OLO REPORT 96-5

April 30, 1996

A STUDY OF INFORMATION TECHNOLOGY DECISION STRUCTURES

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EXECUTIVE SUMMARY

This report by the Office of Legislative Oversight examines how organizations make decisions about information technology spending and projects. The term information technology refers to the computers, telecommunications and office automation systems used to transmit, collect and analyze information. The report summarizes the costs of current and future information technology projects in the five major County and bi-County agencies and reviews their technology decision structures and practices. The report also describes the management models decision makers use in other places to select, evaluate and monitor projects and to manage the investment of information technology dollars and resources.

General Findings Organizations with effective technology decision structures address technology issues at two levels. At the agency level, organizations manage the investment of their technology dollars. Organization executives regularly provide policy, guidance and overall direction for technology decisions through sponsorship of specific projects, establishment and participation on an Investment Review Board, initiation or implementation of a strategic plan, and the use of mission related performance measures to evaluate, compare and monitor technology investments.

At the project level, organizations use project management systems to analyze business problems; to determine whether new technology is warranted; to define and evaluate alternative technology solutions; to identify and manage risks; to provide a framework for participation by management, technical staff and future users; and to define performance measures.

Agency Findings The County and bi-County agencies use technology extensively to deliver services and manage internal business systems. Each of the five major agencies plans to acquire additional information technology equipment in the next few years. As a result, the Council could face $190 million in funding requests to pay for ongoing and future projects, in addition to $40 million requested annually for technology operating budgets.

Historically, the Council and the agencies have used the budget process to structure technology investment decisions and to manage the design, delivery and evaluation of specific technology projects. In some instances, this framework, supplemented by special studies, works well; however, in many cases concerns are raised about whether the County is "funding the right mix of projects and whether the projects are being done right." The Council's establishment of the Technology Innovation Fund program and re-establishment of the Interagency Technology Policy Coordinating Committee in 1994 has addressed some limitations of the budget process.

Recommendations The Council should structure a discussion with executives in the County and bi-County agencies about the relationship between technology and general management systems. The Council should request the agency executives to describe how they perceive the role of technology in their organization; how they provide leadership for technology decisions; and how technology decision structures are linked to other management systems.

There are several opportunities to improve the County's technology decision structures. To decide what strategies would be most effective and appropriate, the Council should address the following key issues: (1) how to report and budget for technology expenditures; (2) whether maintenance and replacement funding issues are putting the County's technology investment at risk; (3) how to improve the project selection process so that technology investments match agency priorities; (4) what information the Council should receive to evaluate and monitor technology projects; and, (5) how to strengthen executive leadership in technology management decisions.

I. AUTHORITY, SCOPE, METHODOLOGY AND ORGANIZATION

A. AUTHORITY

Council Resolution No. 13-223, FY 96 Work Program of the Office of Legislative Oversight.

B. SCOPE

This project examines information technology issues and needs in the County. This report presents a technology management framework, describes information technology decision structures in other places, and highlights technology management practices in five County and bi-County agencies. This project addresses the following issues:

(1) How much money does the County expect to invest in information technology projects in the next five years? How will this investment be distributed among the agencies? What types of projects will be implemented and what program areas will be supported?

(2) How are information technology projects identified, justified, evaluated, selected, approved, funded and monitored both within the agencies and by the Council?

(3) What practices do the County and bi-County agencies and the Council have in place to strategically manage the County's long range investment in information technology?

(4) What strategies, models or techniques are used in the public and private sector to select, evaluate and monitor technology projects, and to manage the investment of information technology dollars and resources?

Throughout this report "**County**" is used inclusively to refer to the three County and two bi-County agencies funded in whole or in part by the Montgomery County Council. The agencies are the Montgomery County Government (MCG), Montgomery County Public Schools (MCPS), Montgomery College (MC), the Maryland-National Capital Park and Planning Commission (M-NCPPC) and the Washington Suburban Sanitary Commission (WSSC).

The term **information technology** refers to computers, telecommunications and office automation. It includes the infrastructure, equipment and software used to transmit, collect and analyze information.

C. METHODOLOGY

This project was conducted by Sue Richards, Program Evaluator, Office of Legislative Oversight, with assistance from Jennifer Kimball, Research Assistant, Office of Legislative Oversight and Christina Kim, OLO Public Administration Intern.

OLO worked closely with agency staff to estimate future information technology costs to be funded in the near term and to understand information technology management practices at each agency. The agency costs cited in the report are estimates for general discussion purposes only. Cost estimates are not comparable across projects because some estimates are based on detailed designs whereas others are based on preliminary concept designs. Except for costs of projects already underway, the cost estimates are unlikely to be the costs decision makers will see if and when a particular project is considered.

OLO reviewed periodicals, journal articles and books and spoke to consultants, vendors and project managers to understand information technology practices, concepts and issues and to identify approaches to project management and technology planning. The decision structure models described in the report are provided to illustrate the details of a particular approach.

D. ACKNOWLEDGMENTS

The Office of Legislative Oversight received excellent cooperation and assistance from staff in the County and bi-County agencies as well as those in other jurisdictions, information technology vendors and consultants. OLO appreciates the time and wisdom of County agency information technology staff throughout the study. In particular, OLO would like to thank Don Evans, John Rafferty, Marilyn Mitchell, Barbara Garrard and Gary McKelvey in DIST, Marshall Spatz and Gary Thomas in the Office of Management and Budget, Dick Leurig at Montgomery College, Drew Dedrick, Vickie Taylor and Richard Osuri at Maryland National Park and Planning Commission, Ed Boone and Bill Oakley at WSSC and Larry Bowers, Joe Villani, Lani Seikaly, and Steve Raucher at MCPS.

OLO extends special thanks to Miriam Browning, Director of the Center for Information Management at the National Academy for Public Administration (NAPA), who provided information about many of the examples described in the report.

E. ORGANIZATION OF THE REPORT

This report is organized as follows:

CHAPTER II presents an information technology management framework.

CHAPTER III examines agencywide strategic management systems including strategic plans, the portfolio management approach, information resources management and oversight programs at the federal level.

CHAPTER IV describes four models used to manage information technology projects.

CHAPTER V summarizes the County's anticipated investments in major telecommunication and technology projects in the next two to three years and describes how the agencies currently structure information technology decisions.

CHAPTER VI presents OLO's findings and recommendations.

CHAPTER VII presents comments from the County and bi-County agencies.

II. AN INFORMATION TECHNOLOGY MANAGEMENT FRAMEWORK

The ongoing rapid rate of change in technology as well as the emergence of technology capabilities that reach to all levels of an organization has created several management issues. In Corporate Information Systems Management: The Issues Facing Senior Executives, authors James I. Cash, Jr., F. Warren McFarlan and James L. McKenney identify six critical questions senior management raises repeatedly:

1. Is my firm being affected competitively either by omissions in information technology work being done or by poor execution of this work?

2. Is my development portfolio effective? Am I spending the right amount of money and is it focused at the appropriate applications?

3. Is my firm spending efficiently?

4. Is my information technology activity sufficiently insulated against the risks of a major operational disaster? (While there is no general purpose answer as to what an appropriate level of protection is, in general firms are much more operationally dependent on information technology's smooth performance than their general managers believe).

5. Is the leadership of the information technology activity being exercised appropriately for the role it now plays in our organization and for the special challenges it now faces?

6. Are the information technology resources appropriately placed in the firm?

How managers, including those in the County and bi-County agencies, answer these questions often depends on three organizational characteristics. These are:

- The role and type of technology in the organization;
- The management practices in an organization; and,
- The structures or management systems used specifically to make technology decisions.

