated disbursement systems.

OFFICE AUTOMATION

The term "office automation" is a frequently used and frequently misunderstood term. Indeed, as noted earlier in this report, the September EDP Survey results indicate that a majority of the state's top management does not have a clear understanding of what the term means. This is not surprising, in view of the fact that the state has not developed any plan for office automation on a statewide basis, nor has it established an effective educational program. In failing to promote the use of this technology on a comprehensive basis, the state is missing numerous opportunities to reduce state costs and increase program effectiveness. This is because the application of office automation technology offers productivity increases not only for clerical and secretarial staff, but for management and professional staff as well.

Simply stated, "office automation" refers to the application of modern information processing technology to typical office procedures. Far more sophisticated than merely "word-processing"--which is also computer-based--a complete office automation system would include: (1)

word-processing with extensive text-editing, formatting and table creation capabilities, (2) electronic filing, (3) electronic mail, (4) electronic phone messages, (5) a personal computing capability, and (6) connection through communications devices to large computing systems for retrieval of information contained in data bases stored in the large computers. Such a system is not just on the drawing boards; it is being installed today.

The terms "electronic filing", "electronic mail" and "electronic phone messages" refer, respectively, to the capability of (1) placing information currently stored in filing cabinets onto a computer-accessible media such as a magnetic disk, (2) sending messages from one computer terminal to another through electronic media, and (3) receiving and digitizing phone messages for retrieval and response at a later time, either through a direct phone conversation or, if the caller is on the computer network, to the caller's terminal through electronic mail.

Practical Applicability

According to the September EDP Survey, the use of office automation in the executive branch of state government is limited primarily to word-processing. The survey results indicate that fewer than five departments are planning to install electronic filing or electronic mail.

One of the more imaginative uses of this technology in state government is underway at the Jules Stein Eye Institute of the UCLA Medical Center. The institute has acquired a medical software system and a multi-user word-processing system which the institute will use in moving toward a "paperless" mode of operation within a three-year period. The

system is intended to eliminate much of the paperwork in the hospital by providing physicians, researchers and support staff with direct access to automated information systems.

In the private sector, office automation is growing much more rapidly than it is in state government. Many companies already are relying on office automation to control administrative costs. For example, the United Services Automobile Association, one of the largest automobile insurers, determined that its use of computer-based systems permits one person to do in 20 minutes five basic tasks that previously required five persons one and one-half days to accomplish.

A study prepared by a major management consulting firm in 1981 concluded that the proper application of office support tools could reduce the number of white-collar workers needed by an average of 15 percent, by 1985. Given that salaries and benefits for white-collar employees represented about 58 percent of the cost of maintaining the average office in 1980, this reduction would have a significant impact on administrative costs.

State Framework for Planning

The Legislature, aware of the increasing proliferation of non-compatible word-processing systems and the absence of an overall statewide policy and planning framework within which office automation can occur, has required the Department of Finance and the Department of General Services to develop, publish and maintain in the State Administrative Manual standards and guidelines relating to the acquisition of these

systems. This requirement, which is contained in Section 4 of the 1982 Budget Act, requires the development of standards and guidelines designed to (1) minimize the proliferation of non-compatible equipment and software, (2) facilitate potential integration of office automation equipment with remote or central data processing systems, (3) maximize the opportunity to acquire equipment through master rental or purchase agreements with equipment suppliers, and (4) ensure that office automation equipment, mini- and microprocessors and software acquisitions are based on appropriate feasibility study reports.

This is yet another example of how the executive branch of state government has been slow to respond to opportunities and problems created by modern information processing technology. In our judgment, the State Office of Information Technology (SOIT) should have established the standards and policies sought by Section 4 of the 1982 Budget Act at least one year ago. It should not have been necessary for the Legislature to prompt the development of these policies, particularly given that the California Information Technology Advisory Board had called attention to the problem in November 1981.

In a comprehensive report entitled "An Action Plan for the Effective Implementation of Automated Office Technology in California State Government," CITAB stated that "State managers don't understand the capabilities of, or potential benefits made possible by, the widespread use of automated office technologies, and don't understand the danger inherent in our present course." One year later, the September EDP Survey indicates

that state managers still don't understand the implications of office automation.

The report states further that " . . . the state has no clear commitment to encourage, coordinate or direct automated office growth in a manner that optimizes the use of the limited resources available." This statement, made over one year ago, is still accurate.

To the extent that office automation systems offer real savings to state government--and all indications are that this is the case--the failure to implement appropriate plans and policies governing these systems perpetuates higher-than-necessary expenditures for personnel.

While the state has made little headway in standards development and planning activities, the California State University (which is subject to SOIT's authority) has shown considerable progress in this direction. In November 1982, CSU published a comprehensive policy regarding office automation, including standards, feasibility study requirements, suggested selection criteria, and funding and management policies.

Accordingly, we recommend that the Department of Finance report to the Legislature on its progress in implementing office automation policy as required by the Budget Act of 1982.

Master Acquisition Agreements Should be Reconsidered

One of the requirements set forth in Section 4 of the 1982 Budget Act is that office automation standards and guidelines to be developed by the Department of Finance and the Department of General Services maximize the opportunity for state agencies to acquire equipment through master lease or purchase agreements with equipment suppliers.

SOIT and the Department of General Services already have developed master agreements for computer terminals, data entry services and desktop computers (CSU only). These agreements were developed on the premise that the guarantee of quantity leases or purchases would result in the lowest unit cost to the state.

Recently, CITAB submitted functional specifications for office automation equipment to the Department of General Services' procurement office. We understand that the department may conduct one procurement, and make an award to one prime contractor.

Our analysis causes us to conclude that the state should not undertake a single procurement with one vendor. Given the rapid changes in the technology of office automation, it would be preferable to award a number of master agreements and allow departments the option of selecting the system which best meets their requirements. Further, by committing itself to a particular system, the state would be restricting its ability to take advantage of technological developments in office automation during the 1980s. An acquisition strategy based on a number of different systems could be cost-effective, provided that appropriate standards and guidelines, recommended by CITAB in 1981 and required by the Legislature in the Budget Act of 1982, are in place.

Accordingly, we recommend that the Legislature direct the executive branch to adopt a policy prohibiting the awarding of any contract for office automation equipment which would limit the state's ability to take advantage of more cost-effective systems.

