Evaluation of the Information Services Bureau

Program Evaluation Division
Office of the Legislative Auditor
State of Minnesota

Program Evaluation Division

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Evaluation of the Information Services Bureau

March 1980

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Office of the Legislative Auditor
State of Minnesota

PREFACE

In June 1979, the Legislative Audit Commission directed
the Program Evaluation Division to conduct a study of the Informa-
tion Services Bureau (ISB) of the Department of Administration and
propose recommendations for administrative or legislative action to
improve performance. In response we conducted a comprehensive
evaluation of ISB focusing on the services ISB provides to state
agencies and the efficiency and effectiveness of ISB's internal
operations. This report presents our findings and recommendations.
Our assessment of ISB's performance is negative in certain areas
and positive in others. We are particularly critical of ISB's perfor-
mance in developing new data processing systems.

ISB has been extensively criticized by the users of its
services and others in recent years. In our view much of the
criticism is justified; ISB has not performed some of its essential
functions well. But the level of criticism directed at ISB also
reflects the fact that ISB provides essential services to many state
agencies and thus its performance failures are highly visible. In
addition, ISB has at times been unfairly singled out as responsible
for failures that ought to be considered, at least in part, the
responsibility of other agencies.

Nevertheless, ISB's performance needs to be improved.
This report presents findings and recommendations that we hope
will be given serious consideration by the Legislature and the
management of ISB. We fully recognize that the problems are
complex and that implementing changes will be difficult. However,
the management of the Department of Administration and ISB have
acknowledged that there are problems which need to be addressed,
and, in recent months they have taken significant action to improve
performance in a number of areas.

It is our hope that the difficulty of the agenda facing ISB
will be recognized, and that this report will serve to steer the
debate over what further administrative and legislative actions are
necessary in a constructive direction.

We wish to thank the Department of Administration and
ISB for their full cooperation in this study. Although aspects of
our report are highly critical, our work was never impeded or
delayed by a reluctance to meet with us, provide requested infor-
mation, and review drafts of the reports of the project. We also
want to acknowledge the invaluable assistance of the scores of
people in other state agencies who cooperated in the study.

PREFACE (continued)

This study was directed by Elliot Long. Major components of the study were carried out by Allan Baumgarten, Jerry Cathcart, Sandra Fritz, Judith Inman, and Jo Vos. Naomi Kahn assisted in the later phases of the project. Alexander Grant & Company was engaged by the Program Evaluation Division to carry out a review of computer operations.

James Nobles
Deputy Legislative Auditor
    for Program Evaluation

March 31, 1980

The Program Evaluation Division was established in 1975 and does studies at the direction of the Legislative Audit Commission (LAC). The division's general responsibility, as set forth in statute, is to determine the degree to which activities and programs entered into or funded by the state are accomplishing their goals and objectives and utilizing resources efficiently. A list of the division's studies is at the end of this report.

Since 1979, the findings, conclusions, and recommendations in Program Evaluation Division final reports and staff papers are solely the product of the division's staff and not necessarily the position of the LAC. On completion reports and staff papers are sent to the LAC for review and are distributed to other interested legislators and legislative staff.

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EXECUTIVE SUMMARY

The Program Evaluation Division has carried out a comprehensive evaluation of the Information Services Bureau (ISB) of the Department of Administration. ISB both provides data processing services to state agencies and, under the authority of the Commissioner of Administration, regulates the use of data processing systems in state government.

ISB operates with an authorized staff complement of 381, (including 72 intermittent data entry positions) and a biennial budget of approximately $27,000,000. ISB is a large computing center, comparable in size to the computing centers of 3M or the two major bank holding companies in Minnesota.

Our evaluation of ISB consists of the following components:

- An evaluation of systems development projects conducted by ISB.

- An evaluation of ISB production (the operation of data processing systems once implemented).

- An evaluation of computer operations (carried out by Alexander Grant & Company for the Program Evaluation Division).

- A study of staff turnover and employee morale.

The results of these studies are presented in this report. A complete statement of methods, findings, conclusions, and recommendations is presented in the five staff papers on which this report is based.

A. SYSTEMS DEVELOPMENT

Systems development, as the term is used here, is the process by which computers and other electronic data processing equipment are applied to the operation of state government.

Our study addressed the following questions:

- How well is systems development carried out by the Information Services Bureau (ISB) for, and in collaboration with, the state agencies it serves?

- What are the causes of performance problems in systems development?

- What action should be taken to improve performance?

Our assessment of ISB's performance of systems development was based on an examination of:

- the extent to which systems development projects are successfully completed and satisfactorily implemented;

- the extent to which projects are carried out on time and within budget; and

- client satisfaction with the performance of ISB.

In order to evaluate systems development we studied twenty individual development projects carried out in recent years. These twenty projects were performed for fifteen departments of varying size and experience with systems development projects.

Our findings can be summarized quite briefly. First, our review of the extent to which development projects were successfully completed shows:

- Of the twenty projects we studied, the only ones that have been successfully implemented close to time and budget estimates are medium sized or small development efforts.

- Of the projects studied, two large projects and one smaller project have been abandoned or shelved at a cost of over $2,000,000.

- Only one of the five largest projects we reviewed was successfully implemented. Two were abandoned or suspended and two have long since slipped their original budgets and time deadlines. Smaller projects have a much greater chance of success.

- These negative findings notwithstanding, most of the twenty projects we reviewed have been implemented in whole or part. Of the twenty projects, eleven have been

successfully implemented, three have been cancelled and the remainder are still in the process of development.

Our examination of the extent of time delays and cost overruns shows:

- Cost overruns were typical among the systems development projects we studied, the rule rather than the exception.

- Significant cost overruns occurred in two-thirds of the projects we examined. Time delays occurred in almost all of the projects we reviewed.

- The four largest development projects which together were estimated to cost about $1,345,000 have actually cost about $4,385,000 so far, an overrun of approximately 300 percent.

Our review of systems development included an examination of the extent of user satisfaction with the services provided by ISB. We found:

- The users of ISB are generally dissatisfied with the systems development services they have received from ISB in recent years.

- Users complain about frequent turnover among ISB staff and that ISB assigns staff to their projects who are unfamiliar with their agency's structure and operations.

- Users complain about the fact that they are billed at the same rate for the services of experienced and inexperienced staff.

- Users generally approve of the use of PRIDE, ISB's system development methodology, but feel it is inconsistently applied and incorrectly used in certain instances.

- Users complain about the lack of project status reporting in general and about their lack of control over ISB billings during development.

- While a third of the users we interviewed complained about ISB's hourly rates for systems analysts and programmers, most users feel these rates are fair and competitive. Instead, they complain about the number of hours

it takes to complete projects and the value of ISB's services rather than the rates.

1. CAUSES OF PERFORMANCE PROBLEMS

We see the immediate causes of the performance problems just reviewed as grouped into three categories: inadequate staff resources, ineffective organization of systems development staff, and problems involving the relationship of ISB with users.

a. Staff Resources

- ISB has experienced rapid turnover among systems analysts and programmers. Experienced staff are constantly being replaced by inexperienced staff because ISB can not, given limitations of pay and advancement opportunities, compete successfully for experienced staff with a demonstrated record of performance.

- Partly as a result, ISB staff resources are insufficient to carry out an ambitious program of new development such as that undertaken in recent years. The principal deficiency is a shortage of experienced project managers with the managerial and technical expertise to solve the range of challenges that every ambitious development project is bound to encounter.

- Management of systems development has been weak, both in the effectiveness of managerial control and in technical leadership.

- The position of ISB director has been filled on an acting basis for several years and has changed hands several times.

b. Organization of Systems Development Staff

- ISB systems development staff has been, until recently, organized in a way which contributed to rapid rotation of staff assigned to specific projects. This arrangement did not permit analysts to become familiar, over time, with the functions of particular agencies and diminished ISB's capacity to serve effectively.

c. Relations with Users

- ISB has lacked an effective means for setting priorities among demands for its services.

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- ISB is consistently low in estimating the time its analysts and programmers require to complete projects. As a result, projects take longer to complete and cost more than anticipated.

- In a significant number of cases ISB and user agencies were unable to freeze system design and move to later phases of development in an orderly fashion.

- ISB has not established necessary communcation with users so that it can plan for systems development and be prepared in advance to meet agency needs.

- ISB has not consistently administered PRIDE, the systems development methodology purchased by ISB for use in state government. The origin of ISB's inability to apply standards consistently is the contradiction between its role as a provider of systems development services and a regulator of systems development.

- ISB has not provided users with meaningful project status reports while projects are underway.

2. RECOMMENDATIONS

Having assessed the extent of performance problems in systems development and analyzed the causes of these problems our report presents a set of recommendations aimed at:

- reducing staff turnover, facilitating recruitment of capable staff and otherwise strengthening staff resources;

- strengthening project management and management of systems development in general;

- improving the organization of systems development staff;

- improving the accuracy of cost and time estimates;

- improving the administration of PRIDE or another systems development methodology;

- improving project status reporting to users;

- improving the ability of the Department of Administration to plan for systems development, set priorities among demands for systems development, and approve development projects.

The specific recommendations made throughout this report have been drawn together in a list which follows this summary.

To avoid possible confusion, it must be kept in mind that the record of performance reviewed in this report generally pertains to a period of time prior to the appointment of the present Assistant Commissioner of Administration in charge of directing ISB.

Furthermore, a number of changes have been made recently at ISB aimed at improving performance of systems development including a change in the organization of systems development staff, appointment of a new director of systems development, activation of a user advisory committee, and other positive steps. As a result, we believe there is some basis for optimism that ISB's performance will improve. Our general assessment is, however, that while ISB has correctly identified many of the problems in systems development and identified many of the steps that need to be taken, the job will be difficult.

We also believe that behind the apparent causes of systems development failures may lie more fundamental problems with the location of responsibility for providing data processing services and authority for regulating data processing, the way in which ISB is financed, and the way data processing specialists are recruited. If the problems reviewed in this report persist we recommend that fundamental organizational changes be seriously considered such as:

●   The establishment of an organizational unit, within Administration or elsewhere, separate from ISB, to perform long-range planning, set priorities among development projects, and approve development projects.

●   Changes in the civil service requirements governing certain managerial and professional positions at ISB, to facilitate the strengthening of personnel resources.

●   Creation of a contingency fund by legislative appropriation which ISB can draw upon when it fails to complete work for an agency within an agreed-upon budget.

●   Delegation of additional authority over systems development to individual state agencies.

These ideas are discussed in Chapter V.

B. PRODUCTION

ISB production consists of providing users with the output of data processing systems in the form of reports, forms, magnetic tape, microfiche, etc., on a pre-determined or on-request schedule. ISB billings for these services account for most of its revenue. In fiscal 1978, exclusive of services purchased by ISB for users from outside vendors, ISB billed user agencies for approximately 6.4 million dollars and approximately 6.8 million dollars in 1979. Thus, billings for production services are nearly twice as large as billings for systems development services.

Our study of ISB production asked:

- Is ISB's operation documentation accurate and complete?

- Is the output received by users timely, accurate, readable, and useful?

- Is the number of copies received by users adequate?

- Is an inordinate amount of exceptional handling required to produce the output, and

- Are frequent changes to the jobstream required to ensure receipt of accurate and timely information?

Additionally, we wanted to measure the extent to which users are satisfied with ISB data processing services because once systems go into production ISB is clearly a service provider, and if ISB is doing its job, it should have satisfied clients.

1. METHODOLOGY

ISB's production activities are organized into sets of tasks called jobstreams. A jobstream consists of a series of both manual and computerized tasks which must be performed to produce output, which is then distributed to users.

ISB has approximately 1,200 production jobstreams in operation at the present time. We selected a representative sample consisting of approximately nine percent of all production jobstreams (108 jobs), reviewed the operations documentation for each system, and conducted telephone interviews with the end users of the output in each system.

2. MAJOR FINDINGS

Although a significant number of users were affected by problems with the delivery of output, our analysis indicates that a large proportion--82 percent of the users sampled--were either very satisfied or usually satisfied with ISB's overall performance. In addition, 93 percent of the users interviewed were either very satisfied or usually satisfied with ISB's response to the problems they experience.

Despite the high overall satisfaction of users we found:

- A serious problem with the operations documentation in 20 percent of the 108 jobstreams reviewed and minor problems in an additional 22 percent.

- A serious problem with timely delivery of output in 23 percent of the systems and a minor problem in an additional 14 percent.

- A serious problem with inaccuracies in 23 percent of the systems and a minor problem in an additional 16 percent.

- A readability problem in 16 percent of the cases.

- A situation requiring exceptional handling in 20 percent of the cases.

- Frequent changes to the jobstreams were required in 9 percent of the cases we reviewed.

Our review of production is fairly detailed and our recommendations are numerous and technical. Recommendations are presented in the report in the context of our discussion of findings and listed in the following section of this report.

There is an apparent contradiction between ISB's performance and user satisfaction. The level of user satisfaction with production services is high, and yet ISB's performance in the areas of timeliness, accuracy, readability, and exceptional handling clearly leaves room for improvement. Users appear to have low expectations, possibly because they are comparing current methods to inferior manual methods.

As users become more sophisticated in their systems knowledge, and as user agencies hire analysts with work experience acquired in other more efficiently run data processing shops, they may find the current level of performance less satisfactory. ISB should be aware of this possibility and consider it a further incentive to improve its performance.

C. COMPUTER OPERATIONS

We engaged Alexander Grant & Co. to perform a review of ISB's computer operations functions.

The objectives of this study were to:

- Determine whether present computer service capability and capacity and related future plans are adequate to satisfy present and future user requirements, and

- Determine whether present ISB computer operational functions are managed effectively and efficiently.

Significant findings of this study relate to the following topics:

- organization of computer operations;
- planning;
- utilization of equipment and operating system software;
- the present status of ISB's capacity to provide comprehensive data processing services.

1. ORGANIZATION OF COMPUTER OPERATIONS

ISB has recently modified its operational organization structure. This new organizational structure centralizes management control under one manager, the Facilities Management Division Director. All computer operational functions (except for data entry) and operational technical support functions report to this director.

- The consultants concur with those changes that combine and integrate ISB's computer operations and technical support resources. Such an approach provides the authority and responsibility to direct those resources to resolve operational problems under one management.

While generally approving the new organization, the consultants observe that:

●   The management responsibilities of the Assistant Commissioner in charge of ISB are too broad given the magnitude of the management tasks facing ISB.

●   While computer operations functions report to a second level of management (an Assistant Director for Computer Facilities), the technical support functions report directly to the Facilities Management Division Director. The numerous significant technical support projects and related personnel resource requirements demand a level of direction and control that should be provided by a qualified Technical Support Assistant Director.

●   The data entry function currently reports to the Support Services Division Director. Normally, the data entry function reports to a manager of computer operations in a large scale computer organization. ISB's data entry function should report to the Computer Facilities Assistant Director so that the management and control of this function may be integrated with the batch processing services to which it is most closely related.

2.   PLANNING

The consultants evaluated ISB's planning activities in terms of:

●   The approach being used to identify short-term and long-term needs of ISB and user agencies;

●   The present level of definition of these needs and the related methods for satisfying these needs;

●   The availability of ISB resources to study ISB technical requirements and user agency needs; and

●   The availability of formal, consolidated planning documents.

a.   Short Range Planning

The consultants found that ISB has no documented short range plans or planning methodology. The planning activities that ISB is conducting primarily address current operational problems. ISB plans to increase its equipment capacity and software capabilities to satisfy identified user requirements. Beyond that, ISB intends to develop plans in a number of areas. As a result, they recommend:

e   ISB management should develop a standard planning methodology that requires inputs from the various operating divisions and provides for a consolidation of these inputs into one comprehensive technical plan for the ISB organization. This comprehensive plan should be prepared on an annual basis and documented as the formal technical plan for ISB.

The consultants determined that ISB's short range planning activities, though ambitious, were currently unstaffed and that ISB lacks the personnel needed to assist in the development of a planning methodology or the implementation of a consolidated operation plan. They recommend that:

e   Two or three qualified, full-time planning personnel should be engaged to assist in this substantial effort as soon as reasonably possible.

b.   Long-Range Planning

While ISB has identified the appropriate objectives of long-range planning, under ISB's current organization only one position, currently vacant, is designated for long-range planning. Since ISB's existing personnel resources are apparently insufficient to carry on short range planning and because there is a need for objective personnel to do the planning, who can balance the potentially conflicting interests of ISB and the user agencies, the consultants recommend that:

e   Long range planning efforts related to the identification of user agency information requirements and application system requirements, as well as the establishment of priorities for system development, should be performed by a planning staff external to the ISB organization.

This recommendation implies a fundamental change in the organization of data processing within the Department of Administration, and is discussed in Chapter V.

3.   UTILIZATION OF EQUIPMENT AND SYSTEM SOFTWARE

The consultants reviewed the availability and utilization of equipment and software at ISB and related management issues, including:

- system performance measurement;
- capacity planning; and
- telecommunication equipment and software.

a. Utilization

The consultants examined ISB's utilization of its three central processing units (CPUs) and found that utilization of available capacity is high (averaging 70 percent) during the first shift of the day, though much lower on the other two shifts. Additionally, during peak periods on certain days, nearly all available capacity is utilized on the two smaller CPUs. If equipment malfunctions occur in the larger CPU, the two smaller CPUs cannot provide an adequate backup during peak processing periods, and telecommunications processing services become substantially degraded.

Alexander Grant & Co. recommends that:

- ISB base its equipment requirements and related procurement on peak period processing requirements, so as not to expose itself to the risk of extended degraded user service due to limited processing capacities.

- Furthermore, ISB should maintain a substantial excess capacity processing position during the next two years to accomodate an anticipated substantial amount of new user system development, new user system implementation, new operational software implementation and related testing requirements. This position is necessary, because ISB does not have quantifiable estimates on the amount of capacity needed by these new uses.

However, an excess capacity position is not continuously justifiable. Quantifiable estimates of demands on capacity should be made and refined within two years so that ISB has a realistic method for identifying processing needs and procuring processing equipment in line with those needs.

b. Systems Performance Measurement and Capacity Planning

The consultants reviewed ISB's use of various tools used for measuring the performance of its computer equipment and operating systems software. In general, they found that the measurement tools ISB uses for collecting data on systems performance are appropriate for ISB equipment and software, and that ISB was performing sufficient systems performance measurement data collection activity.

However, they found an absence of documented internal studies and conclusions based on these measurement activities, which should be closely related to procurement planning. Alexander Grant & Co. recommends that:

● The ISB technical support function should begin to formalize a reporting process for its studies of systems performance, and should formalize the integration of this reporting process into the equipment procurement process.

c. Telecommunication Equipment and Software

ISB has decided to replace the present telecommunications software with a version more compatible with current technology. This should provide a variety of telecommunication terminal and processing options for user agencies.

● The consultants concur with the ISB decision to replace this software, but question why this decision was not made several years ago.

4. PRESENT STATUS AND ALTERNATIVE PROCESSING METHODS

Alexander Grant & Co. found that ISB is substantially behind the state-of-the-art in terms of providing data processing services to user agencies. This situation exists because ISB has not recently (within the last three years) implemented advanced software and terminal-based equipment capabilities. Consequently, ISB cannot provide efficient on-line system processing and state-of-the-art "distributed data processing" services to many user agencies.

The consultants believe that:

● ISB should be able to provide effective distributive data processing alternatives to user agencies.

To provide such services in the near future will require a substantial investment in equipment, software, and personnel resources now, in order for ISB to update its capabilities. ISB needs to acquire a new telecommunications network and data base management system, and to investigate what other equipment is best suited to service a variety of agency requirements.

The consultants note that ISB is currently initiating or operating certain varieties of alternative data processing, such as remote job entry, interactive computing, and IBM's Time Sharing Option. Such efforts should be expanded. While the investment is significant, agencies should realize substantial savings through reduced manual activities and more efficient services.

The report of Alexander Grant & Company is available as one of five staff papers from the Program Evaluation Division. Additional topics are addressed in their report (mainly of a technical nature) which are not mentioned in this executive summary. The recommendations of this study and the studies of systems development and production summarized here add up to an extremely ambitious agenda for the Department of Administration and ISB.