Many organizations establish formal decision structures to guide the use of technology or to leverage technology investments. While decision structures are useful by themselves, their effectiveness increases if they are part of an overall management framework. Successful application of technology depends on management's initiative to articulate a clear mission statement and to decide how technology will support a business. This typically leads to the creation and use of decision structures.

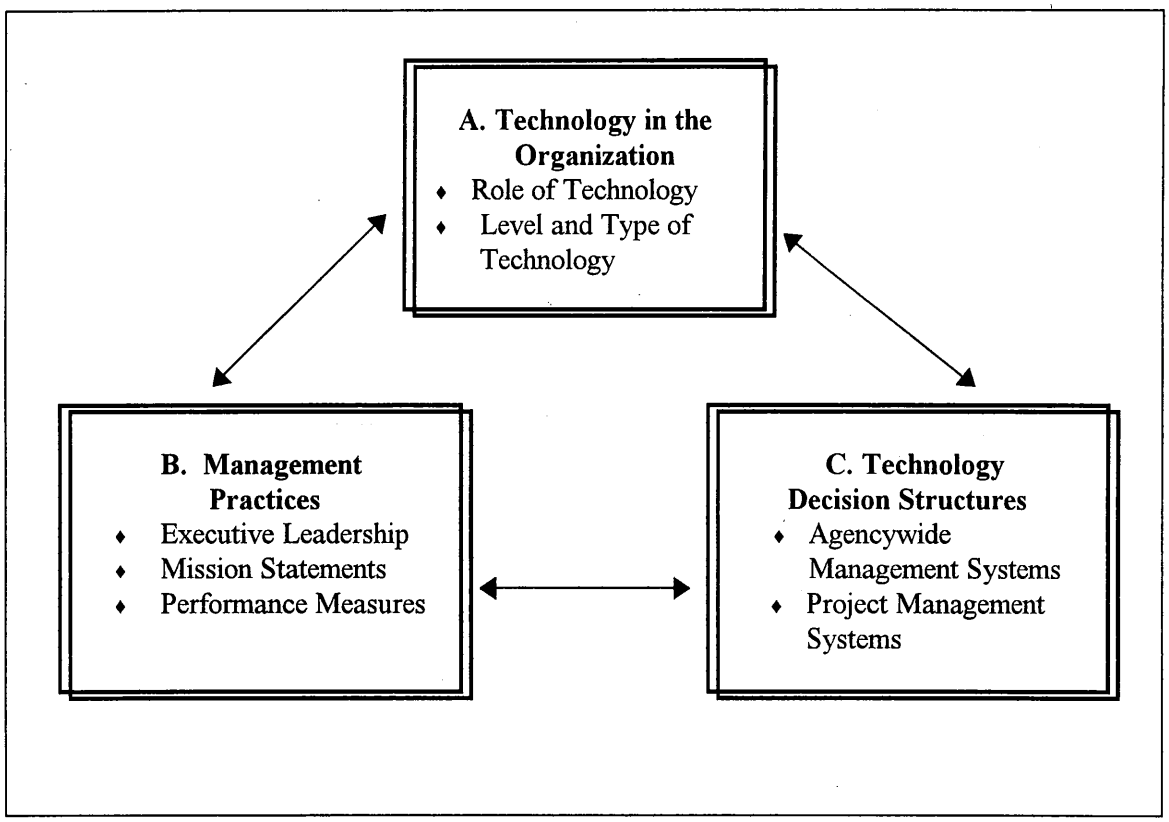
Figure 1 portrays the three components of an overall framework and the sub elements in each area to show how technology decision structures fit into the framework.

Recommendation

The management systems in an organization influence the effectiveness of an agency's technology decision structures. Given this relationship, the Council should discuss with the executives in the County and bi-County agencies the relationships between an agency's management systems and its technology decision structures. In particular, the Council should ask the executives to address:

- **how they perceive the role of technology in their organizations' mission;**
- **how they provide leadership for technology decisions within their agencies; and,**
- **how technology decision structures are linked to other management structures in the organization.**

FIGURE 1. AN INFORMATION TECHNOLOGY MANAGEMENT FRAMEWORK



Source: OLO, 1995

The rest of this chapter briefly reviews the issues associated with each component of the management framework. The remaining chapters of the report present examples of agency and project management decision structures (Chapters III and IV) and describe the technology management practices in the County and bi-County agencies (Chapter V).

A. TECHNOLOGY IN THE ORGANIZATION

The uses of technology in business have evolved from internal tools of the organization to potentially strategic assets. How organizations use information technology can vary widely from stand-alone systems that support automation in one part of the organization to larger networks that either link systems within an agency or connect agency information technology systems to similar systems in other organizations.

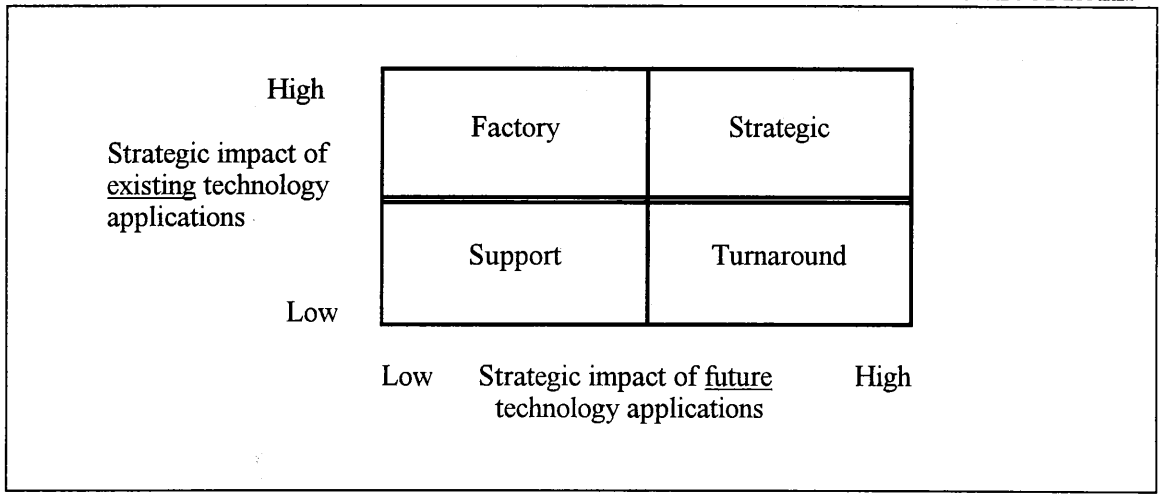
In theory, organizations can decide whether they want to operate stand alone systems for key agency processes; to integrate existing business processes and information systems within an organization; or, to redesign existing processes and implement technology to support a redesigned process. In practice, executives must allocate technology dollars among competing priorities such as the retirement of obsolete systems, the maintenance and support of existing systems, or the development of systems to support new programs or directions. In making these choices, executives should address two issues:

- How should technology support ongoing and/or future operations in the organization?
- What types and levels of technology are appropriate for the organization?

1. How should technology support ongoing and/or future operations?

In some industries, information technology activities have great strategic importance; in others, they play a role that is cost effective and useful but distinctively supportive in nature. Figure 2 taken from Cash et. al. identifies four different information technology operating environments based on whether the impact of information technology is critical to current or future operations.

FIGURE 2. TYPES OF BUSINESS ENVIRONMENTS BASED ON EXISTING AND FUTURE TECHNOLOGY ROLES



Source: Cash et. al. and OLO

Strategic environments exist in those companies where smooth functioning of the IT activity is critical to daily operation and future competitive success.

Turnaround firms are not absolutely dependent on cost effective functioning of current operations but the applications under development are vital to the companies strategic objectives.