Health, Safety and Ergonomics

The rapid increase in the use of cathode-ray-computer terminals, the familiar terminal with a keyboard and television-like screen, has been accompanied by numerous operator complaints of fatigue, eyestrain and back pain. In 1981, the National Institute of Occupational Safety and Health issued a report describing the potential hazards of video display terminals. In February 1982, the Canadian Department of Communications reviewed the health, safety and ergonomic aspects of these terminals. The department's report suggests the desirability of complying with standards which take into consideration the possible effects of video display terminals on the health and productivity of terminal operators.

"Ergonomics" is concerned with the application of biological and engineering data to problems of human beings and machines. It has received considerable attention in recent years because of the widespread belief that traditional approaches to the design of offices and furniture must be replaced with new approaches built around modern office automation systems. Several studies have been made in order to determine how the productivity improvements afforded by office automation can be realized. According to one computer furniture specialist, "If people are comfortable, productivity will be higher than in an office where human needs are overlooked."

Because use of office automation technology in state government will increase sharply in the future, the state should begin immediately to develop appropriate policies, standards and guidelines assuring the health and safety of those operating this new technology.

Accordingly, we recommend that the Legislature direct the executive branch to assess the health, safety and ergonomic aspects of office automation in state government and develop appropriate policies, standards and guidelines to protect employees and enable the maximum productive use of office automation systems.

STATE PAPERWORK REDUCTION

In 1975, the Congress established the Commission on Federal Paperwork and directed it to study and investigate the statutes, policies, rules, regulations, procedures and practices of federal government relating to the gathering, processing and dissemination of information. The purpose of this study was to define methods of better managing and controlling the federal government's information processing activities.

The Commission was established in response to allegations that the federal government's recordkeeping and information processing requirements impose billions of dollars in costs on state and local governments and the private sector each year. The study was also prompted by concern over the federal government's demand for more information, and the resultant added cost to all levels of government and the private sector.

The federal commission, in its report to the Congress, noted that ". . . government bureaucrats must stop regarding data and information as a free good . . . Before organizations can use information technology effectively, they will have to focus more attention on information value and use in two dimensions: management of the information process and management of the data resources."

In response to the commission's report, Congress enacted the Paperwork Reduction Act of 1980 (Public Law 96-511). This act established goals for reducing federal paperwork, assigned to the Office of Management and Budget central oversight in the information policy area, prescribed the duties of federal agencies, provided for review and approval of federal information collection activities, and required a central index of information maintained by the federal government.

The State of California, with its extensive paperwork requirements and numerous information processing capabilities, undoubtedly has information management problems that are similar to those which prompted the Congress to establish the Commission on Federal Paperwork. In fact, during the preparation of this report, we became aware of the difficulty experienced by state managers and staff in obtaining information from systems which already have been automated, ostensibly for the purpose of improved information management. Now, with the emergence of office automation systems and the potential for increasing dramatically the amount of state information maintained in an automated form, it would appear appropriate for the state to determine whether a comprehensive paperwork reduction effort similar to that undertaken by the federal government should be initiated in California.

Accordingly, we recommend that the Legislature direct the executive branch to evaluate the effectiveness of the federal Paperwork Reduction Act of 1980 to determine whether a similar measure should be enacted in California.

CENTRAL INFORMATION SERVICES

If the information center concept discussed in Chapter III proves beneficial to departments (as we believe it would) a variation of this concept should also be useful on a statewide basis. At present, there is no central index of the information maintained in an automated form by various state departments. Consequently, when departments seek to determine the existence or location of information which they require, they usually are told by the State Office of Information Technology to "phone the data centers." The data centers, however, are not aware of all the information that is maintained at their facilities.

We conclude that some form of a central index to information systems should be maintained on a current basis. Our analysis suggests that such an index would be valuable. It could also prove to be cost-effective, provided that the scope of the central index was determined based on a comparison of the benefits to be gained from the index with the cost of establishing and maintaining it. Such an index could be maintained in an automated form in one central location, such as the Teale Data Center, where it could be accessible to other state entities.

Several years ago, when the central EDP control function was in the Department of General Services, the Systems Analysis Office issued a guide to automated filing systems which described the data elements in various automated systems. This guide was not maintained, and therefore quickly became obsolete. Consequently, if a central index is established, it is essential that adequate resources be devoted to keeping it current.

There is also a need for a central repository of technical documents such as feasibility study reports, system procedure manuals, requests for proposals and proposal evaluation plans. These documents typically must be prepared during the information system development and approval process. Currently, a department with limited EDP experience needing examples of these documents must make random inquiries to see what is available. These inquiries, however, may not turn up examples that should be used as models. It is for this reason that we believe a central repository of high-quality technical documents would facilitate the effective use of EDP technology.

Accordingly, we recommend that the Legislature direct the executive branch to establish a central information service to provide: (1) information pertaining to automated information systems maintained by the state, and (2) examples of documentation required of departments in the development of information systems.

MICROCOMPUTERS

Microcomputers, sometimes referred to as "personal" computers, are fast becoming commonplace in the everyday environment of the office and home. Although there is a good deal of speculation as to just how useful a personal computer in the home really is, there is considerable evidence from the business sector that the personal computer is playing an important role in increasing productivity. The Travelers Insurance Group, for example, has concluded that the use of personal computers is a cost-effective alternative to the traditional video display terminal linked to a company computer. As of July 1982, Travelers had authorized the

distribution of some 250 personal computers from a company "store". Rockwell International is motivating its engineers to purchase personal computers for home use, through a company discount program. This program is intended to encourage engineers who have little or no computing experience to achieve computer literacy. According to Rockwell, "Microcomputers are tools that are going to be used more and more widely in the business community, and it's to the corporation's advantage that our people learn how these tools should be used."

The use of microcomputers in California state government is still relatively insignificant. According to the September EDP Survey, there are at least 385 microcomputers in state government, of which 331 are in the California State University system where they are used primarily for instructional purposes. Among the major departments, EDD is encouraging the use of microcomputers on an "experimental" basis. We understand that the Department of Health Services is also investigating the use of microcomputers.

With so many microcomputers, the CSU has been faced with the problem of non-compatibility--that is, the proliferation of microcomputers which could not be integrated with campus computing systems. To avoid this problem, CSU has established standards for the acquisition of these devices. The Employment Development Department in Sacramento has also established such standards.

The likelihood of significant growth in the state's use of microcomputers led the Legislature to add language to Section 4 of the 1982

Budget Act requiring the Department of Finance and the Department of General Services to develop and publish standards for the acquisition and uses of microcomputers. These standards are intended to ensure that, to the extent practical, microcomputers are compatible with existing computing systems.