SUMMARY OF RECOMMENDATIONS

The following pages list the recommendations made throughout this report and associated staff papers. While we feel it is useful to draw these together in a single list, neither the purpose of individual recommendations nor the study findings and conclusions motivating us to propose them will necessarily be clear from the list itself. A thorough understanding of these points will require reference to the text of the reports.

SYSTEMS DEVELOPMENT

STAFF RESOURCES

- A variety of tools should be used to ensure that ISB is a competitive employer. This includes developing a job classification structure which offers opportunities for advancement and sufficient increments of pay and responsibility.

- Alternatively, or in addition, ISB should propose to remove job classes experiencing critical shortages from the classified civil service. The delays in hiring which are built into recruitment of staff to classified positions are a serious impediment to recruitment of professionals in a market where other employers are offering bonuses to their employees who refer qualified candidates, and where new employees are generally hired within a week of the time they apply for a position.

- Alternatively, other approaches to reducing time delays in hiring should be proposed such as delegation of recruiting and selection of data processing specialists to the Department of Administration.

- Alternatively or in addition, ISB should consider the extensive use of private vendors of systems analysis and programming. There are many individuals and firms that will bid for such work. ISB has already let contracts which essentially serve to augment its permanent staff of analysts and programmers and could rely on this approach more extensively in the future, simultaneously developing expertise in selecting and monitoring the contractors which would work for ISB or other state agencies.

- Even without fundamental improvements ISB should discontinue its practice of billing users at the same rate for the services of both experienced and inexperienced staff. ISB should finance on-the-job training of staff out of an overhead account.

MANAGEMENT ISSUES

- The Department of Administration should analyze the management needs of ISB and propose the organizational structure and staffing and salary levels required to meet ISB's top and middle management needs. If Department of Personnel guidelines present a critical impediment, ISB should prepare a proposal for legislative consideration.

- If the Department of Administration is unable to recruit qualified managers, the operation of ISB or components of ISB should be performed through management contracts.

- Leadership in systems development should be strengthened by recruiting an Applications Services Division assistant director able to provide a high level of technical expertise. ISB should work through aggressive recruitment and training to increase the skills of system development staff.

ORGANIZATIONAL STRUCTURE

- We endorse ISB's decision to return to a dedicated staff arrangement, and believe this concept provides the best basis for organizing most systems development, modification, and maintenance staff.

DEFINING SYSTEMS REQUIREMENTS

- ISB must not agree to undertake development projects which are beyond its ability to perform. It is far preferable to recruit or assist users in recruiting another provider of systems analysis or programming, and to monitor or assist users in monitoring the performance of outside vendors.

- ISB must insist that the user also commit sufficient resources, so that all development projects have a reasonable expectation of success.

- ISB must commit its highest level of experience and expertise to early phases of development projects.

COST AND TIME ESTIMATES

- ISB analysts should receive additional guidance and training if necessary in making estimates.

- ISB should assign responsibility to a senior manager in the Applications Services Division for review and approval of all estimates.

- ISB should periodically assess the extent to which estimates are accurate projections of systems development costs.

SYSTEMS DEVELOPMENT METHODOLOGY

- ISB should review the documentation requirements of PRIDE and determine what elements are necessary under what circumstances.

- As a result, ISB should develop guidelines specifying how the requirements of PRIDE can be met in various kinds of development projects.

- ISB should apply its highest level of expertise in the early phases of development projects even if users are heavily involved, and be held responsible for a successful result or early termination of the project.

PROJECT STATUS REPORTING

- ISB should carry out its plan to implement a project control system and provide users with detailed project status reports along with bills.

- Users should regularly review progress against billings and suspend payment in the event of unsatisfactory performance. As a precaution users should avoid encumbering more money than they want to spend on development projects before they are able to make an evaluation of project results.

- ISB should request a legislative appropriation for a contingency fund to be used in the event it cannot perform agreed-upon work for an agency within an agreed-upon budget.

USE OF PRIVATE CONSULTANTS

- ISB should consider the use of private vendors in all areas where performance by its own personnel is weak and cannot be improved in a reasonable period of time.

- The Department of Administration should consider fundamental changes in arranging for and regulating computer

services if the problems which have been documented in this report persist in the future despite corrective action. In the absence of fundamental improvements the option of management contracts should be considered.

SETTING PRIORITIES AMONG SYSTEMS DEVELOPMENT PROJECTS

- ISB should strengthen its capacity to perform long range planning (or this function should be assigned to a separate unit in the Department of Administration) so that future demands on ISB for development, production, and technical and administrative support are known in advance.

- Consideration should be given to charging the Users Advisory Council with responsibility for setting priorities. Alternatively these decisions should be made by a committee of department heads advising the Commissioner of Administration.

- ISB should focus on its responsibility to provide decision makers with the technical information which these decisions require.

LONG RANGE PLANNING

- Long-range planning should receive much more emphasis than it has in the past. ISB's own proposed planning methodology would appear to require two or more full time staff.

- Serious consideration should be given to locating long range planning in a separate organizational unit within the Department of Administration.

PRODUCTION

DOCUMENTATION

- ISB should identify and document all production jobstreams processed by it.

- ISB should develop and implement procedures to periodically verify customer service documentation. It should also ensure that the proper sequence and timing of interdependent jobstreams is documented and followed, and ensure that computer operators have written instructions

available to follow when a job does not go to the normal end of the process.

● ISB should assign responsibility for the physical maintenance of customer service documentation to a specific individual, and monitor performance of that job.

● ISB should establish a sign-out procedure for customer service documentation.

FICHE PROCESSING

● ISB should review the processing and quality control procedures involved in fiche output and make whatever adjustments are necessary to improve the timeliness, accuracy, readability, and exceptional handling involved in this output type.

● These adjustments should include switching to a new fiche vendor if this is warranted.

FORMS PROCESSING

● ISB should review the procedures and quality control methods involved in the processing of forms to improve the timeliness and accuracy, and reduce the exceptional handling involved in this output type.

TIMELINESS

● ISB should negotiate with users a more definite schedule for on-request jobs to allow improved planning of its workload and to prepare for maximum utilization of the automated scheduling system now being installed.

USER TRAINING

● ISB should review the training programs established by agencies without in-house systems departments to ensure that provisions have been made to properly train or re-train input personnel in order to improve accuracy.

● ISB should develop more effective training methods at the onset of a new jobstream, especially for those users who do not have an in-house systems department.

EXCEPTIONAL HANDLING

- ISB should poll users to identify all cases of exceptional handling and take steps to correct each individual case.

PROGRAMMING CHANGES

- ISB should take steps to reduce the cost and improve the accuracy of programming changes.

- ISB should communicate the improved programming procedures to users and encourage them to request needed changes.

- Modifications to existing production systems should be tested and accepted by Operations in the same manner as new systems.

USE OF DEFICIENCY REPORTS

- ISB should institute a program to inform users of the need for and benefits of filing Deficiency Reports.

- ISB should develop guidelines and procedures describing when to file Deficiency Reports, who should file them, where to send them, etc., and communicate this information to users.

CUSTOMER SERVICE

- ISB should set up procedures to consistently and promptly notify affected users if their output will not be available as scheduled.

RJE USAGE

- ISB should initiate a study to determine the practicality of expanding the number of remote job entry (RJE) stations within the state. This study should be conducted in the larger context of expanding distributive processing in general in the state.

GENERAL ADMINISTRATION

- ISB should set up procedures to ensure the weekend and

night crews have competent assistance available to them on a timely basis.

● ISB should reduce the number of on-request jobs to the greatest extent possible by negotiating with users a more definitive schedule.

● ISB should enlist the aid of an outside service or consulting group to assist it in implementing these recommendations so that corrective action can commence in the near future without disrupting ISB's current workload.

COMPUTER OPERATIONS

ORGANIZATIONAL STRUCTURE

● We concur with the organizational change that centralizes the direction and control of computer operational functions and technical support under one management.

● The numerous significant technical support projects and related personnel resource requirements require a level of direction and control that should be provided by a qualified Technical Support Assistant Director.

● The data entry function should report to the Computer Facilities Assistant Director.

● The development of overall information systems requirements for user agencies should be coordinated with resources that are external to ISB. However, we believe that these planning resources should be centrally controlled within the Department of Administration.

● User agency information system plans and priorities must be clearly established on an objective basis to allow ISB to develop appropriate technical plans for data processing equipment, software and personnel. We do not believe that ISB should attempt to provide for the development of user agency information system requirements and their prioritization as well as system development and computer operations services.

● The present Assistant Commissioner responsible for the management of ISB should be provided qualified assistance in dealing with numerous significant management tasks, which we expect will significantly increase in the near future.

● It would be wise to reduce the Assistant Commissioner's management requirements in the next several years to

allow for the undivided attention of the present Assistant Commissioner to: (1) the identified ISB operational problems and their solutions, (2) the personnel reorganization process, (3) the anticipated enhancements to computer equipment, operational software and telecommunication support, (4) the technical planning process, and (5) user agency relations.

● Development and assignment of functional responsibilities for all management and supervisory positions within ISB will contribute positively to the effectiveness of the total operation. Functional job descriptions will be finalized within the next several months. Therefore, we recommend that these functional job descriptions be reviewed in detail when they are finalized by ISB management personnel.

● ISB management should establish a word processing technical support function. This organizational function should maintain a current knowledge of available word processing systems for user agencies and available methods of integrating such systems with distributive data processing solutions. We believe that this particular function should report to the technical support group within the Facilities Management Division of ISB.

ISB PLANNING

Short Range Planning

● ISB management should develop a standard planning methodology that requires inputs from the various operating divisions and provides for a consolidation of these various inputs into one comprehensive technical plan for the ISB organization. Additionally, we believe that this comprehensive plan should be prepared on an annual basis and documented as the formal technical plan for ISB.

● A qualified planning staff (that consists of two or three full-time personnel) should be hired or contracted to assist in this substantial effort as soon as reasonably possible.

● ISB's short range technical plans should be periodically monitored and evaluated during the next 18 months.

Long Range planning

● We concur with ISB's initial approach to long range planning and their initial efforts in developing a long range planning methodology.

- Long-range planning efforts related to the identification of user agency information requirements and application system requirements, as well as the establishment of priorities for system development, should be performed by a planning staff external to the ISB organization. It would be appropriate for this planning staff to be centrally controlled within the Department of Administration. Such an organization would dedicate most of its effort to assisting user agencies. However, this planning staff would also provide some assistance to ISB management in terms of translating user system requirements into ISB technical resource requirements and associated technical plans.

- The entire long range planning process should be monitored and evaluated on a periodic basis in the future.

ISB EQUIPMENT/SOFTWARE AVAILABILITY AND UTILIZATION

- The present operational approach of linking all three computer processors together through software is the most effective approach that currently could be used by ISB computer operations to allocate and control available computer resources.

- ISB should take the time to inventory and document its present status in the areas of equipment configurations, operational software and the processing environment. Additionally, we suggest that ISB maintain a current inventory of these fundamental data processing elements. We do not believe that it would be a time consuming effort to prepare such documentation.

- ISB should establish a goal of 99 percent availability of their communication network for user agencies.

- ISB should base its equipment requirements and related procurement plans on peak period processing requirements. We recommend that ISB maintain a substantial excess processing capacity position during the next two years to accomodate an anticipated substantial amount of new user system development, new user system implementation, new operational software implementation and related testing requirements that were described to us during our review.

- This excess capacity position is not continuously justifiable. We believe that more quantifiable estimates of new user system development and implementation, new operational software implementation and related testing should be defined over the next two years.

- Users are not always interested in attempting to increase the efficiency of their own application systems. We recommend that this particular situation be investigated further to identify the user rationale for not attempting to improve application system processing efficiency.

- The ISB technical support staff should begin to formalize a reporting process for their studies of systems performance. Additionally, we recommend that they formalize the integration of this reporting process into the equipment procurement process.

- ISB technical support personnel should be working with application development personnel to determine near future disk capacity requirements related to user application systems that are expected to be installed in the next twelve months.

- We concur with the ISB decision to replace the present teleprocessing communications software (TP Executive). However, we question why this decision was not made several years ago.

ISB COMPUTER ROOM OPERATIONS

- An automated approach to checking the job processing details (which also would reduce document preparation) has the potential for reducing the number of human errors presently experienced with the production process. Consequently, we concur with ISB's decision to implement an automated scheduling system.

- The development of the final schedule for implementation of the new scheduling system presents another benchmark that should be evaluated when completed. The level of human error and the overall effectiveness of the production scheduling area should also be evaluted after several major systems have been converted to operate under the automated scheduling system.

- Implementation of the new scheduling system will require a thorough review of the processing and distribution requirements of each production system. We recommend that additional personnel resources be applied to this effort to ensure that it is properly accomplished on a timely basis.

- The data center is overcrowded presently. ISB must solve the problem of its space needs.

- ISB should develop a disaster contingency plan that would be intended for use in the event of a major catastrophe. We believe that the plan should include, at a minimum, consideration of the following:

* Identification and prioritization of critical application processing;

* Specification of the off-site location of backup data files, programs, program control statements, operating software and required procedures and necessary documentation for system restoration and operations;

* A roster of key personnel and their specific post-disaster responsibilities;

* A complete equipment specification list which includes data communication features and special equipment;

* Alternate data center arrangements and agreements and reconstruction requirements.

* We believe that ISB operational procedures and activities for equipment and software problem identification and resolution are adequate. However, we suggest that it would be useful to summarize all malfunctions by system or major system component.

* Modifications to production systems should be applied, tested, and accepted by operations in the same manner as for new systems. Further, we believe that this procedure should be enforced for all production systems, except in "emergency" situations.

* Within the last month ISB has been sending user agencies a weekly summary copy of PAC II. This document supplies summary information of time expended by project. The detail reports, which break out the time expended by task is retained in ISB, but available to the user. We believe that ISB should also distribute copies of the detailed reports to user agencies.

* We recommend that a committee of ISB and user representatives review and document user billing concerns that are presently occurring.

ALTERNATIVE PROCESSING METHODS

* ISB should be able to provide effective distributed data processing alternatives to user agencies. However, to provide such services in the near future requires a substantial investment in equipment, software, and personnel resources now. A state-of-the-art telecommunications network should be acquired, tested and installed. Further, another data base management system should be selected, acquired, tested, and installed. Also, various new terminals and mini and micro-computer systems should

be investigated to determine their applicability for a variety of user requirements. In short, ISB needs to invest resources to update its capabilities to the state-of-the-art.

● ISB should continue to build on the successful processing experience that has been developed through the use of the remote job entry services. This service should be promoted as a viable distributed data processing capability to all large user agencies, especially in the near future.

● ISB should pursue the support of interactive computing systems. These systems, if properly used, have the potential of reducing voluminous manual computational activities in user agencies. These manual computational reductions should result in significant agency savings.

● ISB should expand its internal use of the IBM Time Sharing Option (TSO) system to increase programmer productivity. We also believe that this system could serve the same purpose in certain larger user agencies, assuming that data security controls are defined, implemented, and enforced.

● ISB will need additional personnel resources appropriate standards and procedures for users of the various types of distributed data processing systems. ISB should contract for such assistance in the near future so that these standards and procedures will be available to user agencies when required.

INTRODUCTION

The Information Services Bureau (ISB) of the Department of Administration provides data processing services to departments of state government and is also responsible for planning and regulating the use of data processing systems in state government.

In June 1979 the Legislative Audit Commission directed the Program Evaluation Division, Office of the Legislative Auditor to evaluate the performance of ISB and propose recommendations for administrative or legislative action to improve performance.

In response, we conducted a comprehensive evaluation of ISB focusing on the services ISB provides to state agencies and the efficiency and effectiveness of ISB's internal operations.

ISB provides two kinds of services--systems development and production. Systems development consists of analysis of the information and data processing needs of state agencies, and specification of the data processing equipment, computer programs and administrative procedures required to computerize or automate the collection, tabulation, analysis or reporting of information. Data processing systems thus designed may keep track of accounts or other records, produce statistical reports, write checks, or produce cards, magnetic tape or hard copy for a wide variety of uses.

Production refers to the regularly scheduled or user-initiated operation of data processing systems, once they are designed, tested, and implemented.

We carried out major studies of systems development and production services. We also engaged Alexander Grant & Company to perform a review of computer operations, computer capacity planning and measurement and certain other issues requiring technical expertise absent in the Program Evaluation Division. In addition, during the course of our review we learned that staff turnover at ISB was an important factor negatively influencing ISB's performance and we conducted a study of staff turnover and factors influencing employee morale.

This report presents our findings, conclusions, and recommendations and is organized as follows: Chapter I presents background information essential to understanding the history, organization, financing, and authority of ISB, and helpful in understanding the evaluation findings, conclusions, and recommendations which follow. Chapter II presents findings, conclusions, and recommendations from our study of systems development, as well as related findings from our study of staff turnover and employee morale. Chapter III summarizes findings and recommendations from our study of production services. Chapter IV presents a summary of the study of computer operations performed by Alexander Grant & Company. And Chapter V presents a discussion of major policy alternatives relating to the organization of data processing which we feel merit consideration along with the other recommendations offered in the report. A glossary of terms is appended to this report.

1

I. THE INFORMATION SERVICES BUREAU[1]
HISTORY, ORGANIZATION, FINANCING, AND AUTHORITY

This chapter presents basic background information on the history of centralized data processing in Minnesota state government; the organization, functions, powers, and financing of ISB; and its relationship to the other organizational units that are involved with data processing services in state government.[2] Evaluation findings, conclusions, and recommendations are presented in subsequent chapters.

By law, ISB has two functions: it provides data processing services to departments of state government and regulates the use of computer services by state agencies. ISB operates one of the largest computer systems in Minnesota. Operating with an authorized staff complement of 381, a biennial budget of about $27,000,000 and a sizable configuration of computer equipment, ISB is comparable in size to the computer centers of 3M or the two major bank holding companies in the state. As a regulatory agency, ISB can usually have the final word on whether a state agency will acquire computing equipment or develop an information system.

A. HISTORICAL BACKGROUND

The history of computer services in Minnesota state government has been one of increasing centralization of computer facilities in the Department of Administration. However, this trend is slowly reversing as more agencies employ their own data processing specialists and operate their own computer equipment.

Centralization of state government computer facilities dates from 1957, with the establishment of the Central Services Division in the Department of Administration. One of the division's functions was to provide tabulating services to state government agencies. By 1960, the tabulating facilities of seven agencies had been merged into the Central Services Division.

All computer services within the Department of Administration were transferred into a newly-established Computer Services Division by the 1967 Legislature. A year later, an executive order set forth the new division's responsibilities and powers for planning and administering the development and operation of computer facilities for executive branch agencies.

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[1]Until recently, the Information Systems Division (ISD).

[2]Further detail is presented in the staff paper entitled: A Description of the Information Services Bureau.

A second executive order issued in 1970 charged the Computer Services Division with designing and administering a master plan "for the development and implementation of information systems and other computer services within the structure of state government." Agency requests for acquisition of computers or development of systems were to be evaluated by the Computer Services Division within the framework of that master plan.

During this period, the division was growing steadily in personnel and equipment. In 1970 it was reorganized according to its various functions. As a result of a reorganization of the Department of Administration that same year, it was renamed the Information Systems Division (ISD).

By 1970, three sizable computer centers had grown up in state government: the ISD computer center in the Centennial Office Building, the Highway Department installation across the Capitol mall in the Highway Building, and the facilities of the Department of Manpower Services (now Economic Security) in its downtown Saint Paul offices. Using powers granted by the 1969 Legislature, the Commissioner of Administration merged the Highway Department's computer center and staff with ISD. A separate computer center, funded in large part by federal dollars, is still maintained at the Department of Economic Security.

Another important event of 1970 was the issuance of a consultant's report by the Governor's Committee on State Information Systems. That study[1] has served as the state's 10-year master plan for computer systems. The report's recommendations included a call for increased centralization of state government computer functions and strenghtened powers and organizational structure for ISD. It recommended that the new ISD (or perhaps even a new Department of Information Services) should have wide authority over the development and operation of computer systems and computerization and should coordinate the information systems activities of other levels of government in Minnesota, particularly units of local government and institutions of higher education.