Factory environments are heavily dependent on cost-effective, totally reliable information technology operational support. Project portfolios are dominated by maintenance work. New applications are not fundamental to the firm's ability to compete.

Support environments are not fundamentally operationally dependent on the smooth functioning of the information technology activity nor are their applications portfolios critical to achieving strategic revenue and profit goals.

To use technology strategically, executives must assess how important information technology is to the agency's ongoing day to day operations or alternatively to its future strategic operations. In the private sector, successful businesses have used technology to create new entities and new ways of doing business because technology can jump traditional organizational boundaries. A frequently cited example in professional journals is the reservation system in the airline industry. The system has given its developers, American Airlines and United Airlines, major marketing and operating advantages. This model may not be easily transferable to public sector agencies which, by definition, operate in a less competitive environment.

2. The appropriate level and type of technology

Given the continuous development of new technological capabilities, it is important to debate the level and types of technology that are appropriate for an organization. In an article entitled "Leveraging the Yield on Information Technology: What Really Works and What Doesn't," Dr. Stephen R. Ruth offers several interesting insights into the use of technology in the most successful businesses.

- In the top 100 businesses, only 40% of the employees had a computer, less than half of those who had computers were connected to networks and only 5% were connected to customers. Looking more specifically at the top 10 firms, 3 barely use e-mail and 5 use it extensively.

- The successful companies emphasized "mainstream" needs including local area networks, client servers and graphic user interfaces.

- Nearly one-third had altered the structure of their Information System departments during the past year by distributing IS tasks to the business units or reorganizing to functional team units.

- Finally, 28 of the top 100 companies were organized so the Chief Information Officer (CIO) reports directly to the president or CEO, indicating a recognition of the contribution of the CIO to productive operations.

Dr. Ruth concludes that effective operations arise from effective people, not a proliferation of computers. His recommended criteria for new technology investments include low unit cost, high unit yield, proven use in similar applications, little need for unique hardware or software and budgeting 10% of the cost for training users and customers.

B. MANAGEMENT PRACTICES

The second characteristic that determines how effectively an agency uses technology is an organization's general management practices. Three indicators that can be used to assess an agency's readiness to address technology management issues are:

- the leadership of top management in technology decisions,
- the mission focus of an agency, and,
- the use of performance measurement systems.

1. Executive Leadership

The active involvement of top leadership in technology decisions is an essential prerequisite to the effective use of technology. In 1994, the General Accounting Office (GAO) researched the information management practices used by senior management teams in five private sector firms and five state government agencies. The objective was to identify management practices used by leading private and public sector organizations and to share this information with federal agencies.

In testimony before the Senate Subcommittee on Oversight of Government Management, GAO reported that the most critical factor instrumental to the success of leading public and private organizations was the leadership and personal commitment of top executives to improve strategic information management.

The GAO report identified eleven practices that successful senior managers used consistently over time to improve mission performance through strategic information management. For example, many businesses and government agencies have appointed a Chief Information Officer (CIO) to provide leadership and guidance to the Information Technology structure and to link technical and managerial areas. To be effective, the CIO reports directly to the executive management in the organization so that decisions on information technology are moved to the management level of the organization. In addition to the appointment of a Chief Information Officer, other opportunities for top management involvement in technology decisions in the GAO report include:

- Identifying and appointing executive-level sponsors for each major information systems project;
- Institutionalizing a process to propose, select, develop and evaluate the results of all information system investments; and,
- Tasking a senior management team to design and implement an annual information management performance report as an input to strategic planning.

A list of all the executive leadership strategies from the GAO report are found in Appendix A.

2. Mission Statements

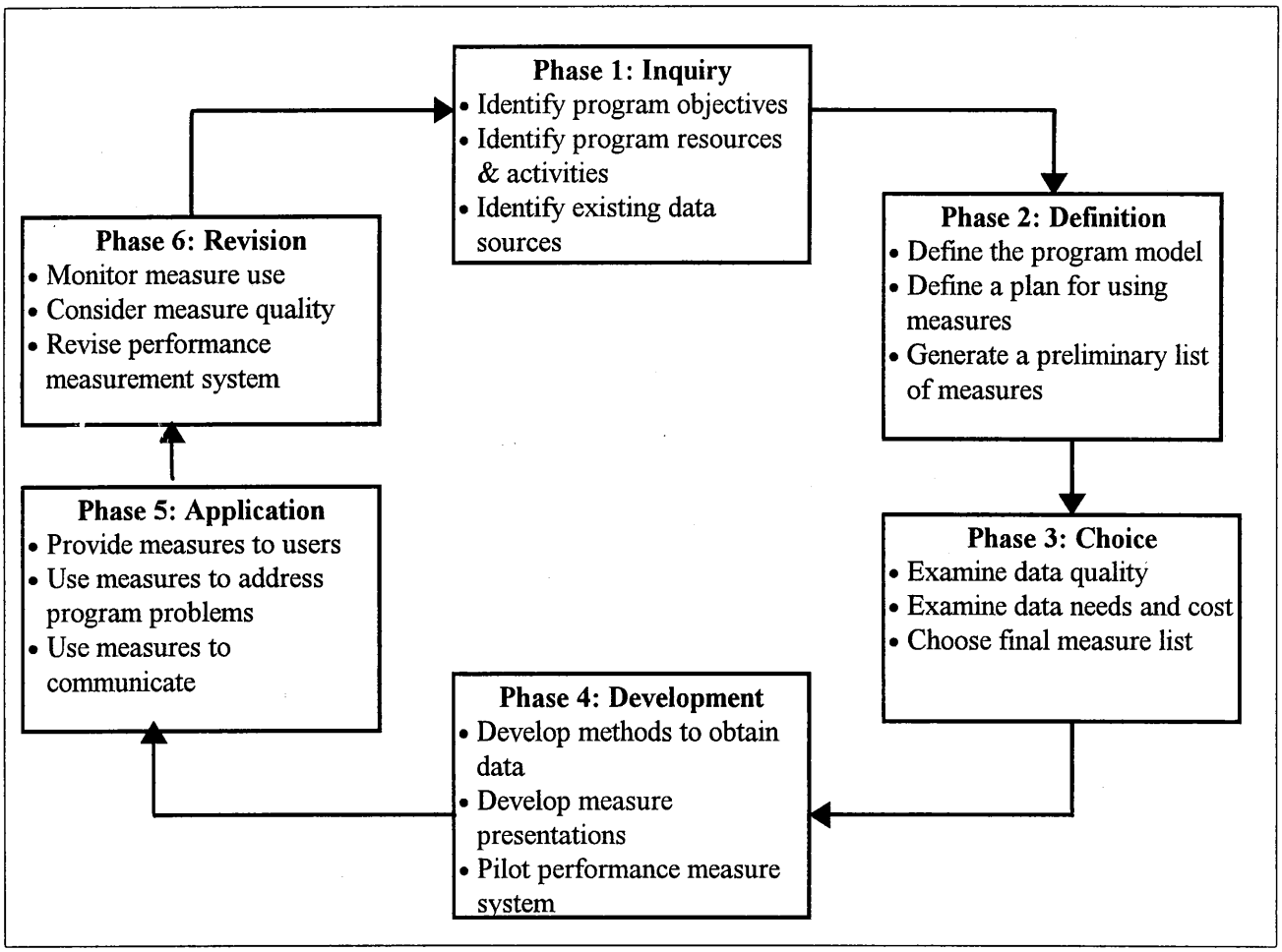
A key objective of decision structures for technology is to tie decisions about technology projects to an agency's mission or service delivery goals. The effectiveness of these processes rests heavily on a clear understanding of an origination's mission. Mission statements are often the product of a strategic planning process for the organization. In Developing Performance Measures for Montgomery County Maryland Information Technology Projects, the National Academy of Public Administration (NAPA) defines a mission statement as follows:

The mission statement is the foundation of the strategic plan. It tells what activities the organization will carry out, why, for who, how, and when. In recent years, customer focus has become one of the priority elements in developing mission statements. Consensus must be reached on the organization's mission statement before team members develop strategic plans or performance measures associated with the strategic planning model.