The standards required by Section 4 apparently are still under development. Considering that both CSU and the Employment Development Department have already developed their own standards, it is unclear why appropriate statewide standards have not been published by now.

Accordingly, we recommend that the Department of Finance inform the Legislature as to the status of its efforts to develop statewide policy and standards regarding the acquisition and uses of microcomputers.

CALIFORNIA INFORMATION SYSTEMS IMPLEMENTATION COMMITTEE

The California Information Systems Implementation Committee (CISIC) was established by Chapter 1237/71, to provide oversight of the efforts then underway to consolidate the state's computer operations. The committee consists of 12 designated members of the legislative and executive branches.

Shortly after Chapter 1237 was enacted, the consolidated data centers were established, thereby removing one of the major reasons for establishing the committee. Consequently, committee meetings in recent years have served primarily as a forum for discussion of current EDP issues. Meetings usually have been limited to one hour, and in recent years have occurred on an infrequent basis.

For these reasons, it is not clear that the CISIC, in its current form, can be effective in providing policy guidance for information processing technology in the 1980s. If the Legislature concludes that an oversight committee is needed, we recommend that it be limited to the legislative branch and take a more active role in ensuring that the problems resulting from the lack of adequate policy formulation and planning on the the part of the executive branch are resolved.

Accordingly, we recommend that the Legislature reassess the need for the California Information Systems Implementation Committee and reestablish the committee as a legislative oversight committee if it is determined that such a committee is still warranted.

SECURITY OF INFORMATION MANAGEMENT SYSTEMS

Section 4841 et. seq. of the State Administrative Manual contains detailed policies and requirements pertaining to the confidentiality of information maintained in state information systems, and the physical and electronic security of these systems. These policies and requirements were adopted to ensure that confidential information is not disclosed to unauthorized persons, that costly equipment and data files are not damaged or destroyed through carelessness or deliberate acts of destruction, and that automated information systems are not subject to unauthorized manipulation.

The policies and requirements set forth in the State Administrative Manual generally are consistent with modern information system management practices.

The Issue of Security

The matter of security is critical, primarily because of the state's vulnerability to computer-related crimes. Estimates vary as to the extent to which computer-related crime occurs in the private sector. Many observers believe that a significant amount of computer misuse is not reported, to save companies from being embarrassed. For example, the Federal Bureau of Investigation estimates that only 12 percent of crimes of this nature are reported. Accordingly, the annual loss from computer-related crime in the U. S. is estimated at anywhere from \$100 million to \$300 million.

Without proper security measures, computer-assisted crime is relatively easy to commit, and the payoff is relatively high. In fact, all experts agree that no existing conventional computing system is fully secure, and that unauthorized persons with sufficient skill can surreptitiously disable or bypass the access control features of virtually any conventional system. This has been demonstrated time and time again, with results ranging from messages left in the system by University of California students seeking to demonstrate that the controls can be bypassed, to a \$21.3 million bank theft.

Campus computing center directors in the California State University system are repeatedly challenged to devise new and improved methods of restricting students from simply "playing games" with security systems, or gaining access to administrative records such as grades or financial status. According to an extensive article on computer system security in

the Los Angeles Times, it has been estimated that as many as 150 individuals in California have the skill to break into a computer system and alter or destroy data. The incentive to break into computer systems is, according to Federal Bureau of Investigation estimates, provided by the relatively high payoff--\$430,000 on the average for a computer-related embezzlement, versus \$23,000 for one not involving a computer.

Significance to California State Government

The significance of computer crime to California state government is not immediately apparent because there has been no disclosure of any major misuse of state computers. In other governmental jurisdictions, however, such misuse has occurred. In New York City, a Board of Education programmer was arrested and charged with illegally using the school system's computer to store programs and data relating to the breeding of racehorses, his personal business, a mailing list and his resume'. Up to 200 students at the University of Toronto used about \$15,000 worth of computer time without paying for it by illegally using a "secured" access code. In Pennsylvania, an employee of the Office of State Inheritance Tax offered to bypass the office's computer to reduce or mark taxes as paid. A former employee of the Los Angeles County Sheriff's department was able to obtain restricted information from computer files simply by telephoning the data center and identifying himself as a police officer. In Dallas, Texas, four municipal court employees were arrested for altering traffic warrants issued to traffic violators. This misuse of computers was especially significant because it resulted in the removal of the violators' names from a regional wanted persons system which served sixteen Dallas-area counties.

These examples demonstrate the vulnerability to misuse of automated governmental information systems. Further, the incidence of reported misuse of government computers demonstrates that no jurisdiction can be complacent. According to the National Association for State Information Systems, "It is not a question of IF but WHEN. When will the first state be faced with a major computer crime or scandal?"

California state government, which maintains very large automated systems to process billions of dollars annually through such applications as payroll, tax collection, and various disbursements, has ample cause to be concerned about the security of its automated systems. Yet, when we attempted to ascertain compliance with but one aspect of the state's extensive security requirements--the requirement for an Information Security Officer in each agency maintaining automated systems--we were informed that the position of Information Security Officer in one key state agency had remained vacant for two months, while another major agency apparently had not even complied with the requirement to designate an Information Security Officer.

Vulnerability Necessitates Review

The vulnerability to misuse of any computer system, the difficulty in detecting misuse, the value of the state's information systems and opportunity for fraud through their misuse, all argue strongly for a review of state policies and requirements pertaining to information system security. One method for accomplishing such a review and at the same time providing for a more effective ongoing security program would be to

establish a computer risk management function. This was the approach taken by the Manufacturers Hanover Trust Co., which established the Computer Risk Management Department to develop security policies and procedures for identifying, measuring and controlling risks associated with computer fraud. If such a function is established within state government, it should be linked with the Auditor General's investigations of alleged computer fraud. Further, information collected by the Auditor General on possible deficiencies in state security procedures should be made available to all departments with data systems.

Accordingly, we recommend that the Legislature direct the executive branch to (1) review and modify, as necessary, policies and requirements contained in the State Administrative Manual regarding the physical and electronic security of state information systems, (2) determine the extent to which state agencies comply with these policies and requirements, and (3) develop a plan to bring high-risk state agencies into compliance.