Several of the major recommendations of the 1970 report were translated into law. A bill passed by the 1971 Legislature provides the Commissioner of Administration with statutory authority for operating and regulating the computer services of state government agencies. That law (M.S. 16.90-16.96) strengthened the commissioner's powers as granted by the two executive orders previously discussed.

Under the 1971 law, "The commissioner of administration is charged with the integration and operation of the state's computer facilities serving the needs of state government." Other operational functions of the commissioner are to develop and operate state data security systems, maintain a library of systems and programs devel-

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[1]Analysts International Corporation, Information Systems in the State of Minnesota, 1970-1980, September, 1970.

oped by state agencies and administer the communications for the state information systems.

The commissioner's power to regulate agency use of computer services is also described in that statute.

> Except as otherwise provided by law, all plans and programs for systems and procedures analysis, information systems, and related computer efforts of all state agencies shall be submitted to the commissioner prior to implementation <u>for</u> <u>review</u> <u>and</u> <u>approval</u>, <u>modification</u> <u>or</u> <u>rejection</u>. (Emphasis added.)

The commissioner is charged with developing and maintaining a master plan for information systems in the state, establishing standards for information systems, and cooperating with other levels of government in developing and implementing information systems and computerization projects. The commissioner can also (with the governor's approval) require state agencies to modify their operating procedures to take advantage of new information science technology. He has rule-making powers in these matters, and is to work closely with the two advisory councils[1] established by the same chapter.

A 1973 Joint Powers Agreement established the Minnesota Educational Computing Consortium. Parties to the agreement were the state Department of Education, the State University System, the Community College System and the University of Minnesota. (The Department of Administration was a non-educational member.) A 1976 revision to the agreement explicitly delegated to MECC the powers of the Departments of Administration and Education (under M.S. 16.90 and 16.93) to regulate computer applications of independent school districts, the State University System and the Community College System. MECC serves as a central source of data processing services to its members and to subscribers.

ISB has clearly developed into the central computer "shop" for state government agencies. During the past few years, ISB billings have comprised 85 to 90 percent of the money which state government agencies have spent on computer production services.[2] Funds spent for systems development are split almost evenly between ISB and outside sources (vendors and consultants). But, as a regulator, ISB can be closely involved in every agency decision regarding whether and when to develop a new system or

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[1]The two councils are the State Information Systems Advisory Council (SISAC) and the Intergovernmental Information Systems Advisory Council (IISAC).

[2]This does not include the large amounts of state money spent on data processing for public education systems, nor does it include salaries paid to agency data processing personnel.

acquire computer equipment. ISB also has authority to limit what kind of data processing personnel an agency can employ.

ISB's authority over the development of computer systems was clarified by a 1979 law, which requires the use of the PRIDE systems development and design methodology on virtually all state agency development projects, whether performed by ISB or by an outside contractor.[1] PRIDE, an acronym for Profitable Information By Design, is a proprietary trademark of Milton Bryce & Associates. Furthermore, the Commissioners of Administration and Finance must approve any such project before it proceeds beyond the initial design phases.

The commissioner's regulatory authority extends to decisions regarding the procurement of electronic data processing (EDP) equipment. He may reject all bids for EDP equipment and then negotiate a contract for the equipment if he finds that the bids submitted do not fully comply with the specifications, terms and conditions of the call for bids. A separate subdivision of the competitive bidding law authorizes the commissioner to:

> purchase, sell, repurchase or otherwise undertake the acquisition, rental or disposal of EDP equipment as best serves the interests of the state, provided, however, the commissioner shall adhere to the competitive bidding requirements of chapter 16.

A reorganization of the Department of Administration in the fall of 1979 resulted in changes in the structure of the former Information Systems Division. What was a division in the department was elevated to be a full Bureau of Information Services, organized into three divisions and headed by an assistant commissioner.

B. THE ORGANIZATION OF DATA PROCESSING IN STATE GOVERNMENT

1. ISB

ISB is the center of computer operations for state government. As mentioned above, if billback amounts are included nearly 90 percent of the dollars expended by state agencies on computer

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[1]A bill introduced in the current Legislature would remove specific mention of the PRIDE methodology from the law.

production services are spent at ISB.[1] Performance of these services requires a large computer operation, and ISB's includes three IBM central processing units (CPUs): two 370/158 computers and one 370/168 computer. The acquisition of a second 370/168 computer is now planned. The CPUs are complemented by five Comten front-end processers, as well as disk drives, tape drives and printers, including a recently acquired IBM 3800 high-speed laser printer. Some 900 terminals at locations throughout the state tie in to the ISB computer center.

A sizable staff is also needed to service the information needs of state government. ISB's staff complement includes three division directors, two assistant directors, 176 professionals (programmers, analysts, operators, customer representatives, and administrators), and 126 data entry operators and clerical workers. ISB's authorized complement of 381 includes 72 intermittent positions for income tax data entry operators. During the last few years, from ten to twenty analyst and programmer positions have been unfilled at any time, sometimes because of the lead time needed for hiring and sometimes because ISB chooses not to fill the positions. ISB has experienced professional data processing staff turnover averaging more than 20 percent per year over the last three years.

The organization of ISB's staff has gone through several changes in recent years. The most recent reorganization was implemented in December 1979 and divides the bureau into three divisions and one staff position. The divisions are:

- Application Services;
- Facilities Management; and
- Support Services

One staff position is designated for long-range planning. Exhibit 1 depicts ISB's current organization and the number of staff assigned to each division.

The Application Services Division is responsible for supporting user agency needs for systems development and modification, as well as problem resolution. The customer representatives and maintenance programmers are located here. The other staff members in this division are assigned to either applications development or applications support. These two sections are both organized to handle the needs of five functionally organized groups of user agencies.

There is an applications manager for each of the five groups concerned with applications development. Analysts are assigned to each group; the analysts are moved between groups
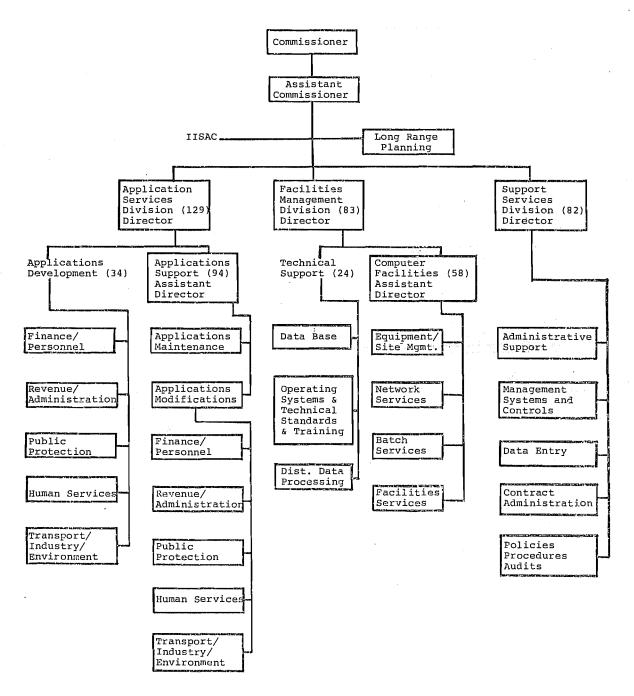
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[1]The rest of the money is spent at the University of Minnesota, private service bureaus and other computing centers.

EXHIBIT 1

ORGANIZATION CHART

INFORMATION SERVICES BUREAU

DEPARTMENT OF ADMINISTRATION

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                          ┌──────────────┐
                          │ Commissioner │
                          └──────────────┘
                                 │
                          ┌──────────────┐
                          │  Assistant   │
                          │ Commissioner │
                          └──────────────┘
                                 │
   IISAC ───────────────────────┼──────────── ┌──────────────┐
                                 │             │  Long Range  │
                                 │             │   Planning   │
                                 │             └──────────────┘
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Application Services Division (129) Director	Facilities Management Division (83) Director	Support Services Division (82) Director

Applications Development (34)	Applications Support (94) Assistant Director	Technical Support (24)	Computer Facilities (58) Assistant Director

Finance/ Personnel	Applications Maintenance	Data Base	Equipment/ Site Mgmt.	Administrative Support

Revenue/ Administration	Applications Modifications	Operating Systems & Technical Standards & Training	Network Services	Management Systems and Controls

Public Protection	Finance/ Personnel		Batch Services	Data Entry

Human Services	Revenue/ Administration	Dist. Data Processing	Facilities Services	Contract Administration

Transport/ Industry/ Environment	Public Protection			Policies Procedures Audits

	Human Services			

	Transport/ Industry/ Environment			

SOURCE: ISB Organization chart, 10/2/79. Modified as described in conversations with
         Assistant Commissioner, 1/29/80.

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occasionally to meet special needs that arise. Programmers are also organized into five functional groups, but may be shifted to development projects as needed.

Similarly, the modification section has five group leaders, each heading an assigned staff that usually does both analysis and programming work. Their assignments are relatively firm and they usually work with their assigned group of agencies.

The applications development staff uses the PRIDE systems development and design methodology, mentioned previously. As noted, the use of the PRIDE methodology is mandated by law for virtually all state agency development projects. ISB is also using certain aspects of Structured Systems Design (by Langston, Kitch and Associates) with the PRIDE methodology.

As an historical note: In the past, systems modifications work at ISB was performed by staff members dedicated to particular agencies, as is currently done. Before 1977 systems development work was also performed by analysts and programmers dedicated to servicing certain agencies. Between 1977 and the end of 1979, analysts and programmers were no longer dedicated to agencies, but rather were pooled and assigned to projects as needed. The dissatisfaction of users and ISB staff members with this pooling arrangement is discussed in the next chapter.

The Facilities Management Division provides support and technical assistance for user agency needs in hardware and software implementation, operation, and evaluation. It manages the computer facilities and is responsible for setting standards and providing data processing training for ISB and user agencies.

The Support Services Division is responsible for fiscal matters, administrative procedures, and data entry. Internal ISB systems for monitoring systems development projects and agency billings are located here, as is the ISB library of systems and programs documentation.

2.   ADVISORY COUNCILS

The Commissioner of Administration and ISB are assisted in their duties by four advisory councils. Two of the councils were established by the 1971 law on data processing and the other two have developed without any statutory authorization.

The State Information Systems Advisory Council (SISAC) was established in 1971 as a successor to the Governor's Committee on State Information Systems, which was created in 1967. SISAC is charged with assisting the commissioner in the development of a master plan for information systems in state government and making recommendations about the state's computerization efforts. Recently, SISAC has been considering ISB's capacity needs and procurement decisions. The membership of SISAC is mostly from private indus-

try, although legislators and legislative staff members have served on the council from time to time.

The 1971 act also established the Intergovernmental Information Systems Advisory Council (IISAC), and charged that group with also assisting the commissioner in the development of a master plan. That statute also provides other duties for IISAC. It is to advise the commissioner on other aspects of state computer services, review and comment on agency applications for outside funding for information systems, prepare guidelines for intergovernmental information systems, and develop recommendations to the commissioner of revenue for gathering and reporting fiscal information about local units of government. Much of IISAC's current efforts deal with helping local governments automate procedures and develop information systems. Besides providing advice, IISAC distributes about $250,000 each year in grants to local governments to aid their efforts.

IISAC currently consists of 25 members appointed by the governor. They come from state departments; county, municipal and metropolitan governments; school districts; and the Higher Education Coordinating Board. Membership in both SISAC and IISAC is governed by the state law on advisory councils, M.S. 15.059.

Two other councils have also been advising the commissioner. The Systems Advisory Council (SAC) was formed about five years ago, at the incentive of the Commissioner of Administration and ISB, as part of an effort to improve ISB-user relations and communication. Its membership consists of systems office heads from twelve state agencies and the Assistant Commissioner for ISB. SAC has been concerned with procedural issues related to ISB's operation and also serves as a sounding board when ISB has proposals to make.

The Users' Advisory Council (UAC) was formed in 1978, and meets with the Commissioner and ISB to discuss policy and management issues. The membership of UAC is primarily composed of assistant commissioners from major user agencies.

C.   ISB FINANCING AND BUDGETING

Like most centralized services provided by the Department of Administration, ISB receives no direct legislative appropriation for its activities. Instead, it is financed by a revolving fund, into which agencies pay for the services they receive. The computer services revolving fund was established in 1968 with an initial capitalization of $250,000.

The computer services revolving fund operates as follows: ISB performs services for a state agency. After the close of the

month, ISB executes a Statewide Accounting System transaction (A68) by which money is disbursed from an agency account and received into an ISB account. ISB then issues billings[1] to the user listing the service charges it has already collected.[2]

In 1978, the U.S. Department of Labor conducted an audit of ISB for the U.S. Department of Health, Education and Welfare. The audit revealed that ISB had accumulated more than $4 million in retained earnings. DHEW concluded that ISB's rates for services, some of which are paid for with federal funds, were too high. The federal auditors insisted that ISB cease accumulating retained earnings and return the retained earnings to the agencies. The 1979 Legislature forbade ISB from accumulating retained earnings but appropriated an additional $1,706,000 to ISB for working capital.

Thus, ISB attempts to budget and conduct its operations so as to show a zero profit or loss. ISB prepares its budget by calculating its expenses for employees, hardware rental, vendor contracts, supplies, floor space, etc. With the assistance of the Department of Finance, it calculates the rates to be charged users to support ISB operations.

A second budgeting process occurs at the same time. Each agency must prepare its own budget for data processing expenses. Using an estimated rate scale supplied by ISB, the agencies calculate how much of ISB's services they plan to use for the year and formulate their budgets accordingly. Each agency data processing budget is included in the "brown book" submitted by ISB to the legislature for consideration.

The actual rate scales are firmed up by ISB after the legislative budgeting process is completed, and, in the past, have differed from the estimated rates. ISB also reserves the right, which it has exercised, to institute retroactive rate changes.

ISB's budget establishes its capacity for providing services to state agencies for that year.[3] The budgets produced by the individual agencies express their expectations for ISB data processing services.

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[1]In the past year, users have not been billed until 4-6 weeks after the end of the month. This delay has been corrected in recent months.

[2]Some larger agencies execute the A68 transaction themselves after they have received and approved the billings.

[3]The revolving fund arrangement should make it easy for ISB to adjust its operations to accomodate demands for service; new requests should, theoretically, pay for themselves. But ISB now has a legislatively approved staff complement, and it cannot necessarily adjust to rapidly changing demands for service.

However, ISB's annual operating budget is consistently lower than the accumulated ISB data processing budgets of state agencies. For the 1980-1981 biennium, agencies requested $31,909,900 for data processing at ISB. ISB's proposed budget for the biennium was $27,007,200, or about 15% less than what the agencies budgeted. ISB points out that it is unrealistic to staff its facilities for complete utilization of agency budgets, because agencies, for a variety of reasons, will not request all the work they budget. Exhibit 2 depicts ISB's budget from 1977 to 1981.

Exhibits 3 and 4 list the major agency users of ISB's production and systems development services in rank order for FY 1978 and FY 1979. The tables indicate the agency expenditures for those years including billbacks. In a billback, ISB is leasing services or equipment from an outside vendor on behalf of an agency. The vendor bills and is paid by ISB, which in turn bills back the cost to the agency, adding a three percent service charge for technical and administrative assistance to users of billback services and equipment. For example, the hundreds of terminals comprising the Bureau of Criminal Apprehension's criminal justice network are leased through a billback arrangement.

Billbacks for production services account for about 40 percent of ISB's total production billings. Billbacks for systems development are less than 5 percent of total development billings. Thus, while ISB had total billings of about $14.6 million in FY 1979, nearly 30 percent of that amount ($4.1 million) is billbacks, for money simply passing through ISB. The other $11.5 million represents work actually performed at ISB and billings generated by that work.

The 1979 Legislature enacted a rider to the appropriation act that required ISB to submit a data processing supplement to the budget, showing all agency requests for data processing services (including personnel, equipment, telecommunication, and contracting costs). The supplement was to include an explanation "of each request for money for the development of a new data processing system or modification of an existing one."[1] ISB, working with the Department of Finance and other agencies, has produced this supplement.

D. CONCLUSION

The Information Services Bureau is currently the center of data processing for state government. New developments in computer technology are changing and will continue to change ISB's role and its relation to the agencies of state government. This chapter has provided the reader with an introduction to the role of ISB in serving the data processing needs of Minnesota government.

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[1]Laws, 1979, Chapter 333, s. 71.

EXHIBIT 2

DEPARTMENT OF ADMINISTRATION
INFORMATION SERVICES BUREAU
ANNUAL BUDGET
(Dollars in Thousands)

Expenditure by Activity	Actual FY 1977	Actual FY 1978	Estimated FY 1979	Budgeted FY 1980	Budgeted FY 1981
Administration	$ 509.7	$ 407.9	$ 298.3	$ 323.3	$ 326.1
Systems and Programming	2,705.2	2,658.4	3,051.4	2,720.1	2,735.5
Operations	6,267.4	6,960.4	8,533.3	8,648.1	9,008.9
Technical Support	458.8	632.1	1,023.2	958.3	981.5
Resource Utilization	555.0	559.6	664.0	648.0	657.4
TOTAL	$10,496.1	$11,218.4	$13,570.2	$13,297.8	$13,709.4

Method of Financing					
Computer Services Revolving Fund	$10,830.0	$11,589.9	$14,000.3	$13,704.0	$14,124.5

Source: 1979-1981 Proposed Biennial Budget (January, 1979).

*The first four activities correspond to the four sections of ISB under its previous organization.

EXHIBIT 3

ISB PRODUCTION WITH BILLBACKS*
TOP TEN AGENCIES BY RANK

FY 1978		FY 1979	
Department	Billings	Department	Billings
Public Safety	$2,548,735	Public Safety	$ 3,066,817
Revenue	1,921,076	Revenue	2,204,931
Public Welfare	1,915,583	Public Welfare	1,896,554
Finance	1,099,058	Finance	1,192,647
Transportation	533,697	Transportation	703,546
Revisor	360,090	Revisor	298,617
Education	216,572	Natural Resources	155,410
Natural Resources	123,804	Labor and Industry	149,821
Administration	121,718	Education	149,249
Energy	77,946	Administration	114,170
All Other Agencies	854,971	All Other Agencies	1,011,320
TOTAL	$9,773,250		$10,943,082

Data Source: ISB KOMAND Billing System.

*Billbacks are the costs for equipment (hardware) or computer ser-
vices purchased or leased for an agency by ISB, "billed back" to
that agency.

EXHIBIT 4

ISB SYSTEM DEVELOPMENT WITH BILLBACKS*
TOP TEN AGENCIES BY RANK

FY 1978

Department	Billings		Department	Billings
Public Safety	$ 699,436		Personnel	$ 623,578
Public Welfare	601,602		Public Welfare	567,431
Transportation	568,901		MN State Retirement	380,379
Revenue	367,562		Transportation	363,722
MN State Retirement	250,402		Revenue	325,544
Finance	217,872		Commerce	315,753
Health	80,118		Public Safety	274,145
Administration	45,865		Finance	251,408
Pollution Control	38,225		Corrections	124,098
Education	29,887		Health	103,962
All Other Agencies	161,200		All Other Agencies	320,093
TOTAL	$3,061,070			$3,650,113

FY 1979 header appears above the second Department/Billings columns.

Data Source: ISB KOMAND Billing System.

*Billbacks are the costs for equipment (hardware) or computer ser-
vices purchased or leased for an agency by ISB, "billed back" to
that agency.

II. SYSTEMS DEVELOPMENT

A. RESEARCH OBJECTIVES

The questions addressed in this chapter[1] are:

- How well is systems development carried out by the Information Services Bureau (ISB) for, and in collaboration with, the state agencies it serves?

- What are the causes of performance problems in systems development?

- What action should be taken to improve performance?