3. Performance Measures

Performance measures are another key ingredient of a strategic management system. They are used to evaluate the success or effectiveness of a technology project, including the degree to which a project supports the organization's mission. Figure 3 from the NAPA report identifies six steps in the strategic planning and performance measurement cycle.

FIGURE 3. THE PERFORMANCE MEASUREMENT DESIGN CYCLE



Source: Developing Performance Measures for Montgomery County Maryland Information Technology Projects, August, 1995, NAPA and OLO

The NAPA report states that the three basic measures commonly used in developing and implementing information technology projects are cost, schedule and performance. Performance measures based on a mission statement allow the performance of technology projects to be evaluated for effectiveness in addition to cost and scheduling. To be most useful, these factors must be considered continuously over the entire life cycle of the project. An agency that is already

using a performance measurement system as a general management practice will have an easier time integrating the use of performance measures into the evaluation of technology projects than those agencies who need to develop a performance measurement system first.

C. Technology Decision Structures

OLO's research found that organizations use several types of decision structures to manage the selection, implementation, and evaluation of technology. This report organizes these decision structures into two groups: those that examine project specific issues versus those that operate at the agency level.

Agencywide strategic management systems are the practices organizations use to manage technology at the agency level. Agencywide structures look at how to select technology that is most compatible with an agency's mission and service delivery goals or at how to evaluate whether technology investments are delivering their promised benefits. Organizations may use strategic plans, information resources management, or a portfolio management approach to guide project selection decisions.

Strategic plans assess existing technology infrastructure and address how investments can be managed to achieve an agency's goals. Strategic plans identify existing and future technology projects based on an organization's mission, goals, objectives and action plans.

A portfolio management process systematically selects new projects to be started and monitors ongoing projects. The project selection phase typically uses criteria that closely reflect the organization's critical missions and goals in addition to costs, benefits and risk assessments. In the monitoring phase, organizations review all cost, schedule and outcome data. High risk projects may receive more frequent reviews. If necessary, projects that are not delivering their promised benefits may be halted. Some places use this approach four times a year for all projects over $50,000.

Information resource management (IRM) systems address all areas critical to proper information resource management including organizational structure, information architecture, organization-wide and project planning, and a framework for developing specific information resources.

A **project management system** is the set of practices and procedures an organization uses to take a project through the lifecycle process. Project management systems guide the design, development and delivery of technology projects and establish participation, documentation and analytical requirements for each step of the decision process. Common elements of a project management system include a needs justification or program of requirements; an alternatives analysis; a detailed design or a recommended alternative; deployment and operations; and maintenance. Four specific project management systems are described in Chapter IV.

III. AGENCYWIDE MANAGEMENT SYSTEMS

Agency management structures for information technology treat the organization's information technology equipment, software and other resources as assets. OLO collected and reviewed information on agency management practices in Phoenix, Arizona; Austin, Texas; and the states of Minnesota, Texas and Washington. OLO also reviewed strategic plans for the Patent Office; Fairfax County, Virginia; Portland, Oregon; DIST; the M-NCPPC Research Division and the M-NCPPC Parks Department.

A. APPROACHES TO AGENCYWIDE MANAGEMENT SYSTEMS

OLO's research found four techniques or practices organizations use to manage technology assets strategically. The four techniques are:

- Preparation of a strategic plan;
- Use of a portfolio management approach to select, evaluate and monitor individual technology projects;
- Implementation of an information resource management system; and,
- Use of oversight programs.

1. Strategic Plans

Organizations undertake strategic plans to match information technology projects more accurately with the direction of the business. For example, Figure 4 summarizes the purposes of the Strategic Plan for the U.S. Patent and Trademark Office.

FIGURE 4. PURPOSES OF THE US PATENT AND TRADEMARK OFFICE STRATEGIC INFORMATION TECHNOLOGY PLAN FOR FY 1995-2000

a. Provide a means to document, monitor, guide and assist with the PTO's Information Resource Management Program for the period FY 95 through FY 00.
b. Provide the information and justification necessary to program information technology resource requirements in the PTO budget process.
c. Focus increased attention on the management of information technology resources.
d. Provide information on the current status and future direction of the use of information technology within the PTO.
e. Involve top level management, program sponsors and customers in the information technology planning process.
f. Avoid duplication of effort and encourage the sharing of resources where appropriate.
g. Present to PTO leadership, program sponsors and customers how funds are projected to be allocated for information technology activities.
h. Focus the information technology activities into a concerted program designed to achieve information technology objectives.
i. Provide the PTO information technology program objectives and plans to a higher authority.

Source: Strategic Information Technology Plan for FY 1995-FY 2000, U.S. Patent and Trademark Office, Jan. 1995

The elements of a strategic information technology plan include:

- identifying the goals and objectives for the organization and/or the information technology department within the organization;
- describing what technology equipment currently exists and how it is used;
- defining future business directions and the information technology needed to support that direction; and,
- articulating an action plan or guidelines to shape future decisions.

In addition to the plan itself, products of an information technology planning process may include an information technology architecture, standards or guidelines or a list of future technology projects.

A key factor that determines the breadth and effectiveness of a strategic plan is whether the plan is initiated at the request of management or the information technology professionals within an organization. Often, the major purposes of strategic information technology plans prepared by an information technology department are to develop and justify future technology projects and to ensure that standards exist so that these projects are interoperable and compatible. These plans frequently include detailed descriptions of an agency's information technology architecture as well as formal technical standards. They serve as useful internal resource documents for the department but may not result in changes needed to produce the strategic management of information technology.

A common frustration technology professionals must address is how (but not whether) to do a strategic plan absent guidance from top management. As a result, it is not unusual for strategic information technology plans prepared by technology departments to co-exist but not be related to an agency's overall budgeting and funding processes.

Strategic information technology plans requested by management are more likely to examine management issues. These might include:

- the relationship between an organization's mission and its information technology spending;
- whether the agency is investing in the right mix of information technology projects;
- whether the promised benefits from information technology are actually being realized; and,
- whether there are sufficient control systems in place to protect the organization either from the high risks inherent in project delivery or from the risk of an operational failure.

While this strategic exercise can be undertaken by information technology professionals within the organization, it may also begin with an assessment by a group outside of the information technology department or outside of the agency. The Fairfax County plan described below (see page 15) was initiated when the County Executive established an Information Technology Advisory Group consisting of top-level executives and managers from the County's business community.

2. Portfolio Management Approaches

Another way to structure decisions about information technology projects is to evaluate and rank individual projects in a group using criteria that reflect agency priorities. Many agencies today are adopting a portfolio approach to the management of information technology projects. This approach assumes that the methods used to manage financial investments, including financial

evaluations, returns on investments and oversight by an Investment Review Board, are transferable to the management of information technology projects.

The generic steps of a portfolio management approach include (1) filtering and screening proposals; (2) analyzing costs, benefits and risks; (3) setting project priorities; and (4) making final decisions about what projects to fund. To establish a portfolio management approach agencies must define the criteria that will be used to compare projects and determine who will serve on the Investment Review Board to make decisions about project selection.