CHAPTER VIII
THE MANAGEMENT OF INFORMATION PROCESSING
TECHNOLOGY IN THE 1980s

Throughout this report, we have made numerous recommendations designed to correct what we find to be serious problems with the state's management of modern information processing technology. Our analysis indicates that these problems can be attributed to a number of factors. First, policy-making responsibility with regard to information systems is fragmented. This is particularly evident with respect to telecommunications planning. Second, there has been a tendency to place emphasis on controlling the use of information processing technology, instead of on developing policies and standards for facilitating its use. Finally, as discussed in this chapter, we find that the state agency primarily responsible for overall management of information systems--the State Office of Information Technology (SOIT) in the Department of Finance--has failed to develop appropriate state policies and standards in a timely manner that take into account the significant changes taking place in computer and telecommunications technology.

Consequently, in this chapter, we discuss the need for a new organizational structure capable of developing policies and plans to facilitate the management of information processing technology during the remainder of this decade and beyond.

STATE OFFICE OF INFORMATION TECHNOLOGY

A brief history of the state's efforts to coordinate and control EDP is included in Appendix B to this report.

Since 1971, the central control function has been performed by the Department of Finance through the State Office of Information Technology (formerly, the Electronic Data Processing Control and Development Unit). This office, which has comprehensive EDP planning and control responsibilities, is authorized 14.5 positions in the current year, and has a budget of approximately \$900,000. By statute, the office is responsible for the cost-effective use of information technology in state government--a \$325 million-per-year program, when all EDP expenditures are considered.

Significant Span of Control

Among the responsibilities which the Government Code assigns to the Department of Finance in the information systems area are the following:

(1) EDP advocacy, (2) budgetary and expenditure control, (3) the designation of which data center shall provide EDP services to each state agency, (4) planning, (5) policies and guidelines for the exchange of data between data centers, (6) equipment management, and (7) the physical and electronic security of EDP equipment and systems.

The requirements established by the department in carrying out its control responsibilities in the EDP area are set forth in the State Administrative Manual. The Legislature has sought to assure that these requirements are followed by including in Section 4 of the Budget Act language that prohibits funds from being expended for EDP activities unless

the criteria contained in the State Administrative Manual have been satisfied. Section 4 also grants additional authority to the department in the exercise of its EDP management responsibilities. From time to time, the department issues Management Memos establishing new EDP-related policies or modifying existing policy.

In carrying out its control responsibilities, the department has established a comprehensive set of requirements with which each state department, with few exceptions, must comply in developing an EDP capability. As a result, SOIT is involved to some degree in the review and approval of (1) feasibility study reports, (2) departmental EDP staffing, (3) EDP equipment, supplies and services procurement, (4) data communications, (5) microfilming technology, (6) word-processing, (7) data entry, (8) post-implementation reviews, (9) critical design reviews, (10) equipment management, (11) EDP training, (12) computing in the CSU system and other facets of the use of information technology.

Adequacy of SOIT

Central control functions, such as those that the SOIT is required to perform, generally are not viewed with favor by the departments that are subject to the controls. Thus, it is not surprising that over the years, the SOIT has been criticized by the line departments as being too inflexible.

Despite attempts to establish within the office a blend of EDP advocacy and control, the SOIT performs what essentially is a control function, consistent with the traditional role performed by the Department

of Finance. In recent years, however, the office has relaxed its control to the point where today it is not as widely perceived by departments as an inhibiting factor to the effective uses of EDP technology, as it was only a few years ago.

According to the September EDP Survey, most departments believe that SOIT is responsive, has met their needs and has technical capability. Nevertheless, those state managers we interviewed still maintain that the EDP control process is too time-consuming and frustrating. To the extent this view discourages agencies from dealing with the SOIT, it may result in the state failing to take full advantage of the opportunities offered modern information management technology.

The SOIT has attempted to expedite its review process by delegating EDP authority to individual departments, thereby freeing up resources that could then be used for the kind of statewide planning and policy formulation needed to promote the cost-effective use of modern technology. This, however, has not occurred. Despite the delegation of authority to the line departments, SOIT has not effectively stepped up its planning and policy-making activities. Instead, the office has a tendency to react rather than lead. As a result, we conclude that the information system's planning and management within state government is not adequate.

Moreover, in some critical areas where the SOIT has developed new policies, there has been little or no followthrough on implementation of the policies by state agencies. For example, the SOIT has published extensive requirements in the manual pertaining to the security and

confidentiality of automated information. As discussed earlier, one of these requirements is that each state agency maintaining an automated information system designate an Information Security Officer, with specified responsibilities. When we contacted SOIT in December 1981 to request the list of Information Security Officers, however, we learned that its list had not been updated since 1976.

In summary, the rapid change in information management technology occurring today requires the development of appropriate state plans and policies, if the state is to take full advantage of the opportunities offered by this technology. We find that the state is falling behind in this area because these plans and policies have not been developed. On this basis, we conclude that the SOIT is not fulfilling its responsibilities.

Does SOIT Have a Role Today?

The responsibilities vested in SOIT by the Government Code and Section 4 of the Budget Act are necessary if the state's large and growing investment in information processing technology is to be managed properly. From this standpoint, there continues to be a need for an office such as the SOIT. The problem, thus, is: how can these responsibilities best be carried out?

When the predecessor to the SOIT was placed in the Department of Finance in 1971, the state's primary emphasis was on the control of EDP. Since then, the ability of state agencies to use information processing technology has increased dramatically. Consequently, it is not so

important that state policies be geared to control this technology. While control of EDP expenditures will always be necessary as part of the overall budgetary control function, more emphasis needs to be placed on creating the conditions under which modern information processing technology can be exploited fully. This requires planning and the adoption of appropriate policies to ensure that the technology is used fully and effectively wherever the benefits to be gained from this technology outweigh the costs.

Improving SOIT's Effectiveness is Not Enough

Our analysis of trends in information technology and the potential impact that effective use of this technology can have on state operations leads us to conclude that simply improving the effectiveness of SOIT will not be sufficient to assure that this technology is exploited in a cost-effective manner. Instead, the state's objective should be to establish a comprehensive policy-making authority in place of the fragmented approach to policy-making and planning that now exists. This would require that SOIT's role be redefined and expanded to include policy and planning functions that are now performed by other agencies.

In addition, our analysis indicates that the state's management of information systems would be strengthened if some limited operational responsibilities were assigned to this policy-making authority. For example, transferring to a redefined SOIT the State EDP Education Program now operated in the Department of General Services would help ensure that new educational policies and plans are successful. For the same reason, planning functions in the California Public Broadcasting Commission and

elements of the Communications Division and the EDP Procurement Office in the Department of General Services could also be transferred to a redefined SOIT. In addition, this authority should be responsible for monitoring federal telecommunications policy as it affects California state government.