Systems development, as the term is used here, is the process by which computers and other electronic data processing equipment are applied to the operation of state government. Systems development first involves the definition of an agency's data processing needs and requirements, including consideration of whether an agency's operations can be made more efficient or effective through the use of computers. Ultimately, systems development requires detailed specification of the equipment, computer programs and administrative procedures required to collect, process and report needed information. Data processing systems thus developed may keep track of accounts or other records, produce statistical reports, write checks, or produce cards, magnetic tape, or hard copy for a wide variety of uses.

B. METHODOLOGY

In order to evaluate systems development, we selected a representative sample of twenty system development projects active during the past several years and investigated each project in considerable detail through a series of personal interviews and a review of project documents and records.

Our purpose in studying twenty individual projects was not to perform separate audits of individual development projects but to reach conclusions about systems development in general.

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[1]A detailed report of our study of systems development is presented in the staff paper: Systems Development Evaluation.

The field work behind the study reported here is extensive. Investigation of each of the twenty projects required a detailed review of project documentation and several personal interviews at a minimum, and as many as thirteen interviews in large, complex projects. Structured interviews were conducted with the person most knowledgeable about each project at ISB and at the user agency, along with other clerical, technical, professional or managerial staff who were involved in the development process or otherwise knowledgeable about it.

In reviewing the twenty projects, we conducted 88 interviews with 78 people (occasionally we interviewed the same person in connection with more than one project). Twenty-nine of these interviews were with ISB professional, technical or managerial staff, and 59 were with user agency staff or outside consultants. Field-work consumed over two months and nearly the total effort of a four-person team during this period.

The twenty projects in the final sample were performed for fifteen different departments, varying in size and experience with systems development projects. Exhibit 5 lists these projects and the abbreviated name used for each in subsequent exhibits, along with the department or departments for which they were carried out.

C. FINDINGS

This section sets out our assessment of ISB's performance of systems development based on the following criteria:

- the extent to which systems development projects are successfully completed and satisfactorily implemented;

- the extent to which projects are carried out on time and within budget; and

- client satisfaction with the performance of ISB.

Our major findings on these points can be summarized quite briefly:

- Cost overruns were typical among the systems development projects we studied, the rule rather than the exception.

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EXHIBIT 5

SYSTEMS DEVELOPMENT PROJECTS SAMPLED

Project Title	Abbreviation	User Department
Financial Information and Resource Management System	FIRMS	Transportation
Minnesota State Retirement System	MSRS	Minnesota State Retirement System
Personnel/Payroll System	PPS	Finance & Personnel
Statewide Licensing II	SWL II	Commerce, Health, and Various Examining Boards
Traffic Records Integration Project	TRIP	Public Safety
Corrections Management Information System	CMIS	Corrections
Biennial Budget System	BBS	Finance
Application Processing	AP	Personnel
Unclaimed Property System	UPS	Treasurers Office
Public Welfare Patient/Hospital Billing	PWP/HB	Public Welfare
Child Support Collection System	CS	Public Welfare
Family Farm Loan	FFL	Agriculture
House of Representatives Agenda System	HRAS	House of Representatives
Skid Resistance	SR	Transportation
Nuclear Density	ND	Transportation
Land and Water Conservation Project	LAWCON	Natural Resources
Personnel Management Information System	PMIS	Personnel
State Judicial Information System	SJIS	Supreme Court
Vital Records Information System	VIRIS	Health
Corporate Tax System	CT	Revenue

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●   Time delays were typical as well and were often associated with cost overruns.

●   Of the twenty projects studied, two large projects and one smaller project have been abandoned or shelved at a cost of over $2,000,000.

●   Of the projects we studied, the only ones that have been successfully implemented close to time and budget estimates are medium sized or small development efforts.

●   In general, users are not satisfied with the systems development services (systems analysis and programming) performed by ISB.

●   These negative findings notwithstanding, most of the twenty projects we reviewed have been implemented in whole or part. Of these twenty projects eleven have been successfully implemented, three have been cancelled and the remainder are still in the process of development.

        In the following pages these findings will be discussed in three major sections focusing on success in system implementation, time and cost problems, and client satisfaction with ISB.

1.   SUCCESS IN SYSTEMS IMPLEMENTATION

        One basic measure of ISB's success in systems development is the extent to which projects are satisfactorily completed. Putting aside for the moment the question of whether projects were completed within budget and on time and whether users are satisfied with the result, most of the projects we reviewed which were scheduled to be completed by the date of our review (eleven of eighteen) were completed in whole or part.

        Exhibit 6 presents a summary of information on each of the projects we studied.[1] The first column of this exhibit indicates whether or not each system development project produced a system that works. As noted, eleven systems have been implemented in whole or part, three were cancelled, and the remaining six are not

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        [1]Exhibit 6 presents a summary of our judgment on five aspects of systems development performance. Reference will be made to each column as each topic is discussed in this report. A clear-cut judgment on each aspect is not always possible; "Y" should be read as "generally yes" and "N" should be read as "generally no."

EXHIBIT 6

SYSTEM DEVELOPMENT PROJECT PROBLEM ANALYSIS
(Project Status as of December 1979)

Project	Does the System Work?	Cost Overrun?	Problem in Requirements Definition?	Does User Share Responsibility?[1]	Is User Satisfied With ISB Performance On Project?
FIRMS	N[2]	Y	Y	Y	N
MSRS	IP	Y	Y	Y	N
PPS	Y	Y	Y	Y	N
SWL. II	IP	Y	Y	Y	N
TRIP	N	Y	Y	Y	N
CMIS	Y	Y	Y	Y	Y
BBS	Y	N	Y	Y	N
AP	Y	Y	N	-	N
UPS	IP	N	N	-	Y
PWP/HB	Y[3]	N	Y	Y	Y
CS	Y	Y	N	-	N
FFL	IP	N	N	-	Y
HRAS	Y	Y	Y	Y	Y
SR	Y	Y	N	-	Y
ND	N	Y	Y	Y	N
LAWCON	Y	N	N	-	Y
PMIS	Y	Y	Y	Y	N
SJIS	Y	Y	Y	Y	N
VIRIS	N	Y	N	-	N
CT	N	N	Y	Y	N

Notes: Y = yes   N = no

IP = still in the development process.

– = not applicable

1 = for the difficulty in requirements definition

2 = A small subsystem of this project was eventually developed and is in use.

3 = Major components of this project were cancelled due to lack of funds for operation. Only the billing subsystem is in use.

Source: Agency and ISB records, PRIDE documentation, and interviews.

yet completed. The Family Farm Loan system (FFL) and the Unclaimed Property System (UPS) were not scheduled to be completed yet.

Closer analysis of Exhibit 6 yields an important finding of our study:

- Only one of the five largest projects we reviewed was successfully implemented. Two were abandoned or suspended and two have long since slipped their original budgets and time deadlines. Smaller projects have a much greater chance of success.

The five largest projects are listed on the first five lines of Exhibit 6. These are FIRMS, MSRS, PPS, SWL II, and TRIP. Each of these is briefly discussed in the following section.

a. Large Projects

The FIRMS system (Financial Information and Resource Management System), a proposed cost accounting system for the Department of Transportation, was cancelled after an expenditure of about $1,800,000 (counting only ISB billings and consultant fees).

This system was designed to enable DOT to increase its recovery of federal reimbursements by about $670,000 per year and to provide a means of improving accountability for the costs of fleet and inventory management.

A significant cost overrun was experienced on the FIRMS project; the estimated cost of the project was $320,000 compared to the actual cost of $1.8 million. (With DOT personnel costs included the estimated development cost was $680,000 and the actual cost between $2.3 and $2.4 million.) The project was expected to take one and a half years to complete. Instead, after six years of work by ISB, DOT and a consultant, only a relatively minor subsystem was installed, and in December 1978, the remainder of the system was abandoned. DOT is currently beginning a new feasibility study for a cost accounting system as the original need for the system still exists.

TRIP, the Traffic Records Information Project designed to integrate motor vehicle registration and driver's license records along with certain other information was also cancelled, although a new project in this area has recently been initiated.

TRIP was cancelled because both the Department of Public Safety and ISB recognized that the system which had been designed would be too expensive to operate as well as technically infeasible.

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About $300,000 was spent on system design before the project was cancelled.

Of the three remaining large projects, only the Personnel/ Payroll System has been implemented, although at a total cost of about $1,241,000 rather than the approximately $750,000 originally estimated. The development of this system was set back when the first development effort was cancelled for a variety of reasons including high cost, questions about technical feasibility and concerns about the scope of the system as it related to the scope of authority of the Finance Department. The Personnel/Payroll System implemented in May, 1979 is a commercially available software package adapted by a private consultant for use in Minnesota state government. ISB remains concerned about the adequacy of this system's documentation and the adequacy of the system to meet the needs of state government. A major modification of the system is, in fact, underway.

A system which will keep track of earnings and employment service credits, process benefits, and control collection of contributions for the Minnesota State Retirement System (MSRS) was initiated in late 1973 with an early cost estimate of $70,000. The latest indication is that it will cost about $1,100,000 by the time it is completed. Completion is expected in 1980.

The total inadequacy of the early $70,000 estimate for MSRS is painfully obvious, and, in fact, the scope of the proposed system was expanded along the way. However, the revised cost estimates made during the course of the project were also much too low at a point well into the development process when realistic estimates should have been made. And in this case several hundred thousand dollars were spent on premature programming which had to be scrapped.

The Statewide Licensing System (SWL II) developed for the Health and Commerce departments is said to be nearly ready for implementation after time delays and a cost overrun of about $300,000. The cost of this system is more than twice the cost estimate made upon completion of PRIDE Phase II, a point in the development process when a reasonably accurate estimate should be possible.

Thus of the five large development projects we reviewed (those with ISB billings over $300,000) only one project was successfully implemented and this involved the purchase of a system rather than development per se. One project, FIRMS, can only be described as a large scale fiasco; another, TRIP, was stopped after $300,000 was spent on a development effort headed in the wrong direction; and the two remaining projects are said to be approaching completion long after they exceeded their budgets and time deadlines.

b.   Smaller Projects

We reviewed 15 medium-sized and small projects (costs under $300,000). These are listed in the lower 15 lines of Exhibit 6. While most of these experienced time delays and cost problems (which we will discuss later), there is only one case among these of an outright failure to bring a project to a successful conclusion. This is the Corporation Tax System (CT), which was cancelled after nearly exhausting the time and money available for its completion while not progressing past the middle of the development process. Two small/medium projects were not due to be implemented until later this year. Altogether, only two of the 13 smaller projects due to have been completed at the time of our study were not in fact implemented at least in part. The overall completion rate among the twenty projects we studied is fairly high, although the size of our sample and the way it was drawn means that it is incorrect to assume that this is an accurate numerical estimate of the final completion rate experienced by ISB. Most of the projects chosen for our review were those that had either been completed or were close to completion, since we could not evaluate system development by looking at projects in the early stages.

As we will see in the next section, when stricter measures of success are used, the rate of on-time completion or completion within budget, ISB's "success rate" is far lower.

2.   COST AND TIME PROBLEMS

a.   Cost Overruns

●   Significant cost overruns occurred in two-thirds of the projects we examined. Time delays occurred in almost all of the projects we reviewed.

Exhibit 6 shows the extent to which cost overruns affected the sample of twenty projects we studied. All but three of the projects that have been completed experienced a cost overrun,[1] although some of these were relatively minor.

Exhibit 7 presents a list of projects with certain information on the development costs of each. Exact cost figures are difficult to put together due to the complexity of project billings and because the total cost to user agencies is not usually calculated. The figures in Exhibit 7 generally reflect only ISB billings to user agencies for development and testing plus ISB contracts with outside consultants where these existed. User agency expenditures

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[1]Of the three projects that did not exceed costs, two (LAWCON and BBS) were performed by a consultant for a fixed price and the other, the Public Welfare Patient/Hospital Billing System (PWP/HB), was completed within a budget that was set for a more extensive system than the one developed.

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EXHIBIT 7

SYSTEM DEVELOPMENT PROJECT COSTS
(in thousands)

Project	Start	Estimated Completion Date	Actual or Projected Completion Date	Estimated Cost	Cost To Date	Additional $'s Estimated to Complete	Currently Over/Under Estimate
FIRMS	1/73	7/77	Cancelled 12/78	$ 320	$1,800	--	+$1,480
MSRS	12/73	12/74	IP 9/80	70	900	100	+ 930
PPS	10/75	7/78	5/79	705	1,241	--	+ 536
SWL II	9/75	12/76	IP 4/80	250	444.6	105.4	+ 300
TRIP	7/77	7/79	Cancelled 11/78	1,032	302	--	- 730
CMIS	12/75	12/77	7/78	263	288	--	+ 25
BBS	1/78	5/78	12/78	184.1	183.6	--	- 0.5
AP	9/78	4/79	6/79	71.4	138	---	+ 66.6
UPS	2/78	6/80	IP 6/80	78	26.9	51.1	0
PWP/HB	10/78	11/78	7/79	60	59.5	--	- 0.5
CS	12/76	12/77	2/78	52.2	71.7	--	+ 19.5
FFL	5/79	11/79	IP 5/80	48	22	26	0
HRAS	6/77	10/77	1/79	19.2	53.8	--	+ 34.6
SR	9/74	10/76	2/78	25.6	30.8	--	+ 5.2
ND	1/78	10/78	4/79*	7.2	9.3	--	+ 2.1
LAWCON	5/78	7/78	9/78	19.1	19.1	--	0
PMIS	1/78	1/79	IP 1/80	**	**	--	**
SJIS	4/74	1/77	7/78	200	236.7	--	+ 36.7
VIRIS	9/75	11/77	7/79	65.4	81.9	--	+ 16.5
CT	11/76	10/78	Cancelled 6/78	93.4	79.3	--	- 14.1

Notes:

IP = Still in the development process. Date listed is estimated completion date.

* = This project was signed off as of 4/79; however, it was not satisfactorily completed until 2/80 due to programming errors.

** = This project was initiated as part of the PPS system, estimated and actual costs are part of the PPS system.

Source: Agency and ISB records, PRIDE documentation, and interviews.

for outside contractors or for agency staff time are not generally included. If an accurate accounting could be made, it might well show that for some projects the cost of user agency personnel is equal to the level of ISB billings shown in Exhibit 7.

Calculation of the exact size of a cost overrun is also difficult, since the exact figure will depend on what costs are counted and what cost estimate is used as a comparison. As we will discuss later, a portion of the cost overruns reported in Exhibit 7 are due to poor estimating practices rather than poor project performance, although this makes little difference to the agency which has to pay in either case. The data in Exhibit 7 should be used as an indication of the extent of the problem rather than a definitive set of estimates on each project.

Computations based on Exhibit 7 show that the four largest projects which together were estimated to cost about $1,345,000 have actually cost about $4,385,000 so far, an overrun of approximately three hundred percent. Exhibit 7 also shows that smaller projects are much more likely to be delivered closer to the estimated cost, and as noted, a few projects were delivered within budget or are projected to be concluded on budget.

b.   Time Delays

Time delays often but not always accompany system development cost overruns and failures. We interviewed the user agency staff members most knowledgeable about individual projects as well as the ISB analyst most knowledgeable and, depending on who was asked, either 17 or 18 out of the 20 projects examined experienced time delays. Only a couple of projects experienced a cost overrun but no significant time delay. Time delays can occur independent of cost overruns if a period of time elapses in the development process during which no work occurs and therefore no ISB billing occurs. Some users complained that this occurred when ISB sign-off on a particular development phase was held up for an extended period for one reason or another. Time delays can be expected to be accompanied by cost overruns if the same problems cause both to occur; this happens when it simply takes longer to perform a piece of work than anticipated.

3.   USER SATISFACTION

Although it has broader responsibilities, it is legitimate to evaluate ISB in part as a service agency accountable for delivering services to state agencies which they view as satisfactory and worth the cost. Our review of twenty systems development projects shows that:

- The users of ISB are generally dissatisfied with the systems development services they have received from ISB in recent years.

- Users complain about frequent turnover among ISB staff and that ISB assigns staff to their projects who are unfamiliar with their agency structure and operations.

- Users complain that they in effect finance training costs which should be borne by ISB, since they are billed at the same rate for experienced and inexperienced staff.

- Users generally approve of the use of PRIDE, ISB's system development methodology, but feel it is inconsistently applied and incorrectly used in certain instances.

- Users complain about the lack of project status reporting in general and about their lack of control over ISB billings during development.

- While a third of the users we interviewed complained about ISB's hourly rates for systems analysts and programmers, most users feel these rates are fair and competitive. Instead, they complain about the number of hours it takes to complete projects and the value of ISB's services rather than the rates.

- Users are generally satisfied with ISB production. They also comment favorably on ISB technical support. These services are evaluated in Chapter III of this report.

Although a working system was developed in eleven of the twenty cases we reviewed, users were satisfied with the experience in relatively few instances. The last column of Exhibit 6 summarizes our assessment of how users feel about ISB's performance of systems development on each of the twenty projects we reviewed. In 13 of 20 cases users were generally dissatisfied, and in the remaining seven cases they were satisfied.

We also asked users directly to characterize ISB performance on each project as excellent, good, fair or poor. Of the sixteen users responding, none characterized ISB's performance as excellent, six described it as good, four as fair, and four as either poor or fair to poor. Two more described ISB's performance as mixed, containing both good and poor elements.

Most users recognize that the systems analysis and programming services provided by ISB are not uniformly poor. When asked about ISB's strengths both ISB staff and users mention most often that ISB's strong point is "some of its staff." Some users have had positive experiences in solving their system development needs, but they feel that the competent analysts at ISB are too few in number and stretched so thin that they either become frustrated

and leave or become ineffective themselves. We conclude that ISB's performance would tangibly improve if it had a larger corps of experienced systems analysts especially analysts with demonstrated project management ability.

ISB charges users for professional services at one rate for programmers and one rate for systems analysts. But ISB and users recognize that the competence of analysts and programmers varies widely based on their previous experience, among other things. Users complain that they are paying too much for inexperienced staff; the hard reality is that ISB can't offer users experienced staff in all cases where it is needed. One alternative worth considering is to charge for services according to a schedule of rates reflecting the experience and competence of staff, or to otherwise finance a greater proportion of on-the-job training out of overhead. Since ISB is funded through its billings to users for equipment and personnel, users in the aggregate won't be paying less but the costs of supporting non-productive staff may be borne more equitably.

Of course, a primary focus of user dissatisfaction is their experience with projects that take longer and cost more than anticipated. The causes of these problems as well as other sources of user dissatisfaction mentioned here are discussed in following sections.

D. THE CAUSES OF PERFORMANCE PROBLEMS IN SYSTEMS DEVELOPMENT

To recapitulate, in reviewing twenty development projects we have found frequent time delays, cost overruns, cases of outright failure and a high level of dissatisfaction among users with new development as it is conducted by ISB.

In this section we set forth our analysis of the causes of these development problems. We see these as grouped into three general categories: insufficient staff resources, ineffective organization of systems development staff, and poor relations with user agencies.

STAFF RESOURCES

- ISB has experienced rapid turnover among systems analysts and programmers. Experienced staff are constantly being replaced by inexperienced staff because ISB cannot, given limitations of pay and advancement opportunities, compete successfully for experienced staff with a demonstrated record of performance.

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- Partly as a result, ISB staff resources are insufficient to carry out an ambitious program of new development such as that undertaken in recent years. The principal deficiency is a shortage of experienced project managers with the managerial and technical expertise to solve the range of challenges that every ambitious development project is bound to encounter.

- Management of systems development has been weak, both in the effectiveness of managerial control and in technical leadership.

- The position of ISB director has been filled on an acting basis for several years and has changed hands several times.

ORGANIZATION OF SYSTEMS DEVELOPMENT STAFF

- ISB systems development staff has been, until recently, organized in a way which contributed to rapid rotation of staff assigned to specific projects. This arrangement did not permit analysts to become familiar, over time, with the functions of particular agencies and diminished ISB's capacity to serve effectively.

RELATIONS WITH USERS

- ISB has lacked an effective means for setting priorities among demands for its services.