There is a close relationship between the portfolio management approach and the management systems used to evaluate, manage and control individual projects described in the following chapter. For example, the life cycle cost estimate for an individual project shows the expected costs required to conceptualize, design, operate and maintain, and eventually upgrade or replace a project. If life cycle cost estimates were maintained for all projects, both ongoing and proposed, a budget could be assembled for new project concepts and development, plus ongoing maintenance and replacement. An agency that relies heavily on technology to deliver its services could choose to establish and fund an ongoing replacement and maintenance fund to cover the costs that will arise after a project has been implemented.

3. Information Resources Management (IRM) Systems

Information resources management represents a change in perspective about information management. Traditional thinking has been to develop systems that address specific business requirements. This approach duplicates resources and assumes a system is the right solution before the problem is clearly understood. Information resources management, on the other hand, requires understanding the business and resources required to carry out that business before solutions are selected.

According to the Minnesota State Information Policy Office (IPO), information resources management (IRM) is "the process of managing information resources to accomplish business objectives. Information resource management establishes an infrastructure for operating a business that includes resources such as data, personnel, funds and information technology."

4. Oversight Programs

The complex, dynamic and expensive nature of technology projects makes it important for agencies to manage risk and address oversight issues on a systemwide level. There are several strategies for managing risk. The discussion of project management decision structures in the following chapter highlights the need for risk analysis as a standard step in the project evaluation process. At the agency level, some organizations decide up front to limit the number of high risk projects they are undertaking at any one time or require that high risk projects be subject to more frequent reviews. Others deliberately limit the size and scope of projects to manage risks. Still others keep a list of projects that are in trouble and establish the authority to stop funding if it appears that the problems will not be overcome.

B. Examples of Strategic Plans and Management Structures

The rest of this chapter describes the strategic plan prepared for Fairfax County, the portfolio management approach described in a Federal OMB investment guide, the information resource management practices in the State of Minnesota, and some oversight programs conducted at the federal level.

1. The Fairfax County Strategic Plan

The Information Technology Advisory Group (ITAG) appointed by the Fairfax County Executive conducted several interviews with information technology professionals in Fairfax County to assess the County's technology. In February 1994, the ITAG presented its reports to the County Executive. The ITAG findings are summarized in Figure 5 on page 15.

The ITAG concluded that Fairfax County had a two-pronged Information Technology problem. On the one hand, the County needed to address the deficiencies in its existing IT infrastructure. On the other hand, it had to define and plan for the introduction of modern IT equipment and processes. The ITAG referred to the first phase as the baseline or tactical phase, and the second phase as the modernize or strategic phase.

The ITAG estimated the cost of the baseline phase at $30 million over a three year period. The modernize phase was expected to cost an additional $55 to $65 million over a five year period. Finally, the ITAG noted that the County should plan for approximately $15 to $20 million per year for continuing upgrade to its IT infrastructure as it moved to FY 2000. Table 1 projects the cumulative amount of technology spending needed. This funding is over and above the current budget for IT staff dispersed throughout the County government.

TABLE 1. SUMMARY OF RECOMMENDED ITAG TECHNOLOGY SPENDING REQUIREMENTS OVER AND ABOVE EXISTING IT SPENDING

Phase	FY95	FY96	FY97	FY98	FY99	TOTAL
Baseline	$7	$12	$11	$0	$0	$30
Modernize	$11	$15	$12	$11	$11	$60
Upgrade	$20	$20	$20	$20	$20	$120
TOTAL						$210

Source: Information Technology Plan for Fairfax County, 1995, Fairfax County and OLO

The ITAG developed 25 policy and technical recommendations. They recommended that the County adopt a centralized management approach to IT and establish a new Department of Information Technology (DIT). The Director of this Department reports directly to the County Executive and has responsibility for the day to day operations of the Department. Other key recommendations were as follows:

- The senior County leadership must recognize that an investment in information technology is essential if the County is to meet the expectations of its citizens. The County must deal with the current deficiencies in the IT infrastructure and, at the same time, begin building the next generation of IT. This requires an ongoing commitment to improving the current IT baseline, while modernizing to meet future requirements.

- While there was not sufficient time to study the County's schools' IT system, there is a general belief that, at some point in the future, the schools should be brought back into the County IT infrastructure.

- The County should resume doing a multi-year Strategic IT plan addressing both central IT and departmental IT user initiatives. The development of this plan would be led annually by the DIT assisted by senior departmental user representatives.

- IT training funds must be restored for both the central group as well as departmental IT staff.

FIGURE 5. FINDINGS OF THE FAIRFAX COUNTY INFORMATION TECHNOLOGY ADVISORY GROUP

Until a few years ago, Fairfax County's size and resources made it a national leader in municipal government information systems technology. This is no longer the case. While demands for services by County citizens have grown dramatically, IT funding has declined considerably and IT resources have become inadequate.

- County staff and computing resources are dispersed throughout agencies and departments and are not effectively coordinated by a central technical or management organization. The central staff and the user departmental staff represent a "technology clash" - i.e., mainframe versus distributed and user versus centralist. We consider the separate organizational focus to be a serious impediment to effective technology utilization.

- While County IT professionals and departmental users generally do an excellent job planning specific IT projects, these projects are often stopped by senior management after approval and initiation, due to other pressing priorities or funding constraints. These same constraints have resulted in a failure to implement recommendations made for IT investment and funding initiatives during annual Strategic IT planning, leading to a decline in the relevance of the strategic planning process.

- Much of the County's IT infrastructure including workstations and business applications, is old, outdated, does not have consistent functions or capabilities, or is not provided in sufficient quantity to satisfy the full spectrum of user needs.

- The County's mainframe computer systems support an enormous amount of the County's applications software workload. Annually, more than 500,000 batch jobs are executed and 150,000 end user jobs are performed. There are almost 3,000 daily users, spread out over 200 separate locations and accessing more than 290 gigabytes of data. Each year more than 2.8 million new data records are entered into the County's data base, more than 1,500 records every hour.

- Although mainframe workloads over a three year period appear to be rising, a careful analysis reveals that "average prime shift" requirements (i.e., between 8 AM and 4:30 PM) essentially have been flat for the last 24 months. Several processors are old and unreliable and opportunities exist for processor tuning and reconfiguration.

- The large workload is processed by 63 separate business systems and 8,200 computer software programs. Many were originally developed as individual systems or "stovepipes," aimed at automating an individual department; interfaces to other systems or shared data bases were not considered. Therefore, the County spends a large part of its central IT resources maintaining existing systems (average age 11-12 years) rather than on modernization and new software development.

- The ITAG was encouraged to note that the County has effectively begun business process reengineering in several business areas.

- The budget for IT training has been virtually eliminated for the last two years. During that same period, mainframe computer technology has evolved at least once and PC technology at least twice. This means that even those County employees hired in 1990 may not possess the necessary technical currency to pursue bold new initiatives.

- The County is seriously deficient in Disaster Recovery/Business Resumption planning, i.e., the ability to re-initiate computer services and facilities after a major catastrophe such as fire or sabotage.

Source: Information Technology Plan, FY 1996, Fairfax County Government

To date, Fairfax County has implemented changes to address organizational issues, planning issues and funding practices. The highlights of the County's actions include:

Organizational changes

- The consolidation and reorganization of information technology functions into the Department of Information Technology;

- The creation and appointment of a Chief Information Officer (Director of DIT) reporting directly to the County Executive to provide leadership and direction to the County's evolving IT structure;

- The establishment of the Strategic Management Steering Committee, a senior policy making group for business improvement and information technology issues. The SMSC is chaired by the County Executive and includes the Directors of Personnel, Management and Budget, Finance, Information Technology and representatives from the Departments of Transportation and Police.