We believe that a reconstituted SOIT should be functionally independent of the Department of Finance, for two reasons. First, the Department of Finance's role traditionally has been to oversee state operations, rather than to serve state agencies. Consequently, a reconstituted SOIT would have responsibilities that were outside the main stream of those assigned to the department. Second, we believe it would be preferable to provide a central oversight function for information systems that is independent of the line operation. In the area of information systems, the Department of Finance is a line operation, in that it is a major user of information technology. Consequently, under current law, the Director of Finance has control over both major information system projects and the office responsible for statewide information system management. While the department has not abused this double role, good management practice requires that these functions be separated.

MEETING THE CHALLENGE OF THE 1980s

In summary, we conclude that in order to maximize state use of information systems technology, the responsibilities for EDP planning and management currently assigned to the SOIT and other state agencies should be redefined within the context of a new organization. We do not believe

that the current approach to statewide planning and coordination can achieve the full benefits offered by this technology, even if the recommendations contained in this report are adopted.

Policy and Planning Responsibilities

We believe the State Office of Information Technology, therefore, should be removed from the Department of Finance, and reconstituted as a separate entity primarily concerned with planning and policy formulation. In addition, communications policy and planning authority currently assigned to the Department of General Services and the California Public Broadcasting Commission should be transferred to the new entity to provide for improved telecommunications policy and planning. Any operational components of the Department of General Services' Communications Division, which should logically be in the same organizational structure as the policy and planning function should also be transferred.

While the State EDP Education Program managed by the Department of General Services and the EDP procurement function could be allowed to remain with the department, we believe the effectiveness of these activities would be enhanced if they were assigned to the policy-making entity. Consequently, we recommend that these, too, be transferred to the new organization.

Given the speed with which information systems technology is changing, the major emphasis of the new organization should be on policy-making and planning. The control of expenditures for information processing should remain in the Department of Finance, where it can be

performed in connection with the department's traditional responsibilities for budget preparation and fiscal management.

If a new organization is created, we would urge that consideration be given to establishing some of the positions in the new organization on a rotational basis, perhaps on two-year appointments. In this manner, there would be a periodic infusion of new skills into the organization. This might have two important benefits: (1) it would help prevent staff from becoming too far removed from the ever-changing environment within which state agencies use modern information processing technology, and (2) it could facilitate a possible reduction in the staffing requirement for policy and planning after the policies and plans are developed and become operational.

Accordingly, we recommend that the Legislature establish a new state authority within the executive branch and assign to it the responsibility to develop policy, guidelines and standards regarding the state's uses of information processing technology. We recommend further that this new authority be given specified operational responsibilities, and that legislative policy expressed in the Government Code and Section 4 of the Budget Act be revised to reflect this new authority.

CURRENT FUNDING LEVEL IS ADEQUATE

We do not believe that a new state entity established within the context of the recommendations made in this report would require an increase in funding above the current level. Instead, the level of funding currently allotted for the activities which would be consolidated should provide sufficient support for the new organization.

VARIETY OF APPROACHES

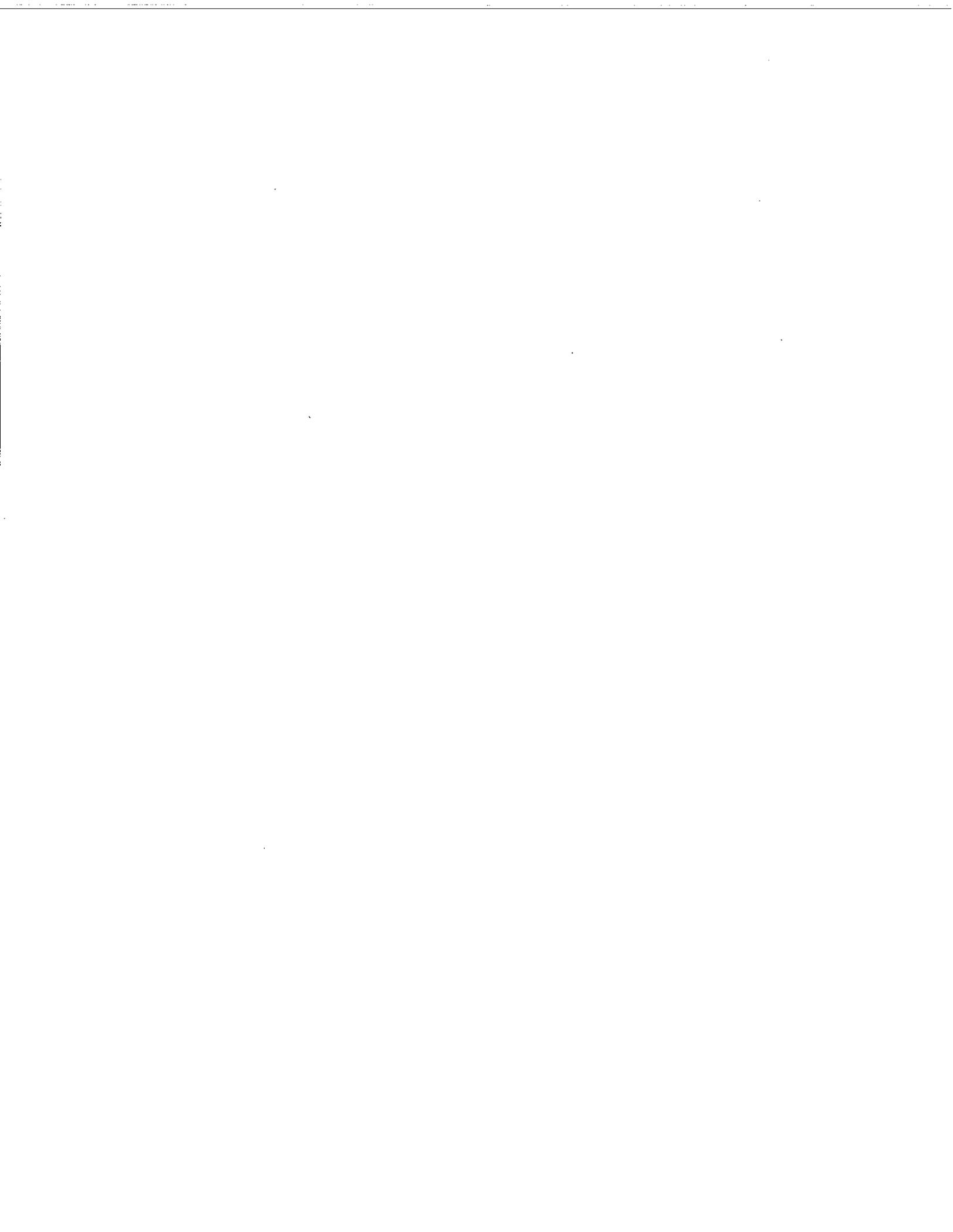
There is a variety of ways in which the new organization could be structured to carry out its policy, planning and limited operational responsibilities. One method would be to establish within the Governor's Office an Office of Information Processing Technology. This would tend to provide the authority needed to obtain compliance with policy and planning direction.