- ISB is consistently low in estimating the time its analysts and programmers require to complete projects. As a result, projects take longer to complete and cost more than anticipated.

- In a significant number of cases ISB and user agencies were unable to freeze system design and move to later phases of development in an orderly fashion.

- ISB has not established necessary communcation with users so that it can plan for systems development and be prepared in advance to meet agency needs.

- ISB has not consistently administered PRIDE, the systems development methodology purchased by ISB for use in state government. The origin of ISB's inability to apply standards consistently is the contradiction between its role as a provider of systems development services and a regulator of systems development.

- ISB has not provided users with meaningful project status reports while projects are underway.

We now turn to a discussion of these points along with a presentation of recommendations.

1.   HIGH STAFF TURNOVER

High turnover among systems analysts and programmers emerges from our review of twenty development projects as an important cause of systems development performance failures. Because we feel it is a key factor in ISB's performance problems, we decided to perform a study of ISB employee morale and investigate the extent and causes of high turnover. Findings from this study are presented in this chapter and reported in detail in a separate Program Evaluation Division staff paper.[1]

Turnover among ISB's systems analysts and programmers has tripled over the past five years; in each of the last three years approximately twenty percent of ISB's analysts and programmers have resigned. While ISB has been able to attract entry level personnel it faces real problems in retaining employees once they obtain a few years of highly marketable on-the-job training. According to current and former ISB employees, ISB can't offer enough money or advancement opportunities. Current and former employees also are critical of ISB managerial and supervisory practices at ISB, and cite this as a factor motivating them to leave.

It would be surprising if high staff turnover did not work to diminish the effectiveness of ISB systems development staff. While turnover affects the entire industry, not just ISB, private employers are able to offer higher pay and more flexible advancement opportunities. Our survey of current and former ISB employees did show that a job at ISB is viewed as highly attractive for a number of reasons connected to the job itself: the work is viewed as interesting, varied and challenging. These factors have apparently enabled ISB to recruit entry level workers fairly easily, and to keep some, but not enough experienced and competent staff.

Thus, there is some evidence that existing civil service procedures are not well suited for recruitment of systems analysts, programmers or data processing managers, given the competitiveness of the market and the inflexibility of civil service salaries and career paths. Changes in recruiting procedures which offer greater flexibility while protecting the essential principles of the merit system are needed.

Based on these findings, we recommend that:

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[1]Staff Turnover and Employee Morale at the Information Services Bureau.

- A variety of tools be used to ensure that ISB is a competitive employer. This includes developing a job classification structure which offers opportunities for advancement and sufficient increments of pay and responsibility.

- Alternatively, or in addition, ISB should propose to remove job classes experiencing critical shortages from the classified civil service. The delays in hiring which are built into recruitment of staff to classified positions are a serious impediment to recruitment of professionals in a market where other employers are offering bonuses to their employees who refer qualified candidates, and where new employees are generally hired within a week of the time they apply for a position.

- Alternatively, other approaches to reducing time delays in hiring should be proposed, such as delegation of recruiting and selection of data processing specialists to the Department of Administration.

- Alternatively or in addition, ISB should consider the extensive use of private vendors of systems analysis and programming. There are many individuals and firms that will bid for such work. ISB has already let contracts which essentially serve to augment its permanent staff of analysts and programmers and could rely on this approach more extensively in the future, developing expertise in selecting and monitoring the contractors which would work for ISB or other state agencies.

2. INADEQUATE PROJECT MANAGEMENT

Both users and ISB staff are critical of ISB project management. In fact, ISB management itself recognizes the problem of a lack of capable, experienced managers of development projects, although this is obviously a sensitive point which does not lend itself to extensive public discussion.

ISB has attempted to carry out a number of extremely ambitious development projects in recent years. The participant account system for MSRS, TRIP for the Department of Public Safety, and FIRMS for the Department of Transportation are each projects budgeted at over a million dollars; they involve the coordinated activity of many participants in a complicated environment. It is these large projects which are most susceptable to failure, as we have seen. The challenge of managing projects of the scope and complexity of any of the examples cited is considerable. Competition among private and public employers for competent analysts capable of project management, is fierce at the present time. Thus, improving performance in project management will not be an easy task.

Again, we propose the same remedies as those designed to reduce staff turnover. ISB should propose changes in the job classification structure, propose removal of certain data processing professionals from the classified civil service, or hire experienced staff on contract. ISB will never be a salary leader in the industry but presumably can offer salaries that are in the ballpark, attractive opportunities for professional development and a varied work experience.

We also feel that project management would improve in any case if the technical leadership in the Application Services Division is strengthened.

3.   SYSTEMS DEVELOPMENT MANAGEMENT

Project management has been weak in part because the next levels of management responsible for systems development have lacked effective control and technical leadership. As we will discuss, several changes have recently been made in organization and personnel which are designed to remedy these weaknesses including replacement of the former head of systems development and a reorganization of systems development staff. This reorganization is discussed in a subsequent section mainly in terms of how it will affect user satisfaction, but the dedicated staff arrangement recently put in place ought to strengthen managerial control as well since systems development staff will probably be assigned to fewer projects at any one time than in the past.

Our review of systems development projects focuses on a period of time before these changes were made, and at the moment it is too soon to attempt to measure their effect. While it is possible to be optimistic at the moment it is perhaps not realistic. Although the systems development staff is now under new direction, ISB itself is under new management, and the supervisory structure of systems development has been changed for the better, the first line supervisors of project managers are the same people as before and the technical leadership of systems development has not been strengthened.

We recommend that:

●   Leadership in systems development be strengthened by recruiting an Applications Services Division assistant director able to provide a high level of technical expertise. ISB should work through aggressive recruitment and training to increase the skills of its systems development staff.

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4. FREQUENT CHANGES IN TOP MANAGEMENT

During the last few years, the position of ISB director has been filled by several people in an acting capacity. In our view this turnover and the lack of a permanent director has placed a burden on middle management to resolve problems which properly required decisions by top management.

We received reports from the ISB staff we interviewed of persistent conflicts among ISB middle management. Although these have presumably been resolved by recent changes in management and the appointment of a new ISB chief, the development projects reviewed in our study were carried out during a period when ISB's leadership changed hands several times and when the differences of opinion among middle management could not be successfully resolved. These conditions cannot have had a positive effect on performance of systems development.

The reason why the ISB director's position remained vacant for so long is that attempts to recruit a permanent director were unsuccessful over a long period of time. Perhaps a qualified candidate with a demonstrated record of success cannot dependably be attracted to the job given the salary constraints which exist.[1]

ISB has a staff complement of 381 positions, a high percentage of which are professional and technical positions. ISB is thus larger than many state departments, and by this logic requires a depth of management appropriate to the size and complexity of the organization. Many state departments smaller than ISB are headed by four unclassified positions, allowing top management flexibility in assembling an effective and compatible management team.

ISB has just been reorganized as a bureau rather than a division and as a result mangagement down the line has been reclassified into higher positions. In addition, the operating divisions of ISB have recently been placed under new management. The record of performance reviewed in this report was compiled before these changes were made. It is too early to tell if they will have the desired result, however, if problems in systems development performance remain, we recommend that:

- The Department of Administration analyze the management needs of ISB and propose the organizational structure and staffing and salary levels required to meet ISB's top and middle management needs. If Department of Personnel guidelines present a critical impediment, ISB should prepare a proposal for legislative consideration.

- If the Department of Administration is unable to recruit qualified managers, the operation of ISB or components of ISB should be performed through management contracts.

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[1] These observations should not be construed as an evaluation of the recently appointed bureau chief of ISB.

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5.   INEFFECTIVE ORGANIZATIONAL STRUCTURE

During a period of approximately two years ending in December 1979, ISB systems analysts and programmers assigned to new development were pooled rather than assigned to serve a particular agency or set of agencies. Users were highly critical of this organizational arrangement because they felt that it impeded their ability to work with a staff that over time would become increasingly familiar with their agency's operations.

In our judgment the organizational pattern in effect until recently did in fact contribute to frequent rotation of staff assigned to work on specific projects. Development of good automated systems requires a thorough understanding of the structure and functions of the agency being served, and this is gained through an accumulation of experience over time.

ISB has recently instituted a change in structure which dedicates certain analysts to specific agencies on a relatively permanent basis. Users as well as experts we have talked to all agree that this change makes sense and that the advantages of a pooled arrangement are more theoretical than real. Our survey of ISB employees shows that they too favor a dedicated arrangement. Therefore,

- We endorse ISB's decision to return to a dedicated staff arrangement, and believe this concept provides the best basis for organizing most systems development, modification, and maintenance staff.

6.   PROBLEMS IN DEFINING SYSTEM REQUIREMENTS

Every systems development project faces certain predictable threats to its successful completion. Among these is the natural tendency of users to want to enhance, embellish or change system capabilities during the development process. Also, successful development may require more work from the user agency than it anticipated or is willing or able to perform. Successful systems development project managers encounter these pressures but handle them by obtaining necessary commitments from users and by freezing the design of the system sufficiently early to permit timely completion of the project.

Failure of the user and/or ISB to successfully define what the proposed system will do, for whom, or on what schedule can lead to cost overruns, time delays or outright project failures.

As Exhibit 6 indicates, we found that the most serious cases of time delays, cost overruns, and outright project failures were in fact accompanied by problems in defining what the system requirements were, and that the agencies for whom the systems

were being developed were responsible, in part (and sometimes primarily responsible) for these problems.

Certainly in the five largest projects we studied user agencies as well as ISB are responsible for the failure to specify system requirements and objectives in a timely, complete and correct fashion. It is ISB's responsibility to see that early phases of development are not approved before proceeding to subsequent phases and ISB has the authority to withhold approval until external requirements are satisfactorily defined. In some instances, however ISB has faced extreme pressure to proceed against its better judgment. On the other hand, in some cases, according to users, ISB has used its authority to withhold approval because of its inability to perform the work.

While it is fairly easy to count the number of times requirements definition has been a problem, it is much less easy to disentangle the respective responsibility of ISB and users. While users were more likely than ISB to report that requirements were adequately defined in the early phases of projects both ISB and users report that such problems occurred in over half of the cases studied.

Our judgment, summarized in the third and fourth columns of Exhibit 6 is that a clear problem with requirements definition occurred in thirteen of twenty projects, and that users shared some measure of responsibility in each case.

We looked for the reasons why requirements have not been defined. We asked ISB and users for the causes of these problems, and the following factors appear to be most important:

 ● Poor project management by ISB.

We have discussed this point in detail earlier. It is the essence of skillful systems development to overcome the normal challenges to successful completion of a project.

 ● User agencies don't know what they want with enough precision.

TRIP is a clear example of a project which proceeded from a general concept, but the user agency did not sufficiently define the external requirements of the traffic records system to be developed. We interpret the fact that project costs are extensively mis-estimated to signify that this problem is fairly common.

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●   User agencies fail to assign a sufficiently high
     priority to the project, resulting in less than suffi-
     cient attention by agency management, staff and end
     users of the proposed system.

     This occurred, for example, in TRIP, FIRMS, and in the
Corporate Tax (CT) system undertaken for the Department of
Revenue. The participant account system for the Minnesota State
Retirement System (MSRS) also suffered from an insufficient commit-
ment of agency resources.

●   ISB fails to perform its proper role when faced with
     poor definition of requirements by users.

     ISB is responsible for suspending subsequent phases of
development until logically prior phases are satisfactorily carried
out. ISB hasn't always done this, and the result in a number of
cases has been time and money wasted on detailed design and
programming. This occurred in the participant account system for
MSRS where at least $200,000 was spent on programming which was
subsequently discarded. Useless programming was also performed
on FIRMS, the accounting system for DOT, and the Vital Records
System (VIRIS) for the Health Department.

     While ISB has formal authority to suspend development
projects, it can face pressure from users which as a practical
matter requires ISB to put aside its technical reservations and
proceed.

     ISB also is not in a completely objective position to make
the decision to go ahead with a development project when there are
unsolved questions because ISB is not in an objective position to
add up the costs of delaying development which are borne by state
agencies. These costs are largely hidden, involving such things as
extra clerical time, absence of needed data which lowers the quality
of management decisions and so forth. ISB can calculate the costs
of proceeding with a project much more accurately.

     Based on this analysis, we recommend that:

●   ISB must not agree to undertake development projects
     which are beyond its ability to perform. It is far prefer-
     able to recruit or assist users in recruiting another
     provider of systems analysis or programming, and to
     monitor or assist users in monitoring the performance of
     outside vendors.

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- ISB must insist that the user also commit sufficient resources, so that all development projects have a reasonable expectation of success.

- ISB must commit its highest level of experience and expertise to the early phases of development projects.

7. INACCURATE COST AND TIME ESTIMATES

The fact that ISB estimates are not just inaccurate but consistently low is evident from Exhibit 7 which indicates that cost overruns are widespread.

Some ISB analysts we interviewed acknowledge that they usually provide users with a "best case" estimate, which assumes that everything will go right. The incentives faced by ISB are different from a private firm marketing systems development or programming services; if ISB consistently fails to deliver a timely product it doesn't suffer a financial loss or go out of business, it usually arranges with users to continue billing beyond the point originally targeted. Most users of ISB services require ISB approval to go outside for systems development and programming, and ISB has naturally been reluctant to approve such proposals because ISB is responsible for subsequent maintenance and operation of systems, and because such approval results in a diminution of ISB's control and influence.

ISB needs to be aware that there is a natural tendency for its analysts and programmers to make optimistic rather than realistic estimates. Realistic estimates are possible, however, once system objectives and requirements are specified and frozen. Private vendors of systems analysis and programming services commit themselves to such estimates, and live with the consequences even though they depend on cooperation from user agencies and face certain contingencies beyond their direct control just as ISB does. Although ISB does not face the same set of risks and incentives as a private vendor, it ought to make estimates that are realistic and include whatever margin for error is required because in evaluating the costs and benefits of a proposed system users need first of all to know what the system will cost to develop and run.

We recommend that:

- ISB analysts receive additional guidance and training if necessary in making estimates.

- ISB assign responsibility to a senior manager in the Applications Services Division for review and approval of all estimates.

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●   ISB periodically assess the extent to which estimates are accurate projections of systems development costs.

       In Chapter V we propose an alternative method of financing ISB that puts ISB at risk for completing work within a specified budget. This would, in our view, create an incentive for ISB to make the technical changes noted above or others that would ensure accurate estimation of the cost of development projects.

8.   SYSTEMS DEVELOPMENT METHODOLOGY

       PRIDE (Profitible Information by Design) is a proprietary tool purchased by ISB from Milton Bryce and Associates. Its use in development projects is a requirement of ISB and a requirement of state law under certain circumstances.

       The first phase of PRIDE requires a feasibility study including an analysis of project costs and benefits. The second phase of PRIDE requires specification of the general system design after which a reasonably accurate cost and time budget should be possible. Approval of development projects after completion of these two phases by the Commissioners of Finance and Administration is currently required by law.

       As we have seen in the twenty projects we reviewed, completion of PRIDE Phases I and II is no guarantee that a reasonable cost-benefit analysis has been done, nor that reasonable estimates of time and money have been made.

       PRIDE or an equivalent system is considered to be necessary and helpful by users and ISB analysts, but the way it is applied is the source of significant dissatisfaction among users. Users and some ISB staff feel that PRIDE requires too much documentation for one-shot or small applications and some users feel that ISB should accept equivalent systems of documentation rather than requiring PRIDE.

       According to ISB the requirements of PRIDE are not supposed to be as rigorous or detailed in some systems as others. However, some users feel that ISB has not consistently applied the requirements of PRIDE and suspect that some users have an easier time than others, depending on their clout. The biggest problems which emerge are disputes in which users feel that PRIDE is being used as a tool for exercising ISB's authority over users rather than as a system development tool. Failure to sign-off on a PRIDE phase has in some cases been a manifestation of a dispute over authority rather than a dispute over PRIDE or its requirements per se.   ·

       In addition, according to experts we have consulted, among systems development methods PRIDE is extreme in the amount of detailed documentation and paperwork it requires. However, as

we have seen, no amount of documentation nor anything else about PRIDE itself provides or guarantees that the development process will go smoothly and the results will be satisfactory.

ISB favors removing specific mention of PRIDE, a proprietary trademark, from the law in favor of a general statement of requirements designed to accomplish the same purpose. This proposal has merit in our view since it is a matter of professional judgment whether PRIDE or some other tool can best serve ISB's needs. In any case, ISB needs to spell out as a matter of administrative policy and procedures exactly how systems development should proceed, the role of ISB and users, and other guidelines which will enable ISB and users to collaborate more productively and with less rancor.

We recommend that:

●   ISB review the documentation requirements of PRIDE and determine what elements are necessary under what circumstances.

●   As a result, ISB develop guidelines specifying how the requirements of PRIDE can be met in various kinds of development projects.

●   ISB apply its highest level of expertise in the early phases of development projects even if users are heavily involved, and be held responsible for a successful result or early termination of the project.

9.   INADEQUATE PROJECT STATUS REPORTING

A significant number of users have complained about the lack of formal project status reporting by ISB. PRIDE requires that a time schedule and budget be produced in the early stages of a project and that new estimates be figured at the beginning of subsequent project phases. As we have seen, however, most of these budgets are unrealistic and in any case are not used effectively to monitor progress against time elapsed and money spent.

Because ISB operates with only a six week cash reserve it needs to keep the money coming in whether or not real progress is being made on projects. ISB insists that agencies encumber money sufficient to cover completion of a project or a major phase before work commences. ISB can, in effect, draw against this money until it runs out without further sign-off from the user. Some users complain that the first real progress report they receive from ISB is a notice that the money has run out.

Users need to receive detailed progress status reports. ISB is in the process of implementing a project control system which

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is expected to provide this information. The user agency project leader, not the agency's bookkeeping staff, needs to review project status reports and bills; this is the user's responsibility, not ISB's.

If ISB were operating on the same footing as a private company it would have to perform better than it has in system development or face non-payment of bills by angry clients. It would in cases of occasional non-performance be able to draw against accumulated profits or company assets. ISB does function like a private company in that it is dependent on client billings for its revenue, but its rates are calculated so that its profit margin remains zero. Thus a change in ISB's modus operandi would be required if ISB is to be placed at risk for the successful performance of particular projects. If ISB were at risk, its cost estimates would have to be higher in the first place than they have been and its rates would have to be increased to cover any development failures. Based on our review, both estimates and rates need to be more realistic, that is, higher in the first place.

We recommend that:

- ISB carry out its plan to implement a project control system and provide users with detailed project status reports along with bills.

- Users should regularly review progress against billings and suspend payment in the event of unsatisfactory performance. As a precaution users should avoid encumbering more money than they want to spend on development projects before they are able to make an evaluation of project results.

- In order to improve relations with users, ISB should charge for its analysts and programmers according to a schedule of rates which varies according to experience and ability. If these rates truly reflected staff productivity, ISB would be more likely to deliver a product on time.

- ISB should request a legislative appropriation for a contingency fund to be used in the event it cannot perform agreed-upon work within an agreed-upon budget. This recommendation has major ramifications and is discussed in Chapter V.

10. USE OF PRIVATE CONSULTANTS

Private vendors of systems analysis or programming services were involved in ten of the twenty projects reviewed here. Vendors have been involved in both successful and unsuccessful

development projects. The Personnel/Payroll System exists now because a decision was made to abandon the effort to develop a home-grown system and to purchase commercially available software from one firm and hire another to adapt it. The Biennial Budget System modification was delivered on a tight time schedule because an outside vendor was hired to do the job after it became clear that ISB could not perform the job within the time available.

The development of the LAWCON System was also carried out in a short time frame, within budget by a private company when ISB agreed that it lacked sufficient staff to do the job.

Private vendors were involved in the early design phases of several other projects with more or less satisfactory results, in a couple of projects with unsatisfactory results according to some reports, and in one major effort which failed, FIRMS.

Projects using vendors to perform detailed design and programming have a better success record based on timely delivery of a project for a preset cost than projects where ISB carries out these functions. If a private company experienced ISB's success rate in development for any length of time, it would quickly be out of business.