Planning changes

- The adoption of planning procedures to guide the identification, evaluation and approval of projects;

- The adoption of a set of targets referred to as IT 2000. These targets include reducing the average age of the County's business systems from twelve years to under ten; eliminating the WANG system by FY 96 and expanding the use of Windows and its successors; reducing the total number of servers by replacing small servers with fewer Super Servers; and reducing the resources assigned to the maintenance of business applications from 80% to less than 40%.

Funding and budgeting changes

- The establishment of a separate fund to strengthen centralized management of available resources and consolidate investment in major projects. The subfund is managed by the DIT and provides a mechanism for capturing aggregate investment in County-wide, multi-year IT initiatives by tracking funding across functional boundaries and over the full life of the project. Funded projects are of strategic importance to the overall management of the County.

- The establishment of a Computer Replacement Program, a formal program for replacing microcomputer technology as equipment ages and becomes inefficient or obsolete. Computer replacement will become a normal business practice so that the County's computer inventory remains consistent with current technology. At the beginning of FY 1995 there were approximately 1,458 obsolete personal computers. Approximately 780 computers or roughly half were replaced during FY 1995. The remainder is targeted to be replaced in FY 1996. An estimated useful life cycle of five years and a replacement cost of $3,000 has been developed for the replacement of microcomputers. For each replacement computer, $600 or one-fifth of the estimated replacement cost will be collected annually from the agencies. Future funding will be required to address additional classes of PCs included in the inventory which have become obsolete.

- The establishment of a Technology Infrastructure Services Subfund to ensure regular upgrade and replacement of mainframe computers and communications equipment.

2. The Federal OMB Investment Guide - Portfolio Management Approach

The federal Office of Management and Budget is preparing an investment guide for federal departments that describes an analytical framework for linking technology investments to an agency's strategic objectives and business plans. The purpose of the guide is to provide information to agency program and technology professionals on OMB's oversight expectations in the technology area and to show how agencies can reduce risks and maximize net benefits from their technology investments. The guide provides useful insights into the issues agencies should address to manage project selection and to control project implementation.

Project Selection

The objective of the selection process is to create a portfolio of technology project investments that maximize mission performance using a standard set of criteria for project comparison. In the selection phase, projects are screened, subject to an analysis of costs, benefits and risks, ranked, and funded. Figure 6 summarizes the questions recommended to structure the filtering and analysis steps.

FIGURE 6. SUMMARY OF ISSUES RECOMMENDED TO FILTER AND ANALYZE TECHNOLOGY PROJECTS

Questions to Filter and Screen IT Project Proposals

1. Is the project clearly relevant to mission priorities?
2. Is the project feasible to design and execute given the agency's demonstrated capability to deliver?
3. Does the project conform to the agency's architecture?
4. Will the project be executed in well defined stages?
5. Do project benefits appear to clearly outweigh any potential risks?

Questions to Analyze Project Risks, Benefits and Costs in Detail

1. How do the proposal's net projected benefits compare with the potential risks?
2. How valuable are these benefits for accomplishing the agency's mission? What are the risks to the program operations and customer service if this project does not proceed?
3. Has a sensitivity analysis been performed?
4. Has the project team prepared a benefit cost analysis that is at a level of detail appropriate to the project's size and relies on systematic measures of mission performance?
5. What are the constraints and assumptions that may affect the costs and benefits of alternative solutions?
6. Is an IT investment considered an infrastructure project that makes future projects possible? If so, how does the benefit-cost analysis account for expected payoffs from future investments?
7. Have the benefit estimates been validated or approved by users?
8. Do assumptions supporting the analysis reflect market conditions where costs are declining each year? Are cost assumptions based on today's prices or prices expected at budget execution?
9. Has the project team assessed project risks using a comprehensive, well understood, documented process?
10. Should the Investment Review Board put plans in place to conduct additional risk assessments periodically to minimize areas of exposure?
11. Has the relevant agency group successfully managed previous IT investments of similar risk and complexity?

Source: Federal OMB Investment Guide (Draft), August, 1995

After projects have been screened and analyzed, they are ranked to create a priority list of investments. The investment list should use expected risk and benefits to identify projects with the greatest chances of success for effectively and efficiently supporting key mission objectives within given budget constraints. The effectiveness of the process will be determined in part by what criteria are used to compare the projects. Figure 7, on page 19, from the OMB guide, presents an example of a scoring guide used to rank projects. Note that different factors can be given different weights.

In the final step of the selection phase, senior managers determine the right mix of projects, make final decisions about what specific projects to fund, and identify any special approval conditions. OMB identifies the following factors for managers to consider in arriving at the final resource and project mix:

- strategic improvements versus maintenance of current operations
- new projects versus ongoing projects
- high versus low risk
- impact of one project on another
- other complicating factors such as opportunity costs, external funding or budget constraints.

Controlling Project Implementation

The control phase is an ongoing activity to review new and ongoing projects as well as operational systems. The steps in this phase include:

- reviewing the projects in the portfolio;
- taking actions to correct any problems or deficiencies; and,
- measuring the progress of ongoing projects against their projected costs, schedule and benefits.

In taking action to correct problems, OMB states that senior managers need to ensure that the solution to problems are not the sole province of the technology department, and that decisions are documented. It is important to continually compare actual and projected costs and benefits because projects change as they develop. The guide states that proper control of IT investments allows senior management to mitigate the risk of schedule and cost overruns or the development of a project that does not meet its original goals.

FIGURE 7. SAMPLE SCORING GUIDE USED TO RANK TECHNOLOGY PROJECTS USING A PORTFOLIO MANAGEMENT APPROACH

OVERALL RISK FACTORS	
Investment Size - How large is the proposed technology investment, especially in comparison to the overall IT budget?	1_____3_____5 Small Large
Project Longevity - Do projects adopt a modular approach that combines controlled systems development with rapid prototyping techniques? Are projects as narrow in scope and brief in duration as possible to reduce risk by identifying problems early and focusing on projected versus realized results?	1_____2_____4 Non-modular Modular
OVERALL RETURN FACTORS	
Business Impact or Mission Effectiveness - How will the technology investment contribute toward improvement in organizational performance in specific outcome oriented terms?	1____ ____5_____10 Large Small
Customer Needs - How well does the technology investment address identified internal and/or external customer needs and demand for increased service quality and timeliness or reductions in costs?	1_____3_____5 Low High
Return on Investment - Are the return on investment figures using benefit cost analysis thresholds reliable and technically sound?	1_____3_____5 Risky Reliable
Organizational Impact - How broadly will the technology investment affect the organization (i.e., the number of offices, users, work processes and other systems)?	1_____3_____5 Low High
Expected Improvement - Is the proposed investment being used to support, maintain or enhance existing operational systems and processes or designed to improve future capabilities? Are any projects required by law, court ruling or Presidential directive? Is the project required to maintain critical operations at a minimal operating level? What is the expected magnitude of the performance improvement expected from the technology investment?	1_____3_____5 Tactical Strategic
Total Risk Adjusted Score	

Source: Federal OMB Investment Guide (Draft), August, 1995

3. Information Resource Management Practices in the State of Minnesota

In 1987, the Minnesota State Legislature created the Information Policy Office (IPO) in the Department of General Administration. The threefold mission of the office is to ensure that Minnesota's information resources are:

- Well managed to avoid duplication of efforts and the potential waste of resources;
- Developed and operated in a manner that maximizes the use of technology to the benefit of the state's citizens; and,
- Responsive to a variety of requirements of public policy related to information.

Some of the specific responsibilities of the IPO set forth in the legislation are to develop and establish:

- Policies and standards for state agencies to follow for the development, purchase, and training for information systems;
- Techniques for planning and managing information systems that ensure the needs of the agency and the state as a whole are met;
- A state technology architecture, standard and guidelines that ensures individual agency systems do not needlessly duplicate or needlessly conflict with the systems of other state agencies;
- Information needs analysis techniques;
- Contracts for the purchase of equipment and services;
- Training of state agency personnel on these issues; and,
- Efficient and cost-effective methods of producing, sharing and storing data.