The functions of the Office of Information Processing Technology (OIPT) would include comprehensive statewide policy formulation and planning for information processing technology and telecommunications systems. These policies and plans would focus on system standards, compatibility, resource sharing, security, and education. Policies and plans adopted by OIPT would form a basis for achieving the best utilization of computing resources from the large data centers, office automation, mini- and microcomputers. In this manner, the optimum mix of resources would be guided from a statewide perspective.

In addition to statewide planning and policy responsibilities, the OIPT would perform educational and procurement functions. The educational component would be responsible for developing, delivering or acquiring information processing-related training for personnel in EDP classifications, general management and other personnel as appropriate. Educational services provided through OIPT would not compete with training programs administered by individual departments, but would complement those programs to provide statewide access to training.

Procurement activities vested in the OIPT would apply to the acquisition of information processing technology equipment, software, supplies and personal services.

Other approaches to structuring the new organization should also be considered, as the Legislature and the executive branch seek to improve the manner in which information processing technology is managed in the executive branch.



APPENDIX A

Language Intended by the Legislature for Inclusion in Section 4.00 of the 1982 Budget Act:

The Legislature finds that numerous problems, many of which have been exemplified by the Statewide Public Assistance Network project in the Department of Social Services, necessitate a thorough review of the control and uses of electronic data processing technology in California state government. The Legislative Analyst, and the California Information Technology Advisory Board, shall each perform an independent review of electronic data processing control and uses and report findings in separate reports to the Legislature by January 5, 1983, in accordance with the following objective and criteria:

Objective: The objective of the reviews shall be to identify the major problems inhibiting the cost-effective application of electronic data processing technology in state government, and recommend measures intended to eliminate or minimize these problems.

Criteria: In performing the reviews required by this section, the Legislative Analyst and the California Information Technology Advisory Board shall address, but not be limited to, the following areas:

- (1) Further consolidation of data processing service centers.

(2) Establishment of a central data processing system development capability to be employed in the design and development of large systems whenever it is decided that a system is to be designed and developed using state personnel.

(3) Consolidation of data communications systems and management.

(4) Establishment of a central data processing organization encompassing (a) computer support, (b) large systems development support, (c) data communications, (d) equipment, supplies and services procurement and (e) any other function which may be suitable for centralization.

(5) Recruitment and retention of an adequate number of qualified managerial and technical staff.

(6) Methods of resolving problems created by the migration of skilled managerial and technical staff from one system development effort to another.

(7) Difficulties experienced by agencies in attempting to implement electronic data processing systems for the first time.

(8) The adequacy, role and placement of the State Office of Information Technology.

APPENDIX B

BACKGROUND

EARLY CONTROL AND COORDINATION EFFORTS

The state's use of information technology has always been a topic of keen interest to both the executive and legislative branches. The first step toward control of this technology within state government occurred in 1962, when a position was established in the Department of Finance to gather information on all electronic data processing activities within the state. Subsequently, a high-level steering committee was appointed by the Administrator of the Revenue and Management Agency to consider the management of automation within state government. In a report issued during 1964, the committee criticized the manner in which automation was being managed, and identified the need for a long-range master plan and improved management control. In response, the Governor, in January 1965, issued a policy statement on automation and created an advisory committee to implement the recommendations contained in the 1964 study.

In March 1965, in response to HR 472/63, the Assembly Interim Committee on Ways and Means issued a report to the Legislature which, like the 1964 executive branch report, criticized automation management and cited the need for a long-range plan. Subsequent reports which cited problems in the state's uses of automation technology were issued by the Legislative Analyst (1967), the Governor (1967), the Joint Committee on Legislative Organization (1969) and the Office of Management Services (1968, 1970).

Among the issues identified in these early reports were centralization versus decentralization, standards, duplicative system development efforts, management's understanding of and role in automation programs, the availability of skilled personnel and the adequacy of policies and planning.

Formal state control of automation activity initially was vested in the Systems Analysis Office in the Department of General Services. Established in 1965, the office reviewed contracts, provided consulting service to various state agencies, and conducted studies and projects. Generally, however, the office was not successful in resolving any of the major EDP problems previously identified, and in 1968 its functions were transferred to the newly created Office of Management Services in the Lieutenant Governor's Office (Ch 1327/68).

The enabling legislation also created the State Electronic Data Processing Policy Committee to (1) act on recommendations made by the Office of Management Services and (2) advise the Governor and the Legislature on data processing policy. In addition, Ch 1327 created the Intergovernmental Board on Electronic Data Processing to perform specified coordinative functions relating to automated systems with intergovernmental implications. Finally, Ch 1327 defined in the Government Code legislative policy and intent regarding the use of electronic data processing (EDP) technology. Key aspects of legislative intent embodied in this legislation included the optimum use of EDP equipment and the development and maintenance of a master plan.

In 1969, Section 4 was added to the Budget Act for the purpose of providing additional legislative direction regarding the control and coordination of EDP technology. In revised forms, this section has appeared in each subsequent Budget Act.

A major product of the Office of Management Services was the "Long-Range Master Plan for the Utilization of Electronic Data Processing in the State of California." Issued in May 1970, the report recommended establishing seven consolidation "groups" comprised of functionally related departments, with specific plans requested from each group. Dissatisfaction with this report and the lack of progress toward resolving previously identified problems led to the transfer of the office's functions to the Department of Finance in 1971 (Ch 1237/71), and the creation of a new position--State Data Processing Officer--to manage the department's new EDP control responsibilities. The department formed the Electronic Data Processing Control and Development Unit to carry out these responsibilities. This unit subsequently was renamed the State Office of Information Technology.

In addition to transferring EDP management responsibilities to the Department of Finance, Ch 1237 also replaced the State Electronic Data Processing Advisory Committee with the California Information Systems Implementation Committee, a joint legislative-executive branch committee. The initial charge to this committee was to review the state's EDP policies and recommend a new organizational structure.