Since ISB is responsible for operating data processing systems once development is complete, it needs to ensure that all systems including those developed by vendors, meet documentation and performance standards established by ISB. Among the projects we investigated we found cases of dispute between vendors and ISB concerning the size and extent of documentation required to meet ISB's standards.

ISB is also naturally concerned that systems are developed according to specifications relating to hardware and system software and other considerations based on interests that go beyond those of a single agency. While use of outside vendors could result in systems that are expensive to run or maintain, systems that are poorly documented, or systems which fail to take other needs into account, there is nothing about the use of vendors per se which makes it impossible to safeguard against these unwanted consequences.

Based on the extent of use of outside consultants in the period studied and our expectation that demands on ISB will tend to increase rather than diminish in the future, ISB ought to be actively preparing to facilitate the use of outside vendors in order to augment its own system development capabilities and to permit users to arrange contracts with vendors under clear, consistently defined conditions.

ISB has, in fact, considered these issues and recently solicited bids for relatively small contracts for systems analysts and programmers.

We recommend that:

● ISB consider the use of private vendors in all areas where performance by its own personnel is weak and cannot be improved in a reasonable period of time.

● The Department of Administration should consider fundamental changes in arranging for and regulating computer services if the problems which have been documented in this report persist in the future despite corrective action. In the absence of fundamental improvements the option of management contracts should be considered. This subject is discussed further in Chapter V.

11. SETTING PRIORITIES AMONG SYSTEM DEVELOPMENT PROJECTS

Our interviews with ISB user agency managers and staff lead us to conclude that an improved mechanism must be developed for deciding on system development priorities. ISB and users both recognize that ISB cannot simultaneously meet all demands for its services.

Possibly in an effort to accomodate users, however, ISB has in recent years taken on more work than it can perform. The decision concerning which system development projects have highest priority is not properly ISB's; it must be made at a higher level where the competing needs of separate departments can be discussed and prioritized. Currently this is the responsibility of the Commissioner of Administration.

We recommend that:

● ISB strengthen its capacity to perform long range planning (or that this function be assigned to a separate unit in the Department of Administration) so that future demands on ISB for development, production, and technical and administrative support are known in advance.

● Consideration be given to charging the Users Advisory Council with responsibility for setting priorities. Alternatively these decisions should be made by a committee of department heads advising the Commissioner of Administration.

● ISB should focus on its responsibility to provide decision makers with the technical information which these decisions require.

12. INADEQUATE LONG-RANGE PLANNING

ISB can only plan intelligently if it knows what user agencies data processing needs and requirements will be in the future. While ISB acknowledges this need and has identified an appropriate methodology, it has not yet assigned sufficient staff to this task.

Alexander Grant & Company, serving as consultants to our project, reviewed ISB's long range planning activities as part of a study reported elsewhere.[1] They recommend that long-range planning efforts relating to the identification of user agency information requirements and application system requirements, as well as the establishment of priorities for system development, be performed by a planning staff external to ISB but controlled by the Department of Administration. This unit could be assigned additional responsibility for regulating system development as well. Based on our review as well as the Alexander Grant study we recommend that:

- Long-range planning receive much more emphasis than it has in the past. ISB's own proposed planning methodology would appear to require two or more full time staff.

- Serious consideration be given to locating long-range planning in a separate organizational unit within the Department of Administration. This option is discussed further in Chapter V.

D. SUMMARY

This chapter has presented the findings, conclusions, and recommendations of our study of systems development. We have concluded that, in general, systems development has not been effectively carried out in recent years. We have pointed to management, organizational structure, and staff resources as factors which we believe explain at least some of the problems ISB has experienced in systems development.

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[1]Alexander Grant and Company, Review of Computer Operations, Minnesota Department of Administration, Information Services Bureau. The main findings of this study are presented in Chapter IV.

The development projects reviewed in this chapter were conducted, in large part, prior to certain changes in ISB management and organizational structure. In addition, ISB has taken steps to improve communications with users along with other steps that, if successful, will work to increase its capacity to anticipate or meet the data processing needs of state government. It is not clear that these measures will be sufficient, and significant structural changes in the organization of data processing may be required. Alternatives of this kind are discussed in Chapter V.

III. PRODUCTION

A. RESEARCH OBJECTIVES

ISB production consists of providing users with the output of data processing systems in the form of reports, forms, magnetic tape, microfiche, etc., on a pre-determined or on-request schedule.[1]

As Chapter I makes clear, ISB billings for these services account for most of its revenue. In fiscal 1978, ISB billed user agencies for approximately 6.4 million dollars and approximately 6.8 million dollars in 1979.[2] Thus, billings for production services are nearly twice as large as billings for systems development services.

Our study of ISB production asked:[3]

- Is ISB's operation documentation accurate and complete?

- Is the output received by users timely, accurate, readable, and useful?

- Is the number of copies received by users adequate?

- Is an inordinate amount of exceptional handling required to produce the output, and

- Are frequent changes to the jobstream required to ensure receipt of accurate and timely information?

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[1] We did not review the on-line processing services provided by ISB. On-line processing involves a different set of issues and performance measurements than the batchmode services we looked at.

[2] These figures exclude money billed to users for services purchased by ISB for users from outside vendors. Including these billbacks, ISB billed users for 9.8 million dollars in 1978 and 10.7 million dollars in 1979.

[3] A more detailed version of this chapter may be found in the Program Evaluation Division staff paper entitled Production Services Evaluation.

Additionally, we wanted to know if users were aware of and using ISB Deficiency Reports to communicate their problems, and we wanted to measure the extent to which users are satisfied with ISB data processing services, because once systems go into production ISB is clearly and unambiguously a service provider. If ISB is doing its job, it should have satisfied clients.

B. METHODOLOGY

ISB's production activities are organized into sets of tasks called jobstreams. A jobstream consists of a series of both manual and computerized tasks which must be performed to produce output, which is then distributed to users. The output may be a single report or a number of related sets of information, and may be in the form of hard copy, magnetic tape, microfiche, or cards.

ISB has approximately 1,200 production jobstreams in operation at present. Because it was impossible to talk with the users of the output created in all 1,200 jobstreams within a realistic timeframe, we selected a representative sample consisting of approximately nine percent of all production jobstreams (108 jobs). In choosing the sample, we systematically included jobs for both large and small state agencies, jobs utilizing both remote station output and in-house batch output, jobs run on various output schedules (i.e., daily, weekly, etc.), and jobs having various output types (i.e., hard copy, fiche, tape, etc.).

An interview guide was then developed, and with the help of two temporary assistants, Program Evaluation Division staff members conducted phone interviews with the end users of the output in each of the 120 jobstreams. Responses to the interview questions were then summarized, tabulated, and analyzed.

C. MAJOR FINDINGS AND CONCLUSIONS

Although a significant number of users were affected by problems with the delivery of output, our analysis indicates that a large proportion, 82 percent of the users sampled, were either very satisfied or usually satisfied with ISB's overall performance. In addition, 93 percent of the users interviewed were either very satisfied or usually satisfied with ISB's response to the problems they experience. We believe this is due to the competent performance of Customer Service personnel at ISB, because there were enough actual problems that a greater level of dissatisfaction would probably exist if the problems that did occur weren't handled properly.

The following sections of this chapter discuss the extent and nature of the production problems that we discovered in our review of a representative sample of current jobs being run by ISB. A more detailed presentation of our findings appears in the staff paper entitled: Production Services Evaluation.

1. DOCUMENTATION

We reviewed the operations documentation for each of the sampled jobstreams. Incomplete or inaccurate documentation can have a serious effect on a data processing department's ability to perform effectively. Jobstream documentation defines when to run the job, how to set it up, what output to expect, and what to do with the output once the job is executed. It is the "bible" for processing activity in any data processing department, and must be kept up to date so that changes to jobstreams can be implemented correctly and that users receive the information they need to perform their functions effectively.

It is especially important for ISB to have accurate and complete Customer Service documentation because ISB management has recently purchased and is installing an automated scheduling system, whereby the computer would automatically produce the daily schedule of jobs to be run. If the Customer Service information loaded into the computer for the scheduling system is not accurate, the resultant schedule the system produces will be faulty and the benefits of computerized assistance will be lost, no matter how sophisticated the system is.

ISB's working copy of production documentation is contained in a series of books called Customer Service manuals. In analyzing the quality of Customer Service documentation available at ISB, we sought to determine the documentation's accuracy and completeness in defining output and its distribution. We looked for discrepancies in the definition of output quantity, definition of output type, definition of output timing, and definition of output distribution. We also attempted to verify the active/inactive status of jobstreams as defined in the documentation.

As Exhibit 8 shows, we found that 46 of the 108 jobstreams we studied were inaccurately or incompletely documented; this represents 42 percent of the total sample. Twenty percent of the 108 cases involved serious problems with documentation, meaning scheduled output was obsolete, not all output was defined, reports in reality were to be distributed to a different agency, output defined as hardcopy was in reality microfiche, etc. And 22 percent of the jobstreams had a minor documentation problem e.g., the wrong person in the right agency was identified as the recipient, or an on-request output was no longer being requested and was thus effectively obsolete.

Serious documentation problems must be remedied immediately. If a new employee were to set up and distribute a job

EXHIBIT 8

INCIDENCE AND SEVERITY OF PRODUCTION PROBLEMS

Problem Area	Total Incidence[1]	(Frequency)	Severity[2] Significant	Minor
Documentation	42%	(46)	20%	22%
Time Delays	37	(40)	23	14
Inaccuracies	39	(42)	23	16
Readability	16	(17)	--	--
Unneeded Information Produced	9	(10)	--	--
Needed Information Not Produced	19	(20)	--	--
Information Not Useful	4	(4)	--	--
Exceptional Handling Involved	20	(22)	--	--
Frequent Changes to Jobstream	9	(10)	--	--
Other	7	(8)	--	--

[1]Base of all percentages is 108 jobstreams. Thus, 20 percent of 108 jobstreams experienced a significant problem with documentation and 42 percent of the jobstreams experienced some kind of documentation problem.

[2]No analysis of problem severity is presented for certain categories where the information was insufficient for such analysis.

according to erroneous documentation, or if a programmer were to make a change to the jobstream based on it, output would be misrouted, obsolete reports would be generated, reports would be printed at ISB instead of sent to a vendor for microfiche processing, etc. All of this would have negative impact on user efficiency and user satisfaction.

Additionally, the high volume of both serious and minor documentation problems indicates that ISB is not conducting sufficient periodic verification checks with users to update their documentation. This is a routine procedure in most data processing departments.

The physical condition of the Customer Service documentation also deserves a comment. Many of the jobstreams were misfiled, tabs on the jobstreams were missing, and jobstream documentation had been removed without signing it out. These conditions increase the potential for running a job incorrectly and should be corrected as soon as possible.

We recommend the following actions be taken by ISB to improve the accuracy of operations documentation:

- Develop and implement procedures to periodically verify and update jobstream documentation. User directed questionnaires or periodic phone surveys should be considered.

- Assign responsibility for the physical maintenance of the Customer Service documentation to a specific individual and monitor performance of that job.

- Identify and document an accurate list of all production jobstreams to be processed at ISB.

- Establish a sign-out procedure for the Customer Service documentation.

2.   TIMELINESS

In analyzing the timeliness of output, we sought to determine if ISB processes jobstreams and delivers the output to users according to the schedule agreed upon. The late receipt of reports can have a serious impact on the work of an agency. Some typical examples, as expressed by agency staff whom we interviewed, are:

- If the report is late, then half of my staff cannot get started on their work.

- If the notices are not issued by this date, then the agency is in violation of its legal responsibility.

- If the report is late, then our applications for federal reimbursements will not be processed until next month, and we won't have the use of that money until then."

- If the job was not run on the weekend as scheduled, then it must be run on Monday. This means that our on-line system will not be available for input during our work day. [which causes significant delay in updating statewide accounting].

As Exhibit 8 shows, timeliness was reported to be a problem in 40 of the 108 jobstreams we studied, 37 percent of the total sample. Twenty-three percent of the 108 jobstreams experienced timeliness problems of a significant nature, meaning the late output had a serious impact on the work of the agency, happened repeatedly, or a daily/weekly report was several days/weeks late. The other 14 percent of the 108 jobs experienced timeliness problems of a minor nature, meaning delays happened only occasionally or were delayed for a short time only.

Timing problems are more common among certain output types than others. For example, 71 percent of all tape output, 61 percent of all fiche output, and 33 percent of all standard report output experienced delays. It would appear that the additional handling required of tape and fiche output retards the timely delivery of this information to users.

It is interesting to note that those jobstreams run on an "on-request" basis suffered the fewest delivery problems. Jobstreams run on-request mean the user initiates the processing of a job by calling or writing Production Control personnel, leaving any special instructions and due dates with the Production Control staff at that time. Only 19 percent of the jobs run on-request were delivered late, according to users.

Users want to maintain an on-request schedule because they feel it gives them more control over the operation of the jobstream, which results in more efficient and timely service to them. ISB, however, would like these jobs scheduled on a regular basis to allow it to plan its workload and assist it in scheduling the computer facilities. Apparently the special handling involved in running a job on-request contributes to the timely receipt of the output, however.

The reasons given by users for late delivery of output varied from "ISB misplaced our input/output" (18 percent) to "the printer made an error and the job had to be run again" (10 percent). No single reason stands out as the cause of late reports, nor was ISB always the cause of the problem. In 10 percent of the cases, delays in receiving input from the users caused the output to be late.

Since fiche and tape output types account for a disproportionate number of problems in timely delivery, we recommend that:

● ISB review the procedures involved in processing these output types and make whatever adjustments are necessary to ensure timely delivery.

● Additionally, even though on-request jobs experienced the least time delays in delivery, we recommend ISB negotiate with users a more definite schedule for these jobs to allow improved planning of its workload and to prepare for maximum utilization of the automated scheduling system to be installed. As it stands now, jobstreams scheduled on-request cannot be scheduled via the new scheduling system.

3. ACCURACY

In examining the accuracy of output, we sought to determine if ISB produced output consistent with the specifications of the programs and consistent with the users' expectations of what the output should be.

Receipt of inaccurate information by state agencies can have an adverse effect on an agency's ability to perform its work. Agencies rely on computerized information to account for how the public's money is being spent, to report to the Legislature and the public on how well programs are operating, and to identify the number and types of people served by the agency, etc. Thus it is vitally important that the computerized information received by an agency be accurate.

Problems involving inaccurate output were reported in 42 of the 108 jobstreams we studied, 39 percent of the total. Twenty-three percent of the 108 jobstreams experienced accuracy problems of a significant nature, meaning the output was not usable because the data was not reliable. One example is the Directory of Manufacturers created for the Department of Economic Development: input errors make the resulting output useless according to the agency. Another example is the Safety Training Firearms Report created for the Department of Natural Resources: the fiche produced in this jobstream has lacked whole pages of needed information; this obviously renders the output less than useful. The other 16 percent of the jobstreams contained inaccuracies of a minor nature, meaning the information was still useable or did not have a serious impact on the performance of the agency.

Inaccurate input by user agencies and programming bugs were the major causes of incorrect output. Our study showed that only 4 percent of the jobstreams producing incorrect information were reportedly caused by ISB input errors, while 27 percent were

caused by user input errors--either filling out the input form wrong or incorrectly entering the information on a terminal. Smaller agencies experienced more problems with inaccurate input than larger agencies. Fifty-six percent of the agencies experiencing input problems were small agencies, possibly reflecting a need for additional training of input personnel in small agencies.

The other major cause of inaccurate information is programming errors. Errors in the logic of the program caused incorrect information in 33 percent of the jobstreams. ISB is responsible for ensuring that programs are working according to documented specifications for the operation of a jobstream. Of those interviewees who cited programming difficulties as the source of output inaccuracies, several noted that the problems had persisted for some time and ISB's efforts to de-bug the system frequently led to the creation of new bugs. This type of problem is a reflection of the quality of the systems development at ISB, rather than production per se. These problems are discussed along with other detailed findings in the staff paper: Production Services Evaluation.

Forms and fiche output types were especially likely to experience accuracy problems. Forty-two percent of all forms in our sample and 48 percent of all fiche output in our sample contained inaccurate information. Additionally, about half of all quarterly and semi-annual jobs in our sample contained inaccurate information. Jobstreams produced on an on-request basis, however, again enjoyed relatively few problems with accuracy of information received.

We recommend the following actions be taken by ISB to improve the accuracy of information produced:

- Review the training programs of small agencies to ensure that provisions have been made to properly train or re-train input personnel.

- Set up procedures to ensure that programming changes are adequately tested before being implemented, and that all programming bugs are identified and corrected.

- Review the procedures involved in processing fiche and form output to identify additional causes of inaccuracies and correct them.

4. READABILITY

We sought to determine if the readability of output produced by ISB was at an acceptable level, (i.e., if the print was dark enough, if the forms were aligned properly on the page, if carbon copies were not clear, or if fiche was formatted properly and of acceptable quality, etc.).

Problems with readability were reported in 17 of the 108 jobstreams we studied, 16 percent of the total sample. These problems ranged from misalignment of printer, printovers, and bad ribbon on the printer to incorrectly formatted or blotchy fiche output. Hardcopy and fiche output had the most readability problems. Readability problems were cited in 39 percent of the jobstreams producing fiche output.

Users report that hard copy output quality has improved with the introduction of the new IBM 3800 laser printer ISB began using in July 1979. The opposite appears to be true, however, with ISB's attempts to improve fiche quality by switching to a new vendor. Some of the fiche users experiencing readability problems report their problems began when a different vendor began processing the fiche in early 1979.

We recommend that:

●   ISB set up internal quality control procedures to monitor fiche output supplied by the vendor and take whatever remedial action is necessary to improve the readability of fiche.

Since the new printer appears to be correcting the hardcopy readability problems, no additional changes in this area are warranted at this time.

5.   EXCEPTIONAL HANDLING

We sought to determine the number of steps above and beyond normal requirements the users had to take to ensure that a jobstream ran correctly. The requirements to process a production jobstream should be of a routine nature and the process should be set up so that needed steps are executed automatically. We found that 22 of the 108 jobstreams studied involved exceptional handling; this constitutes 20 percent of the total sample.

The users of eleven of the affected jobstreams reported a need to have constant contact with ISB to ensure that production runs were processed correctly. This involved many cases of reminding ISB of the proper sequence of interdependent jobstreams or the proper timing of the jobs. Another user also visits ISB at the time of the agency's yearly run to make sure the keypunchers are completely familiar with the agency's requirements.

The users of four of the jobstreams requiring exceptional handling felt a need to pre-process the input in order to get correct output. For example, one user manually calculates interest rate changes prior to input because previous attempts to include changed rate routines in the program produced inaccurate results.

The users of another four of the jobstrems had to complete a significant amount of post-production work before the output could be used. For example, because one jobstream cannot print labels in the sequence needed, the agency spends a significant amount of time manually sorting the output prior to using the labels. Based on prior experience, another agency feels a need to inspect each output form for proper printer alignment to ensure the return address appears properly in window envelopes.

Again, problems were concentrated in systems producing fiche and form output. Twenty-five percent of all forms output studied in our sample and 30 percent of all fiche output included in our sample involved exceptional handling, in spite of the fact that additional handling of these two output types is already included in normal and routine processing because of the nature of the output.

We recommend that ISB take the following corrective actions:

- poll users to identify all cases of exceptional handling and take steps to correct each individual case;

- review production documentation to ensure that the proper sequence of interdependent jobstreams and the timing of each job is thoroughly and accurately documented, and that operators read and follow this documentation; and

- review the procedures involved in form and fiche processing and make whatever changes are necessary to reduce the amount of exceptional handling associated with these two output types.

6. OTHER PROBLEMS

We have discussed each of the production problems occurring in at least 20 percent of the jobstreams we reviewed. As Exhibit 8 shows, we also examined the frequency with which other kinds of problems occurred. These are noted in Exhibit 8 and discussed in detail in the staff paper: Production Services Evaluation which backs up this chapter.