Minnesota is implementing Information Resource Management practices through the adoption of policies, statewide technical standards, guidelines and the budget review process. Information on the policies, standards and guidelines is found in Appendix B. IPO uses the budget review process to ensure that the needs of the agency and state are met and to apply information needs analysis techniques. The details of the budget review process are summarized below.

How the Budget Review Process Works

Minnesota law requires that the IPO review all state agency information resource budget requests before they are submitted to the legislature. IPO has identified a framework of six critical success factors and 15 standards that it uses to measure agency requests. Some standards measure agencywide commitment to information management; others focus on project level management. IPO states that both sets of standards are needed "to ensure that the proposal is doing the right project based on agency level Information Resources Management and also doing the project right based on project level Information Resource Management.

Agency project requests must include a one page summary of the purpose of the request, including the business needs the request will meet and the potential risks to organizational stakeholders if needs are not met. Agencies must provide several products to demonstrate compliance with the standards. Figure 8 shows the relationship between the six critical success factors, the fifteen standards and the agency and project requirements.

FIGURE 8. FY 1996-97 FUNDING REQUEST REQUIREMENTS SUMMARY

Critical Success Factors/ Evaluation Areas	Agency-wide Requirement	Project Requirement
Background/Overview of Project		
One Page Project Summary		X
1. Executive Leadership Involvement: Improve Executive leadership and involvement.		
1.1: Executive in Charge	X	
1.2: Executive Steering Committee	X	X
2. Information Management Infrastructure: Develop an information management infrastructure built around policies, standards and guidelines, which are necessary to allow repeatable processes and sharable products.		
2.1: Policies	X	
2.2: Guidelines	X	
2.3: Standards	X	
3. Planning: Develop a continuously updated agency-wide implementation and migration plan that allows agencies to determine project priorities and provides a longer range view of how projects fit with the strategic business direction.		
3.1: Agency-wide Implementation Plan	X	
3.2: Project Scope		X
3.3: Project Cost, Benefit, Risk		X
3.4: Project Plan		X
4. High Level Resource Models: Create and use high-level information resource models that collectively describe agency data, technology and application resources and how they support business functions.		
4.1: Agency Functional Business Model	X	
4.2: High Level Data Model		X
4.3 High Level Distribution Model		X
4.4: High Level Technology Model		X
5. Organizational Structure: Develop an Information Resource Management (IRM) oriented organizational structure that has the authority to manage all aspects of the agency's information resource projects.		
5.1: Organizational Structure and Assessment	X	
6. Effective Skills Base: Investments will be needed to acquire, train and retain skilled professionals who can carry out IRM responsibilities.		
6.1: Self-Assessment Matrix and Plan		X

Source: Information Policy Office, May 1994

IPO gives each project a rating of excellent, good, satisfactory, fair or poor along with direction on what to do to improve the project's potential for success. IPO's analysis evaluates the progress an agency is making in achieving Information Resource Management standards as well as whether the agency is taking the appropriate actions to manage the specific project. IPO request that specific agency management or project management actions be written into every appropriation.

For project management actions, IPO often recommends:

- That projects be funded in phases with interim reviews so all requirements are met along the way, or
- That an independent evaluation/assessment of design, cost, benefit and risk analysis and implementation plans for the project be completed.

At the agency level, IPO recommends that an agency:

- Formalize high level executive authority and responsibility for Information Resources;
- Formalize an agencywide information Resource Steering Committee defining membership, process and criteria;
- Establish a 1 to 2 year implementation plan identifying and sequencing major agency projects; and,
- Plan and implement an Information Resources organization to effectively manage data, applications and technology.

Lessons Learned From the Budget Review Process

The 1996-97 Information Resource Funding Recommendations booklet published by the IPO notes that after eight years of reviewing project proposals, the IPO has identified four areas of positive movement. These are:

Executive leadership The IPO notes that state agencies are beginning to recognize the importance of a CIO, as a high level position with authority that cuts across traditional functional lines and that to be successful in helping to set agency strategic direction, a CIO must be prepared to tackle long standing and often complicated organizational issues.

Agency planning Some agencies have done excellent work in developing project-specific plans but they are hampered because the projects are often not connected to agency-wide goals. Few agencies have fully developed an implementation plan for all potential information related projects.

Organizational structure The organizational structure that supports information resource management needs to be integrated throughout all of the agency's operational and support units.

Skills Effective information management requires staff with the appropriate skills and expertise. A few agencies have completed skills assessments but most have not.

IPO also identified three ongoing issues that the government must address since they affect the success of the agencies in managing information resources to support business goals. These are summarized in Figure 9 below.

FIGURE 9. "ONGOING ISSUES" IDENTIFIED BY THE STATE OF MINNESOTA, INFORMATION POLICY OFFICE

1. Infrastructure Investment

Information resource investment needs will be on-going. An initial investment in information technology may make an operation cost efficient for today, but unless there is a plan for funding ongoing monitoring and upgrading, the operation may become ineffective. Funds must be available on an on-going basis to support infrastructure. Funding mechanisms need to be developed that allow for regularly scheduled infrastructure upgrades.

Information resource budgeting and contracting processes will need to change. Information resources development follows a process that includes planning, design, development and maintenance. The biennial budget process requires agencies to estimate a dollar amount for all phases of development and maintenance before detailed work has been done to determine the total dollars needed. The result is that phases may be inappropriately funded and agencies must return for additional funding. A new process would provide funding for each phase as it was needed with go/no go check points at the end of each phase.

To achieve the greatest investment value, it is important that the state continue looking for ways to improve contracting for information resources in order to respond to the changing market and technological environment. Government must provide one face to citizens. From a customer (citizen) perspective, there is a need for "virtual agencies". This means that information is organized as customers need it, coming from several agencies in a seamless manner, transparent to the customer. Statewide infrastructure investments to provide a common, user friendly face to government information are essential and must be made on an on-going basis.

2. Oversight

Important to effective management of the investment in information resources, is independent oversight of both the development and maintenance of these resources. The complexity of both the business problems and the technological resources available to help solve these problems present continuing challenges. Independent risk assessments and evaluations provide support for agencies in dealing with these challenges. Funding appropriations should require agencies to do independent assessments and evaluations as specified by the IPO.

3. Obtaining Technological Skills

As the technology supporting the public sector, for example local and wide are networks and client server applications, become increasingly complex, the skills required to manage the technology change rapidly. Agencies are finding that they must continually refresh skills to keep pace with changing technology. Government is competing with private sector enterprises for the same set of skills. Funding needs to be available, planning needs to be dynamic and staffing options need to be flexible. In addition, the state needs to be able to leverage consultants to gain internal skills. Knowledge transfer should be a required part of all consulting contracts.

Source: 1996-97 Information Resource Funding Recommendations, IPO, February 1995

4. Oversight and Risk Management Practices at the Federal Level

In a recent report on Information Technology Investment, GAO provided an overview of risk management and oversight practices at the federal level. GAO reported on three existing programs plus the recommendations of a working group that was convened to review the current process for planning and acquiring technology and to recommend improvements. Three agencies in the federal government administer oversight programs to monitor federal projects and programs. OMB's and GAO's efforts are generic oversight programs that include technology projects. The third program, administered by the General Service Administration, focuses solely on information technology projects.