CONSOLIDATION OF COMPUTER OPERATIONS

In May 1972, the Department of Finance issued a draft of its plan to consolidate EDP computing operations into five data centers. The proposed centers were (1) Business and Services, (2) Revenue, (3) Human Relations, (4) Law Enforcement and (5) State Colleges. The department's plan was endorsed by the California Information Systems Implementation Committee in a May 17, 1971, letter to the Governor and the Legislature, and Ch 787/72 provided statutory authorization for implementation of the plan.

The consolidation plan soon became embroiled in controversy. Most of the controversy arose as a result of the Department of Finance's decision to award a sole-source contract for data center equipment. A lesser controversy centered around opposition within the executive branch to the establishment of a Revenue Data Center, which would have consolidated the computer operations of the Franchise Tax Board and the Board of Equalization.

In response, the Legislature directed that equipment be acquired on a competitive basis. In addition, it modified the specifications for the Business and Services Data Center (which eventually was renamed the Stephen P. Teale Consolidated Data Center) to remove the Department of Motor Vehicles from the list of agencies to be served by the center. The concept of a Revenue Data Center was abandoned, the Human Relations Data Center was deferred, and the Legislature placed very stringent controls in Section 4 of the Budget Act to govern executive branch uses of EDP.

Thus, the first comprehensive consolidation plan offered by the executive branch and supported by the Legislature generated considerable controversy, leaving a legacy of mistrust. This served to put the use of EDP technology in state operations in a bad light--a condition that to some extent has persisted to this day.

1973-1983: A DECADE OF SIGNIFICANT GROWTH

Organization as to Control and Oversight of EDP

Although the Department of Finance has remained the central EDP control agency since the early 1970s, in accordance with the Government Code and Section 4 of the Budget Act, the Department of General Services has exercised control responsibility for EDP-related procurements and data communications activities. The department's responsibility for procurement was redefined by Ch 761/80, which created a separate acquisition authority applicable to EDP goods and services. The Department of General Services' authority with respect to data communications emanates from various Government Code sections which give the department responsibility for "general communications."

Extensive administrative guidelines and requirements contained in the State Administrative Manual govern the state's uses of EDP technology. In fact, the EDP section constitutes one of the largest sections of the manual.

In May 1980, the Director of Finance established the California Information Technology Advisory Board (CITAB) for the purpose of reviewing proposed policies or policy revisions to be included in the manual, and

assisting the Director in the formulation of statewide EDP policy, EDP planning and the identification and resolution of significant problems inhibiting the state's effective use of the technology.

Legislative oversight of the state's EDP activities has occurred through a variety of means. This oversight has been conducted with the assistance of (1) the California Information Systems Implementation Committee, which has held periodic hearings on selected issues, (2) the Legislative Analyst's office, which prepares an extensive analysis of the Governor's Budget and issues special reports on major policy issues, (3) the Auditor General's office, which issues special reports and conducts audits of automated information systems and computer operations, (4) the Senate Select Committee on Governmental Efficiency, which recently received testimony concerning the SPAN project and certain computer program acquisitions, and (5) the fiscal committees of each house which review the funding requests for the data centers and various information system projects.

Statutory provisions concerning legislative intent and policy relating to EDP are contained in Section 4 of the Budget Act and Government Code Sections 11700-11998. The Government Code provisions were modified significantly in 1980 by Ch 643, which eliminated the Intergovernmental Board on Electronic Data Processing and deleted the requirement for a statewide EDP master plan. In 1981, Ch 102 established the Equipment Management Revolving Fund for the purpose of providing loans under specified conditions to state agencies for the purchase of leased equipment. The fund, however, has not been allocated any monies.

Section 4 of the Budget Act has been revised annually to reflect both technological changes and current perceptions of major problems in the EDP areas. In general, modifications to Section 4 have provided increased flexibility to the Department of Finance with respect to the manner in which it may exercise its control responsibilities.

Current Organization as to uses of EDP

Section 4 of the Budget Act and the State Administrative Manual prohibit the expenditure of funds for EDP activities unless certain procedures have been followed. These procedures include the preparation of structured feasibility study reports which describe the need for new projects, or significant modification to existing systems, and indicate the most cost-effective alternative available for fulfilling the stated need. Feasibility study reports and other required reports and plans are subject to the approval of the Department of Finance, through its State Office of Information Technology. Certain activities are subject to the approval of the Department of General Services. Both departments have provided for the delegation of approval authority to line agencies under specified conditions.

Within this framework, departmental EDP requirements are met through a variety of means, ranging from the large, central data centers to commercial facilities to, more recently, small but powerful desktop computers.

Computing Support

The Stephen P. Teale Data Center, the largest general purpose computing center operated by the state, began operations in 1973 with a complement of three computers--two general purpose computers and one dedicated to time-sharing. Since that time, the Teale Data Center has grown rapidly. Currently, it has eight large computers located in two separate facilities. During this same 10-year period, the center's customer base has increased from 34 to 105. The center's computerized information network now includes some 2,500 terminal devices.

In January 1978 the Health and Welfare Agency Data Center began operation. This center, established in accordance with the Department of Finance's 1972 consolidation plan, brought together the computing activities of the constituent departments of the Health and Welfare Agency. Since its inception, the center has grown at such a rapid pace that in 1983 it will be relocated from its original site in the Employment Development Department building in Sacramento to a substantially larger facility. From this new facility, the center will operate two large computing systems which will provide direct access to approximately 1,005 computer terminal devices located throughout the state, including those located in various counties for the purpose of accessing the state-maintained Medi-Cal Eligibility Determination System.

The California State University system began a major computing equipment upgrade in 1980, which resulted in the installation of newer and more powerful computers at the university's central processing facility in

Los Angeles and each of the 19 campuses. The availability of this system ushered in a new era of instructional computing support. Numerous computer terminals were installed for student access to both the campus and the central computing facilities. Since installation of the new computers, both instructional and administrative computing demands have grown steadily and have necessitated a review of system computing requirements and the capacity of the current equipment line to continue meeting those requirements.

The Law Enforcement Consolidated Data Center, unlike the Teale Data Center and the Health and Welfare Data Center, did not result in actual consolidation of disparate computing facilities. This is because the Department of Justice, which operates the data center, had maintained a centralized computing facility prior to consolidation. Further, this facility remains dedicated to serving the administrative computing requirements of the Department of Justice and the automated information needs of various law enforcement agencies, through the California Law Enforcement Telecommunications System. This system allows law enforcement agencies throughout the state, as well as out-of-state jurisdictions, to have electronic access to various police information files located in Sacramento and other locations. These files include information on wanted persons, stolen property and criminal history, as well as certain automated files maintained by the Department of Motor Vehicles.