7. USE OF DEFICIENCY REPORTS

The formal procedure used by state agencies to report production problems to ISB is the filing of the Deficiency Report. In the report, the agency describes the problem that occurred and requests corrective action. ISB then looks into the problem, makes the corrections necessary to solve the problem, and replies to the

user via the bottom half of the report. The processed reports are retained by ISB and are analyzed periodically.

We wanted to know how frequently agencies experiencing problems filed Deficiency Reports. Respondents to our survey indicated that Deficiency Reports are used very infrequently. Only 19 percent of the users interviewed in our sample said they used Deficiency Reports "most of the time" when they experienced a production problem. Another 19 percent indicated they filed Deficiency Reports "sometimes," while the rest (62 percent) said that they "never" filed a Deficiency Report.

Why don't agencies use Deficiency Reports more often? In 18 of the cases (21 percent), problems were not formally reported because there were none to report. The user was experiencing no serious problems in the operation of the jobstream.

Another 20 percent of the users did not know what a Deficiency Report was. (This number is appreciably higher in smaller agencies. More than one-third of the people we interviewed in those agencies did not know what a Deficiency Report was.) In some cases, this may be explained by the fact that there is another person in the agency who serves as liaison with ISB and who is responsible for Deficiency Reports.

Another 53 percent of users interviewed said they just call up their Customer Representative at ISB or contact the systems person in the agency instead of filing a Deficiency Report. The remaining 6 percent of the interviewees did not file reports because there were too many needed or for various other reasons.

We recommend that:

● ISB institute a formal program to inform agencies, especially smaller agencies, of the need for--and benefits of--filing Deficiency Reports. Guidelines should also be established and communicated to users regarding when to file a report, who is responsible for initiating the report, where to send the report, and other necessary procedures.

If used properly to document significant or persistent problems, Deficiency Reports can be a helpful tool in aiding ISB to identify trends in problem areas and take appropriate corrective action.

8. OVERALL SATISFACTION WITH ISB'S PRODUCTION SERVICES

At the conclusion of each interview, users were asked how satisfied they are with ISB's operation of each job we reviewed.

Most respondents were satisfied with ISB's performance: 82 percent responded that they were "very" or "usually" satisfied. Only a few individuals indicated any serious dissatisfaction with the operation of the jobstream in question.

The satisfaction level among small agency users was lower than that of the large agency users. While some 87 percent of respondents from large agencies said that they were "very" or "usually" satisfied, only 56 percent of the users from small agencies responded similarly. Additionally, the only respondents reporting that they were "hardly ever" satisfied were from small agencies.

There is an apparent contradiction between ISB's performance and user satisfaction. The level of user satisfaction with production services is high, and yet ISB's performance in terms of timeliness, accuracy, readability, and exceptional handling clearly leaves room for improvement.

We believe there are several reasons. First, many of the users interviewed operated under a manual or semi-automated system prior to computerization of the function. User satisfaction may be high because users are comparing current methods to inferior manual methods.

Second, most user agency staff are not formally trained systems analysts. Much of their systems knowledge has been acquired through on-the-job training as state employees. As a result, they are sometimes unaware of industry standards and what computer performance should or could be. They do not demand more because their point of reference is their own limited experience.

As users become more sophisticated in their systems knowledge, or as user agencies hire analysts with work experience acquired in other more efficiently run data processing shops, they may find the current level of performance less satisfactory. ISB must be aware of this tendency and consider it a further incentive to improve its performance.

Based on our findings, we recommend that ISB take the following actions to address the criticisms which have been made and to assure continued user satisfaction:

- Set up procedures to ensure that the night and weekend crews have competent assistance available to them on a timely basis.

- After consultation with the user, ensure that all jobstream documentation identifies the action computer personnel should take if a job does not go to normal end of process, and ensure that computer personnel are following the documented instructions.

●   Set up procedures to consistently and promptly notify affected users if their output will not be available as scheduled.

●   Develop more effective methods of training users at the onset of a new jobstream, especially those users who do not have an in-house systems department.

IV. COMPUTER OPERATIONS

A. RESEARCH OBJECTIVES

We engaged Alexander Grant & Co. to perform a technical review of ISB's computer operations functions. The major findings of that study are presented in this chapter.[1]

The objectives of their study were to:

- Determine whether present ISB computer service capability and capacity and related future plans are adequate to satisfy present and future user agency data processing requirements, and

- Determine whether present ISB computer operational functions are managed effectively and efficiently.

B. METHODOLOGY

In order to accomplish these objectives, Alexander Grant & Co. conducted a detailed study that consisted of:

1. A review and evaluation of ISB's computer hardware, software, and organizational structure, which address the following issues:

   a. The adequacy of ISB's present organizational structure for meeting user agency requirements and related plans for modifying the present structure to satisfy anticipated user agency needs.

   b. The adequacy of ISB's organizational structure in comparison to other large scale computer operational organizations.

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[1]The full report by Alexander Grant & Co. is presented as a staff paper entitled Review of Computer Operations of Minnesota Department of Administration, Information Services Bureau.

c. The adequacy of ISB's present computer hardware and software capability and capacity in terms of operational effectiveness and the satisfaction of user agency needs, and the adequacy of long-range plans for acquiring additional computer and software capabilities and capacities consistent with projected user agency needs.

d. The adequacy of the system performance measurement methods that are used by ISB to measure current system utilization and to project future system capacity requirements.

e. The adequacy of ISB's ability to satisfy user processing requirements through alternate processing methods that include: (1) on-line data entry and information retrieval systems, (2) on-line interactive computing systems, (3) remote job entry systems, and (4) micro-computer and mini-computer distributive processing systems.

2. A review and evaluation of ISB computer operational management practices, which address the following issues:

a. The adequacy of management practices pertaining to: (1) planning and budgeting activities, (2) operational project management and control methods, (3) system turnover procedures, and (4) daily computer operational activities.

b. The adequacy of operational management practices regarding technical support activities pertaining to : (1) systems performance measurement, (2) data base management, (3) operating systems, and (4) telecommunication systems.

3. General discussions with representatives of the five largest users of ISB services were also conducted to obtain their viewpoints regarding agency processing requirements and ISB's abilities to satisfy these processing requirements.

C. MAJOR FINDINGS AND CONCLUSIONS

Alexander Grant & Company began its study in December 1979. Five months before that, the first permanent director of ISB in several years was appointed. A number of operational problems were identified during those five months by the new Assistant Commissioner for ISB. This was followed by a series of ISB management decisions and related actions directed toward correcting the identified problems. Furthermore, the consultants were informed that several other corrective actions were also being planned.

Since the corrective actions were only recently instituted, Alexander Grant & Co. found it difficult to evaluate their effectiveness at this point in time. However, they evaluate the appropriate-

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ness of the corrective actions and recommend additional actions where appropriate. Furthermore, the report identifies benchmarks by which ISB's future performance can be properly evaluated during the next six months to two years.

The consultants report the following findings regarding ISB's computer operations:

1. OPERATIONAL ORGANIZATIONAL STRUCTURE

ISB has recently modified its operational organization structure. (A chart depicting ISB's current organization appears on page 7 of this report.) This new organizational structure centralizes management direction and control under one manager, the Facilities Management Division Director. All computer operational functions (except for data entry) and operational technical support functions report to this director.[1] Computer operational functions include equipment/site management, network services, batch services, and facilities services functions. The operational technical support functions include data base management, operating systems/technical standards and distributive data processing.

- The consultants concur with those changes that combine and integrate ISB's computer operations and technical support resources. Such an approach provides the authority and responsibility to direct those resources to resolve operational problems under one management.

Many large-scale data processing organizations, both in the private and public sectors, have consolidated technical support and computer operations functions under one management and have found this approach to be more effective and responsive in managing the computer operational aspects of a data processing organization.

While generally approving of the new ISB organization, the consultants make these observations and recommendations:

- The new Assistant Commissioner for ISB faces numerous demands on her time for dealing with previously identified operational problems and for the development and implementation of an effective planning methodology. At the same time, the Assistant Commissioner has been delegated

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[1]Previously the operations and technical support sections had reported to separate authorities.

other responsibilities, such as the Telecommunications Division. Given the tasks the Assistant Commissioner now faces, it may not be appropriate to increase her management responsibilities. Indeed, qualified assistance should be provided to the Assistant Commissioner to help her deal with the existing significant management tasks.

● While computer operations functions report to a second level of management (an Assistant Director for Computer Facilities), the technical support functions report directly to the Facilities Management Division Director. The numerous significant technical support projects and related personnel resource requirements demand a level of direction and control that should be provided by a qualified Technical Support Assistant Director.

● The data entry function currently reports to the Support Services Division Director. Normally, the data entry function reports to a manager of computer operations in a large-scale computer organization. ISB's data entry function should report to the Computer Facilities Assistant Director so that the management and control of this function may be integrated with the batch processing services to which it is most closely related.

2. ISB PLANNING

The consultants evaluated ISB's planning activities in terms of:

● The approach being used to identify short term and long term needs of ISB and user agencies;

● The present level of definition of these needs and the related methods for satisfying these needs;

● The availability of ISB resources to study ISB technical requirements and user agency needs; and

● The availability of formal, consolidated planning documents.

a. Short-Range Planning

The consultants found that ISB has no documented short-range plans or planning methodology. The planning activities that ISB is conducting primarily address current operational problems. ISB plans to increase its equipment capacity and software capabilities to satisfy identified user requirements. Beyond that, ISB

<u>intends to develop plans</u> (both short-range and long-range) to establish pilot programs to provide a state-of-the-art telecommunications support system to agencies, and to provide interactive distributed processing to users. ISB also wishes to develop plans to enhance the development projects for new applications, and to prepare for disaster contingencies.

Alexander Grant & Co. found all the proposed plans described to be appropriate. However, the plans described address only a limited number of the current operating problems that ISB management has identified. Furthermore, there is no current documented listing of ISB plans or planning methodology. The consultants recommended that:

- ISB management should develop a standard planning methodology that requires inputs from the various operating divisions and provides for a consolidation of these inputs into one comprehensive technical plan for the ISB organization. This comprehensive plan should be prepared on an annual basis and documented as the formal technical plan for ISB.

The consultants determined that ISB's short-range planning activities, though ambitious, were currently unstaffed and lacked the qualified personnel needed to help develop a planning methodology or the implementation of a consolidated operation plan. They recommend that:

- Two or three qualified, full-time planning personnel should be engaged to assist in this substantial effort as soon as reasonably possible.

Since most of ISB's short-range planning is still in the conceptual stage, the consultants were unable to evaluate its effectiveness. However, the short-range plans described by ISB can serve as benchmarks for future review. Those plans and ISB's efforts to develop operational plans should be periodically monitored and evaluated during the next 18 months.

b.   <u>Long-Range Planning</u>

ISB has documented eight long-range objectives as a first step toward developing a formal long-range plan for the next four or five years. These objectives include: improved planning aimed at meeting user information system needs; defining and implementing

the equipment capabilities required to meet user needs; developing standards, policies, and procedures on issues related to computer operations; and developing training programs for user and ISB staff. The consultants concurred with ISB's initial approach to long-range planning and their initial efforts in developing a long-range planning methodology.

The development of meaningful and practical long-range plans for an organization that serves as many different user agencies as ISB is a formidable undertaking requiring a staff of full-time, qualified planners. Under ISB's current organization, only one position, currently vacant, is designated for long-range planning. Since ISB's existing personnel resources are apparently insufficient to carry on short-range planning, it could be imprudent to require ISB to utilize additional planning resources to carry on the long-range planning activities ISB has described. Furthermore, there is a need for objective personnel to do the planning who can balance the potentially conflicting interests of ISB and the user agencies.

The report therefore recommends that:

    e   Long-range planning efforts related to the identification of user agency information requirements and application system requirements, as well as the establishment of priorities for system development, should be performed by a planning staff external to the ISB organization.

The report recommends that this planning staff should be centrally located and controlled within the Department of Administration. This unit would dedicate most of its effort to assisting user agencies, but it could also provide assistance to ISB management in translating user information system requirements into ISB technical resources requirements and associated technical plans.

Creation of such an external planning staff will provide a benchmark for assessing long range planning. The entire long range planning process should be monitored and evaluated on a periodic basis in the future.

3. AVAILABILITY AND UTILIZATION OF EQUIPMENT AND SOFT-WARE

a. Capacity Planning

ISB's three central processing units (CPUs) are all operated through one set of operational software and can be controlled

centrally.[1] This type of operational environment allows computer operators to maximize the utilization of all equipment resources through one central control station and allows operators to shift the processing load between computer processors when equipment malfunctions or overloads occur.

- Alexander Grant & Co. believes that this is the most effective approach that could be used by ISB to allocate and control available computer resources.

The consultants examined ISB's utilization of the three processors and found that utilization of available capacity is high (averaging 70 percent) during the first shift of the day, though much lower on the other two shifts. Additionally, during peak periods on certain days, nearly all available capacity is utilized on the two smaller CPUs. If equipment malfunctions occur in the larger CPU, the two smaller CPUs cannot provide an adequate backup during peak processing periods, and telecommunications processing services become substantially degraded.

Most large-scale data processing organizations base their data processing equipment procurement on the need to satisfy peak period processing requirements. In general, these organizations are unwilling to risk facing situations in which they cannot provide sufficient data processing capacities to their user organizations. Many of these organizations, like ISB, have peak processing periods during the first operational shift and periods of low utilization during the third processing shift.

Alexander Grant & Co. recommends that:

- ISB base its equipment requirements and related procurement on peak period processing requirements, so as not to expose itself to the risk of extended degraded user service due to limited processing capacities.

- Furthermore, ISB should maintain a substantial excess processing capacity position during the next two years to accomodate an anticipated substantial amount of new user system development, new user system implementation, new operational software implementation and related testing requirements. This position is necessary, because ISB does not have quantifiable estimates on the amount of capacity needed by these new uses.

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[1]ISB operates one large CPU (IBM 370/168) and two relatively smaller CPUs (ISB 370/158).

However, an excess capacity position is not continuously justifiable. Quantifiable estimates of demands on capacity should be made and refined within two years so that ISB has a realistic method for identifying processing needs and procuring processing equipment in line with those needs.

b.   Systems Performance Measurement

The consultants reviewed ISB's use of various tools used for measuring the performance of its computer equipment and operating systems software. In general, they found that the measurement tools ISB uses for collecting data on systems performance are appropriate for ISB equipment and software, and that ISB was performing sufficient systems performance measurement data collection activity.

However, they found an absence of documented internal studies and conclusions based on these measurement activities, which should be closely related to procurement planning. Alexander Grant & Co. recommends that:

* The ISB technical support function should begin to formalize a reporting process for its studies of systems performance, and should formalize the integration of this reporting process into the equipment procurement process.

c.   Telecommunication Equipment and Software

The present teleprocessing communications software (referred to as the TP Executive) was developed by data processing personnel in the Highway Department in the late 1960s. A substantial number of technological changes have occurred in hardware and software since that time. Consequently, ISB has decided to replace the present telecommunications software with a version more compatible with current technology, which should provide a variety of telecommunication terminal and processing options for user agencies.

* The consultants concur with the ISB decision to replace this software, but question why this decision was not made several years ago.

4.   ISB COMPUTER OPERATIONS

The study by Alexander Grant & Co. included a review of ISB computer operations facilities and activities. Findings and recommendations were made in the following areas:

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a.   Input and Output Control

The consultants concur with ISB's decision to implement an automated production scheduling system. The new system should effectively reduce the opportunity for human error in processing and the number of documents currently required in the production process.

b.   Production Scheduling

A final schedule for implementation of the automated production scheduling system should be available in March 1980. The development of the implementation schedule and the effectiveness of the new system should be closely evaluated in the future. Additional personnel resources will be needed to ensure that the operational processing and user distribution requirements for each production system will be in correct form for conversion to the new scheduling system.

c.   Storage Controls

ISB's off-site backup data file procedure is appropriate and provides a necessary control over the many volumes of sensitive data files prepared for various state agencies.

d.   Computer Room Space

The new computer processor cannot be installed in the computer room, which is currently filled to capacity, unless other equipment is moved out. ISB must solve the problem of space needs. Its success in accomplishing this presents another benchmark for future evaluation.

e.   Disaster Recovery Plans

ISB should develop a disaster contingency plan for use in the event of a major catastrophe. Such a plan should present detailed provisions for maintaining operations after a catastrophe.

f.   Equipment and Software Error Reporting

ISB's operational procedures for equipment and software problems identification and resolution are adequate. They would be more useful if malfunctions would be summarized by system or major system component.

g. Operational Acceptance Procedures

Modifications to production systems should be applied, tested, and accepted in the same manner as for new systems. This procedure is not now uniformly followed by ISB.

h. Accounting and Billing

Users have expressed concerns about certain ISB billing practices. These concerns should be addressed by a committee of ISB and user representatives.

5. ALTERNATIVE PROCESSING METHODS

Alexander Grant & Co. found that ISB is substantially behind the state-of-the-art in terms of providing data processing services to user agencies. This situation exists because ISB has not recently (within the last three years) implemented advanced software and terminal based equipment capabilities. Consequently, ISB cannot provide efficient on-line system processing and state-of-the-art "distributed data processing" services to many user agencies.

Alexander Grant & Company believes that:

• ISB should be able to provide effective distributive data processing alternatives to user agencies.

To provide such services in the near future will require a substantial investment now in equipment, software, and personnel resources, in order for ISB to update its capabilities. ISB needs to acquire a new telecommunications network and data base management system, and to investigate what other equipment is best suited to service a variety of agency requirements.

The consultants note that ISB is currently initiating or operating certain varieties of alternative data processing, such as remote job entry, interactive computing, and IBM's Time Sharing Option. Such efforts should be expanded. While the investment is significant, agencies should realize substantial savings through reduced manual activities and more efficient services.

V. MAJOR POLICY ALTERNATIVES

Our evaluation study of ISB has diagnosed a number of specific weaknesses in ISB performance of systems development, production, computer operations and management. Since our review was quite detailed and technical, many of our recommendations are detailed and technical.

However, the general finding of our report is that ISB is not effectively meeting the data processing needs of the state, and quite possibly a fundamental organizational change is required in order to assure effective data processing support in state government.

Although ISB is currently implementing a variety of positive changes which ought to improve its capacity to serve state government, it remains to be seen how effective these are. In any case none of the changes now being made at ISB fundamentally changes the structure or authority of ISB, and although it is difficult to be certain, such fundamental changes may ultimately be required.

In this section we describe four approaches to changing the organization of data processing in state government. Depending on how the findings of our report are viewed, and depending on an assessment of the likelihood that ISB will solve its problems without fundamental organizational changes, one or more of these alternatives may be worth considering:

- A proposal to exempt ISB or parts of it from existing civil service requirements.

- A proposal to remove planning and regulatory authority from ISB and create a separate organizational unit to carry out these functions.

- A proposal to delegate additional responsibility and authority for data processing to individual state agencies.

- A proposal to change the method by which ISB is financed in order to create desirable organizational incentives.

A. A PROPOSAL TO EXEMPT ISB FROM CIVIL SERVICE REQUIREMENTS

This proposal is made in response to our findings that staffing problems are an important source of performance failures at ISB.

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- ISB suffers from high staff turnover and appears unable to successfully compete for experienced systems analysts in a highly competitive environment.

- ISB project managers are not compensated at a level which provides reasonable assurance that experienced managers can be recruited.

- While ISB is a large organization with a complement of about 380 positions, only the top spot is unclassified. Thus, there is no convenient way for the head of ISB to assemble a management team of his or her choice.

If ISB is unable to solve these problems with other remedies such as reclassification or unclassification of certain positions or classes of positions, the Department of Administration ought to consider contracting with a private organization for the management and operation of ISB.

If management of ISB is contracted for, a new or existing unit within the Department of Administration will have to assume responsibility for monitoring contracts for ISB operations and performing long-range planning, priority setting, and technical review of the performance of contractors.

In point of fact, ISB is currently moving to greater reliance on contracts as a means of assembling needed staff, and as a way around the barriers to recruitment presented by civil service requirements. Private vendors were involved in about half of the twenty systems development projects we reviewed.

The issue that needs to be decided here is, fundamentally, whether a private organization can provide data processing services to state government better than a state-run organization, and whether a private organization can be regulated in the interests of the state at least as well as ISB.

B. A PROPOSAL TO SEPARATE PLANNING AND REGULATION FROM SERVICE DELIVERY

Systems development is a collaborative process requiring essential contributions by user agencies as well as ISB. In many of the projects we reviewed ISB and users have failed to successfully define system requirements and hold them constant during subsequent phases of development. Partly as a result ISB is unable to provide users with realistic cost and time estimates. ISB has not established the necessary pattern of communication with users so that it can plan to meet future user needs, and it lacks an effective means for setting priorities among demands for its services. Finally,

ISB and users differ in how PRIDE, the systems development methodology used by ISB, should be applied, and possibly because such reports usually contain bad news, ISB has not provided users with meaningful project status reports while projects are underway.

In our judgment, many of the disputes between ISB and users are due to the ambiguity and complexity of ISB's responsibilities in systems development and the absence of a mechanism to resolve the disputes that are bound to arise between ISB and clients in every development project.

At present, ISB is responsible for planning, deciding priorities among user demands for service, actual performance of systems analysis and programming, and making the decisions to approve, suspend or cancel development projects.

The location of all these functions within the same organization potentially creates internal conflicts in objectives which can interfere with successful performance.

Forward-looking planning as well as priority setting among development projects which are motivated by concern with data processing needs of the state as a whole can easily get lost when they are the responsibility of a service provider struggling to meet service demands. If ISB is unable to meet present demands, it is not likely to react correctly to new demands even if they involve data processing systems of greater importance.

According to Alexander Grant & Company which served as a consultant to our study, the incompatibility of planning, regulating and providing data processing service is recognized in private industry, and system analysis, programming and production functions are usually performed by an organizational unit dedicated solely to providing services. A separate unit is assigned responsibility for long-range planning, priority setting among demands for services, and approval of development projects. Therefore, we believe that the following proposal should be considered:

- The Department of Administration should establish an organizational unit, separate from ISB, responsible for long-range planning of data processing applications, setting priorities among the needs of user agencies, and approval of large development projects.

C. A PROPOSAL TO DELEGATE ADDITIONAL RESPONSIBILITY AND AUTHORITY TO INDIVIDUAL STATE AGENCIES

As this report has shown, many users of ISB are dissatisfied with ISB's services, especially ISB's performance of system

development. One solution which has already received some legislative attention is to change the law so that user agencies would not have to obtain approval from the Department of Administration for systems development projects, the acquisition of data processing equipment or the employment of data processing specialists. This arrangement would allow users to lease or buy equipment, or use ISB, or contract with a private vendor, whichever is most economical. Similarly, user agencies could perform systems analysis and programming, contract with a private vendor, or use ISB in order to carry out new development, whichever makes the most sense.

This proposal is motivated, in part, by rapid technological changes in data processing which have resulted in a sharp decline in the cost of data processing equipment. As a result, some of the arguments in favor of centralized control of computer hardware are less salient than they used to be. Also, training and familiarity with data processing, including the ability to use computers, is now a part of professional training in many fields, and as a result state agencies have naturally developed a degree of data processing expertise as they hire recent graduates.

As a result of these trends users are demanding highly accessible data processing systems--that is, systems which permit the end user of the system who is not necessarily a highly trained data processing specialist to enter and retrieve data or perform statistical analysis without constant assistance from a data processing department or data processing specialists.

Such capability is referred to as "distributed data processing," and the debate over delegation of authority is sometimes confused with discussion of whether or not distributed data processing is a good thing. Actually, there is no profound difference of opinion between ISB and users (or among experts) over whether distributed data processing, in general, is desirable. Everybody agrees that it is, although there are obviously going to be differences of opinion concerning the merits of particular systems.

The benefits of distributed data processing are sometimes offered as a reason for reducing or eliminating ISB's authority to approve agency data processing plans, under the assumption that ISB will not agree to state-of-the-art distributed processing systems because they potentially will work to diminish ISB's control by diffusing expertise and hardware throughout state government.

ISB has argued that the advent of mini-computers and other distributed data processing options actually increases the need for a regulatory role for ISB. Since in the future it will not physically control processing capacity, ISB argues that it will need to regulate state agencies more rather than less actively. And ISB points out that centralization of processing capacity is not incompatible with the objective of bringing data processing capabilities closer to users.

Our study found that ISB is substantially behind the state-of-the-art in providing "distributed data processing" services.

However, before concluding that this is a reflection of the distribution of authority between ISB and state departments, it must be noted that ISB management appears to be aware of ISB's lack of ability to meet user needs and plans to replace its outmoded teleprocessing monitor, expand its time-sharing capabilities, experiment with interactive computing systems, and expand its already successful installation of remote job entry terminals. Whether it will be successful in implementing these plans remains to be seen, but the critical impediment seems to be insufficient staff resources to carry out these plans rather than negative incentives facing ISB as an organization.

Delegation of authority for development and/or operation of data processing systems to state agencies need not be considered as an "all or nothing" decision. Consideration could be given to a proposal to delegate to agencies authority over certain kinds of systems. For instance, small systems, or one-shot studies, or systems that clearly don't involve multi-agency use could be routinely left to individual agencies while the relatively few large systems or systems with sharable data bases, or systems essential to the basic functions of state government could be more closely controlled by the Department of Administration and ISB. In any case, the exact location of control could vary depending on how this question is decided.

The advantages of delegating a greater measure of authority to user agencies include:

- satisfying those users who have been calling for such a change;

- permitting users to negotiate contracts among competing bidders, thus allowing greater control over costs;

- removing some of the demands for services now facing ISB, thus allowing it to do the work it does take on more effectively than it can at the present time;

- permitting users a faster solution to their data processing needs, resulting in improved efficiency and effectiveness in user agency operations.

The disadvantages include:

- ISB might find itself in a highly uncertain planning environment, without the ability to make staffing or equipment procurement decisions.

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● Agencies could make decisions contrary to the interests of the state as a whole, even if in their own interest, (unless another organizational unit in Administration or elsewhere reviews such decisions).

● Essential data processing functions of state government could be compromised if they are not directly controlled by a state run computing facility motivated to provide essential security and back-up.

● As a practical matter it might not be possible to contract for the development and operation of certain data processing systems without agreeing to long-term contracts with single vendors, and agencies over time could become dependent on certain private firms which become largely immune from competition from other vendors.

Whether or not a change in law is made, as a matter of internal policy ISB can decide what kind of data processing applications require close regulation and which do not. Further, ISB can accomodate the desire of certain agencies to carry out a substantial program of development and production independent of ISB.

We recommend that the Department of Administration consider what regulatory functions are essential in data processing for particular kinds of data processing systems, and develop formal policies which permit agencies greater flexibility in arranging for data processing in small-scale applications, one-shot studies, systems that do not involve multiagency use, and in other appropriate circumstances. In any case the Department of Administration needs to regulate hardware procurement so that compatible equipment is acquired in all agencies.

D. A PROPOSAL TO CHANGE THE METHOD BY WHICH ISB IS FINANCED

A fourth alternative we offer for consideration proposes a major change in the method by which ISB is financed in order to put in place some incentives that we believe will help drive ISB toward a position where it will be better able to serve its clients. This proposal is motivated by the following considerations:

● The Legislature is frustrated by its inability to understand what ISB is doing. Part of the problem is that ISB is not financed through the regular appropriations process, but through billings for equipment use and staff time.

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- For a number of reasons, not the least of which is that ISB's management and staff have been sorely taxed in just coping with daily operations, ISB has not devoted enough time to prospective planning.

- ISB has not been able to complete major projects on time and within budget. In fact, ISB does not have an incentive to provide clients with a realistic estimate of the time and money development projects require, because it is not at risk for completing projects within budget. If ISB can't give users a realistic estimate users can't make an informed decision on whether a project is worth its cost.

- ISB and users do not generally collaborate effectively on new development. The exact nature of this collaboration depends on the expertise of the client in systems analysis, but in all cases ISB needs to ensure that development is conducted in an orderly fashion, and the management of the client agency needs to arrange for the availability of staff and needs to be directly involved in the process of defining what the system will and will not do. In practice relations between ISB and users have been rancorous and unproductive because system objectives and requirements have often not been sufficiently well defined in the early phases of development projects.

- Users of ISB are frustrated that they in effect pay for ISB's mistakes when a project takes longer than anticipated.

Therefore, we propose for systems development projects (and possibly other work performed by ISB) that ISB commit itself to completion of specific work for a fixed price in the same way that a private vendor would in bidding for a piece of work.

In making this kind of estimate ISB would naturally seek to reach a formal, contractual agreement with users concerning the product to be delivered; the exact nature of the user agency's participation in the project; and the period of time when the project would be carried out including when system design would be frozen, when detailed specifications would be written, and when programming testing and implementation would be carried out. In general, a firm, realistic estimate can be made at the end of PRIDE phase II or shortly thereafter.

If it behaved prudently ISB would include in its estimate some margin for error. If its clients wanted to embellish or change the design of a system once frozen, this would, if feasible, be accomodated in an amended contract and bid.

Under this system, if ISB fails to deliver the specified product within the budget ISB would draw against a contingency fund appropriated each biennium. ISB would request this contin-

gency fund each biennium based on a planning study that takes into account all the reasons why ISB might not be able to deliver projects for reasonable, competitive bids. The contingency fund should be large enough so that users of ISB can be assured that ISB's bids (and charges) for work are at competitive levels.

ISB would be expected to report to the Legislature on its use of the contingency fund and the results obtained for the expenditure of this money each year or biennium.

1. WHY IS A CONTINGENCY FUND NECESSARY?

As explained above, we feel that financing of ISB through a combination of client billings supplemented by a direct appropriation introduces desirable incentives for:

- regular communication with the Legislature on ISB activities;

- performance of needed planning by ISB;

- calculation of realistic estimates of time and money for completion of projects. Such estimates allow users to make an informed decision on the value of a development project;

- precise specification early in the development process of the product to be delivered and the exact role of ISB and the client agency;

- greater attention within ISB to strengthening managerial and technical expertise.

All these incentives would result from putting ISB at risk for successful completion of its work, even without allowing for a contingency fund. Realistically there are several reasons why this would be unfair and impossible:

- Private companies that are at risk for successful completion of work they bid on have a profit margin or company assets to fall back on in cases of occasional failure.

- Private companies are not constrained by provisions of the civil service system which sets limits on pay and limits the flexibility of management to hire and fire staff. Private companies are in fact headed by management earning much more than ISB top management and staffed by

experienced project leader, who earn more than ISB project leaders.

   ⊜   As a practical matter, ISB's recent record of performance suggests that it would need a substantial contingency fund, at least part of which should not be interpreted as necessary because of ISB's inability to perform.

E. CONCLUSIONS

Four major reforms have been presented and discussed along with the performance problems they are meant to address.

Although ISB is currently implementing a variety of positive changes which ought to improve its capacity to serve state government, it remains to be seen how effective these are. In any case none of the changes now being made at ISB fundamentally change the structure or authority of ISB, and although it is difficult to be certain, such fundamental changes may ultimately be required.

GLOSSARY OF TERMS

Application

Any specific use for computers and computing (solving statistical problems, numerical processing, payroll, etc.)

Audit Trail

Trail of references or record accounts which allows an investigator to trace a transaction from initial recording through to the reports in which it is aggregated, or the reverse procedure.

Batch Processing

A method of running jobs in which all requests for computing are presented to the operating system of the computer as a unit. The user cannot usually intervene in the processing of these requests. As contrasted with interactive processing.

Bug

A mistake in a computer program.

Central Processing Unit (CPU)

The main computer in a computer system containing the hardware which controls the interpretation and execution of arithmetic and conditional instructions. On IBM 370 series machines, the series presently used at ISB, the central processing unit does not generally handle input/output operations.

Computer

A programming machine which processes data. Modern computers are high-speed, electronic devices consisting of an arithmetic unit, memory, control unit, and input/output devices.

Configuration

The specific set of equipment connected together to form a computing system.

Cut-Over Procedure

The process of bringing a completely developed system from the test stage into actual, ongoing production. (Sometimes referred to as "turnover procedure.")

Data

Any material given to the computer for processing or received by the user as the result of computer processing.

Data Base

An organized collection of data composed of logically inter-related items. Data bases can be physically arranged and indexed (cross-referenced) by programs called data base management systems.

Data Base Management System

Programs used to physically arrange and reference data within data bases.

Data Transmission

The movement of data in a coded form by means of electrical signals (as in telephone lines).

Degrade

Reduction of system capability; this does not mean that the machine is physically wearing down, but rather that due to peak loading or minor mechanical problems the system provides service at a less efficient or "degraded" rate than normal.

Disk

A flat circular object with a magnetic surface on which data can be stored.

Disk Pack

Equipment that holds collection of disks incorporated into a single unit.

Disk Drive

The mechanism on which disk packs can be mounted.

Decentralized Data Processing

The processing of data within each subdivision or at each geographical location. Each subdivision has its own data and data processing capability.

Distributed Data Processing

1. Generally, a configuration of equipment and software designed to make data processing technology highly accessible to the user who is usually not a highly trained data processing specialist.

2. A network of decentralized data processing units, capable of sharing data bases and/or transmitting data to and from other geographical locations.

Documentation

Written descriptions of how to use a computer system, especially software. Documentation may appear in printed and machine retrievable forms.

Down Time

The interval or quantity of time a piece of hardware is inoperative, unresponsive, or unavailable.

Front End

A small computer handling communications or other tasks for the main computer system. Remote job entry processing is often handled by front end processors and not directly by the main computer itself.

Hardware

1. The electrical, mechanical, and electronic components of a computer system. Contrast with software.

2. Any piece of computing equipment.

Hard Copy

Computer output printed on paper.

Interdependent Jobstreams

Jobstreams which are dependent on the successful completion of previous jobs or jobstreams.

Information System

A collection of manual and/or computerized procedures and operations which develop and support the flow of information within an organization.

Interactive Processing

A mode of running jobs in which the user may intervene after each step (or command). Interactive processing allows the user to take appropriate action depending on the outcome of the previous command. As contrasted with batch processing.

Job Control Language (JCL)

All the available operating system commands. The JCL permits a user to direct job processing by the operating system.

Job

A unit of work given to the computer system by a user.

Jobstream

A series of both manual and computerized tasks needed to produce a given output, which is then distributed to the user.

Log

Part of the receiving function during production; to register a users request for computer services.

Maintenance

The activity of keeping computer equipment and programs in satisfactory working condition. Maintenance is either corrective or preventative in nature.

Micro-Processor (Micro)

A CPU entirely contained on one integrated circuit chip.

Mini-Computer (Mini)

A small computer about the size of a typewriter with manual information storage capability.

Modem

A modulator-demodulator of digital signals onto an audio carrier signal for transmission over telephone lines. Modems are needed at both the transmission and receiving ends of the telephone lines. Used in connection with peripheral devices such as terminals and remote job entry operations.

On-Line

Connected directly or via communication lines to the computer system. This provides the capability of entering data immediately (as opposed to batch entry).

Operating System

The system of programs and procedures that supervise the interactions of the central processor with other hardware and with users.

Output

Results obtained from a program or job processed by a computer system. Output often refers to such results printed on paper.

Package

A collection of programs designed for a specific application. For example, a statistical package is a collection of programs which can be used to perform various statistical analyses.

Peripheral Equipment

Devices at the central computer site such as magnetic tape units, printers, and punch card readers which are located outside the central processor.

Production Program (application)

A fully developed program or application which is used frequently.

Production Service

Services to users which surround the running of production programs and applications. Examples: inputting data and jobstreams, and providing reports, tapes, forms, etc., on a pre-determined schedule.

Program

A problem solution expressed as a series of instructions written in a programming language. The instructions used in a program specify actions to be performed by the computer at a given time to provide certain output data.

PRIDE

Profitable Information by DEsign, a proprietary systems design methodology; distributed by Milton Bryce & Associates.

PAC II

Project Accounting Control number II. A proprietary project status reporting system.

Proprietary Package

A purchased set of information on programs which is copyrighted by its developer.

Remote Job Entry (RJE)

A type of distributed data processing service which allows the user to submit a complete computer job (job instructions and data) through a terminal at the user's site. The job is run in the central computer and is transmitted back to the user for printing at the agency site.

Run

1. Verb: To execute a program or job.

2. Noun: A completed execution of a program or job.

Saturation

The state of having a fully loaded or overloaded computer system. This condition causes degraded services.

Son-Father-Grandfather Rotation

A procedure to save and back up historical data files in a generational manner. This is done chronologically with the sone file being the "youngest," father file being the "older," and the grandfather file being the "oldest." This procedure simplifies file re-construction in the event of a disaster damaging the working data files.

Software

A program or a collection of programs. Software is the flexible, versatile part of a computer system. Contrast with hardware.

Sort

To rearrange data of a similar type into an order determined by comparing items in a set of related data or comparing items of the data itself.

Source Document

A textual representation of a computer program written in a programming language.

System

A coordinated network of interacting components such as a computer system, an operating system, or any software system.

System Analysis

The process of identifying needs of the user/client and converting those needs to an information system. It represents the initial stages of system development.

System Analyst

An individual trained in the methods and techniques necessary to develop systems.

Systems Development

The process of converting inforamtion needs of a user into an information system. This usually, although not always, include development of a computer system. In general, the process includes information requirement definition, system design, system evaluation and justification, and programming, testing and implementation.

Tape

A reel of magnetic tape. A kind of long-term sequential access data storage.

Tape Drive

A computer system peripheral device which reads and writes a reel of magnetic tape.

Telecommunications

The process and equipment involved in the transmission of computerized data via telephone or comparable communication devices.

Terminal

A machine that sends input to and receives output from an interactive or batch job. Terminals are the end points of a computer network.

Time Sharing

Concurrent use of a single computer system by many independent users. Users operate without awareness of the other users of the facility.

Turnaround Time

The elapsed time from job submission to job completion. Note that the meanings of "submission" and "completion" vary in interpretation depending on whether one is a user submitting a batch job via the input/output window at ISB, or at an RJE station, or at a terminal.

User

Any person who runs jobs on a computer system.

Word Processing System

Any number of various efficient, multi-functioned systems that provide typewriting and printing services.

LIST OF RELATED STAFF PAPERS

1. A Description of the Information Services Bureau
   Allan Baumgarten and Judith Inman

2. Systems Development Evaluation
   Elliot Long

3. Staff Turnover and Job Satisfaction at the Information Services Bureau
   Jo Vos

4. Production Services Evaluation
   Sandra Fritz, Allan Baumgarten, and Naomi Kahn

5. Review of Computer Operations
   Alexander Grant & Company

STUDIES OF THE PROGRAM EVALUATION DIVISION

Final reports and staff papers from the following studies can be obtained from the Program Evaluation Division, 122 Veterans Service Building, Saint Paul, Minnesota, 55155, 612/296-8315.

1. Regulation and Control of Human Service Facilities, February 1977.

2. Minnesota Housing Finance Agency, April 1977.

3. Federal Aids Coordination, September 1977.

4. Unemployment Compensation, February 1978.

5. State Board of Investment: Investment Performance, February 1978.

6. Department of Revenue: Assessment/Sales Ratio Studies, May 1978.

7. Department of Personnel, August 1978.

8. State Sponsored Chemical Dependency Programs, February 1979.

9. Minnesota's Agricultural Commodity Promotion Council, March 1979.

10. Liquor Control, April 1979.

11. Department of Public Service, April 1979.

12. Department of Economic Security (Preliminary Report), May 1979.

13. Nursing Home Rates, May 1979.

14. Department of Personnel (Follow-up Study), June 1979.

15. Board of Electricity, January 1980.

16. Twin Cities Metropolitan Transit Commission, March 1980.

17. Information Services Bureau, March 1980.

18. Department of Economic Security, March 1980.

19. State Bicycle Registration Program, in progress.

20. Department of Revenue Income Tax Auditing Policies and Procedures, in progress.

21. State Architect's Office, in progress.