A major expansion of the Department of Justice's centralized computing facility was begun in 1978. This expansion was necessary to meet

both increased administrative information processing requirements as well as the steady growth in workload imposed by the various law enforcement jurisdictions which, by law, the Department of Justice must accommodate. A significant portion of this workload growth has resulted from the modernization of local police communications systems, which in a number of jurisdictions include computer terminals in patrol cars to provide a direct link to local and state-maintained information systems.

Non-consolidated Computing Facilities Also Have Grown

In addition to the significant growth in computing capacity experienced by the consolidated computing facilities, the state's other major computer facilities also have undergone capacity increases. These other facilities include those maintained by the Board of Equalization, the Department of Motor Vehicles and the Franchise Tax Board. In addition, some departments which relied previously on a consolidated data center for primary computing support have developed, or are in the process of developing, internal computing systems of their own. These include the California Highway Patrol, the State Teachers' Retirement System, the California Health Facilities Commission and the Department of Industrial Relations.

Several departments rely on both a consolidated data center and a dedicated computing system to meet their needs. For example, the Department of Developmental Services is in the process of installing small computing systems in each of the hospitals it administers. The Department of Rehabilitation has installed a relatively powerful computer which

provides computer access to its field offices. At the same time, both of these departments continue to receive computing support from the Health and Welfare Agency Data Center.

Some departments rely heavily on the commercial sector for information processing services. These include the Department of Health Services (Medi-Cal claims processing), the Department of Social Services (in-home supportive services) and the Office of Economic Opportunity (Low Income Energy Assistance Program).

Personnel Resources

Over the years, the state has relied on a number of sources to satisfy its requirements for technical EDP personnel. Generally, departments have sought to develop and maintain permanent staffing for EDP purposes. In situations where a permanent staff has not been required, or a special expertise is needed, departments usually have contracted with other state agencies, or the private sector to provide the necessary expertise.

The primary source of "contract" personnel within the state is the Department of General Services. Over the years, other state agencies have provided contracted personnel services, including the Department of Water Resources, Caltrans and the Franchise Tax Board. Inmates housed at facilities maintained by the Department of Corrections have also been used in this manner.

Private sector personnel resources usually are acquired on a competitive basis, in accordance with established policies and procedures.

Recently, the California Information Technology Advisory Board initiated an effort to develop master service agreements with private sector firms which specialize in providing contract programmers and analysts. By law, all contracts for private sector consultant services must be evaluated formally by the contracting agencies.

Major Reports

Following the equipment acquisition and data center controversies of 1972, the Legislative Analyst, in February 1973, issued a comprehensive report on EDP in California State Government. This report, which focused on the consolidated data center effort, identified several major problems which were inhibiting the cost-effective use of EDP. Many of these problems had been identified in an earlier report prepared by the Analyst's office in 1967. The problems identified in the 1973 report included (1) management's lack of understanding and involvement in EDP matters, (2) inadequacy of standards, (3) failures in automation attempts, (4) shortage of skilled staff, and (5) inadequacies in planning. The report contained 18 recommendations designed to address the identified problems. Several of these recommendations subsequently were adopted.

In January 1979, the Department of Finance, in response to a requirement in Section 4 of the Budget Act, released a report on problems inhibiting the effective use of EDP technology. This report identified as "continuing problems" (1) the identification of state activities which could benefit from the use of EDP technology, (2) the validation of the need for and the effectiveness of ongoing information systems, (3) the

productivity, quality and pay of EDP personnel, and (4) the utilization of EDP equipment. In addition, the report identified the requirement for a state EDP master plan, departmental EDP plans, a reliable and cost-effective data communications network and a consolidated equipment management function.

A "Review of Data Processing Usage in the Executive Branch", issued in May 1979 by the Auditor General, also contained a number of significant findings. Specifically, the Auditor General found (1) a lack of adequate statewide planning, coordination and cooperation, (2) opportunities for further consolidation of the state's computing operations, (3) opportunities for developing consolidated EDP applications through the interdepartmental development of common systems, and (4) 40 EDP applications which were of little value and therefore candidates for elimination.

In June 1979 the Director of Finance established an EDP Advisory Group to review the management and control processes associated with electronic data processing. This group was formed in response to a recommendation made by the Legislative Analyst in the Analysis of the 1979-80 Budget Bill.

The EDP Advisory Group, composed of high-level state officials and senior officials from the private sector, released its report to the Director of Finance in November 1979. Entitled "Recommended Changes in Management and Control Processes Regarding Electronic Data Processing in California State Government," the report recommended (1) making department

directors more responsible for the uses of EDP, (2) creation of the California Information Technology Advisory Board, (3) streamlining policies and procedures contained in the State Administrative Manual, (4) centralization of EDP-related procurement in the Department of General Services, (5) development of a full capability in the Department of General Services to meet the requirements of departments lacking adequate technical staff, and (6) that departments advise the California Information Technology Board as to problems regarding the recruitment, retention and development of EDP personnel.

Recent Trends in the Use of EDP

The basic premise underlying the plan to establish consolidated data centers in California State government was that it would be more cost-effective to meet computing service needs through a large, consolidated facility than through a number of uncoordinated separate facilities. At the time, this premise was a reasonable one. Equipment was very expensive, and the Department of Finance believed that departments would develop common information systems if they were required to share a common computing facility.

Consolidation brought substantial computing capability to departments which could not afford a computer of their own. In addition, some common systems were developed as a result of consolidation.

As the cost of computing power declined, however, departments were able to argue more persuasively for some "local" (independent) computing capability. Local computing holds considerable appeal to departments

because it often is perceived as not only less costly, but also more responsive to the needs of the department. Consequently, an increasing number of local computing systems has been the trend within state government in recent years. Some of these systems amount to self-contained data centers. As noted earlier, a number of departments have installed relatively powerful computing systems to either replace or complement services received from a large data center. Personal, or desktop computers are only just beginning to appear, as are office automation devices.

The implications of this trend for state operations are far-reaching. The increasing decentralization of computing power has implications for planning, standards, training, personnel, compatibility and control. As discussed in the body of this report, decentralization is occurring without adequate attention being given to the long-term implications of this trend.