OMB's High-Risk Program

OMB implemented its high risk program in 1989 following the disclosure of widespread and costly problems at the Department of Housing and Urban Development. The program identifies federal programs that are at risk of abuse, fraud and waste and suggests corrective actions. OMB's sources of information for the list include agency reports to the president as required by the Federal Managers Financial Integrity Act and reports by inspectors general and the General Accounting Office. The program is not specifically targeted to information technology projects, however, GAO's review of the OMB's 1995 list identified seven IT related areas.

GAO's High Risk Series

According to the GAO, at the heart of high risk situations is a lack of fundamental accountability. In 1990, GAO began a special effort to increase this accountability by reviewing and reporting on federal program areas considered to be high risk. They identified 18 areas that were especially vulnerable to waste, fraud, abuse and mismanagement and were costing the government billions of dollars without clear returns.

In 1992, GAO reported that some agencies were openly recognizing high-risk problems and developing and implementing corrective actions. They also reported that legislation needed to address certain individual high risk areas had been passed. Improvements in 5 of the 18 high risk areas have permitted GAO to remove their high risk. Since the 1992 reports GAO has continued to monitor high risk areas and press for further improvements.

In recognition of the government's large investment in information technology, GAO included information system modernization as a newly designated high-risk area in 1995. The GAO reports that after spending more than $200 billion on information management systems during the last 12 years, project after project continues to lag behind schedule, consistently fails to provide intended mission benefits, and exceeds estimated costs by hundreds of millions of dollars.

GAO included four multibillion dollar information technology initiatives on their high risk list in 1995 because "they have experienced past difficulties, involve complex technology and are critical to improving their agency's mission performance." They include efforts underway to modernize the air traffic control system, the tax system, the corporate information management system at the Department of Defense and the weather observing, information processing and communications systems at the National Weather Service.

In addition to focusing on these four high risk information technology initiatives, GAO is working with Congress to amend the Paperwork Reduction Act to provide a leadership structure for, and strengthen the management of, the government's information technology resources. They are also working with the Executive Branch to bring into government the strategic information

management "best practices" that successful organizations have used to improve mission performance.

GSA's Time Out Program

GSA established its "Time Out" program in 1994 to focus attention on some of the largest and most important federal IT acquisitions that have experienced problems. The responsibility for procuring information technology equipment is centralized in GSA unless GSA delegates this authority to an agency. Under this program, GSA establishes a means to restrict or cancel the procurement authority previously delegated to an agency.

The four criteria GSA uses to identify high risk projects that should be considered candidates for Time Out include:

- Cost overruns, which may indicate poor contractor performance, poor management or ineffective controls;
- Schedule delays which may point to a lack of agency focus, management problems or technology problems;
- Failure to meet mission objectives as evidenced by changes in program scope, milestones or contractual requirements; and,
- Management problems, as demonstrated by high-level leadership changes or organizational restructuring that suggest a program is encountering difficulties.

If a project is placed in Time Out, GSA requires the agency to stop work on the project until an independent assessment is completed. Before the delegated procurement authority is restored, the agency must restructure the project to include goals and interim measures for tracking progress.

Findings of the OMB/GSA Working Group

In a report to the President's Management Council, an interagency working group chaired by OMB and GSA presented three findings about the federal government's current IT practices:

- The most important points in the life cycle of an IT investment occur well before the present oversight process begins. The oversight process should be focused on promoting sound capital planning, beginning with an analysis of how IT investments will be used to improve an agency's business processes.

- To help manage their IT investments, agencies need to reach for expertise and talent across agency lines.

- The practice of undertaking large, unwieldy projects needs to be replaced with processes that support the use of incremental and evolutionary approaches to major system development and acquisition.

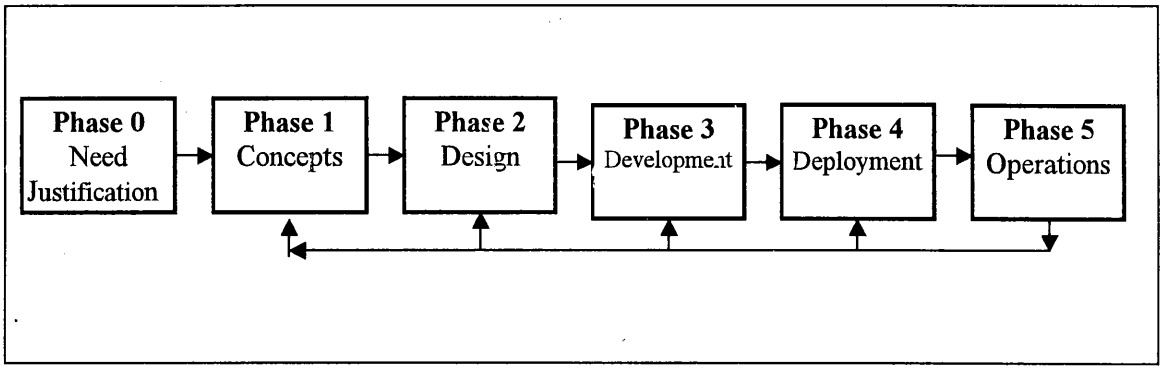
IV. PROJECT MANAGEMENT SYSTEMS

Any project to build or acquire an information technology system has identifiable steps or phases. While the size, scope and complexity of projects may vary widely, all projects generally go through similar steps. Common elements in a project management system include:

- A requirements analysis based on user needs;
- The evaluation of the cost, benefits, and risks of alternative solutions;
- Acquisition and implementation;
- System testing and acceptance; and,
- Ongoing project monitoring.

Early information technology project management systems were tightly controlled, complex, and time consuming processes. Separate steps requiring individual sign-offs created a lengthy process. Today, more approaches to project development have created other project management options. The project management system for a particular project must be tailored to match the size, scope and complexity of the project. The phases of a traditional information technology life cycle project management model are illustrated in Figure 10 below and defined in Figure 11 on page 27.

FIGURE 10. INFORMATION TECHNOLOGY PROJECT LIFE CYCLE MODEL



Source: Developing Performance Measures For Montgomery County, Maryland Information Technology Projects, NAPA, August 1995

A. ISSUES ADDRESSED BY PROJECT MANAGEMENT SYSTEMS

1. Roles, Responsibilities, and Documentation

Since technology projects bring together senior management, technical staff, budget staff, users, and decision-makers, effective project management systems must address how management, users, and technology professionals will share project responsibilities as a system is developed and implemented. The implementation of networks, particularly those that cross departmental or organizational boundaries, complicates participation and responsibility issues. Often a steering committee is developed to bring participants together to plan and/or implement a project. The committee can be made up of future system users, technology and/or information system specialists, private sector representatives, managers, and executives.

FIGURE 11. DESCRIPTION OF THE PHASES IN A LIFE CYCLE MODEL

1. The **need or justification phase** defines and validates the need for a system based on an existing problem or a future opportunity. This phase identifies users and their requirements, sets forth assumptions or constraints on solutions and recommends the exploration of alternatives. Key products in this stage are the statement of need and/or the program of user requirements.

2. The **concepts or alternatives phase** develops alternative solutions, evaluates the costs and benefits of the alternatives, assesses project risks and recommends alternatives for further analysis. This phase determines whether an acceptable and cost-effective approach can be found to address the need and whether technology can support it. Business re-engineering may be addressed in this phase.

   Products in this phase include a project management plan, a risk management plan and a concept systems decision paper. The Concept Decision paper identifies the business need, the user requirements, and the performance measures that will be used to evaluate the system; describes the evaluation of alternatives; and states the costs and benefits of the recommended alternative. The approval of a Concept System Decision Paper marks the end of this phase.

3. The **design or detailed analysis phase** further refines functional and data requirements, addresses more detailed system requirements and plans the transition to the new system. At the end of this phase, the system is described by a completed logical design. Products of this phase include completed descriptions of new business and information systems. If business process re-engineering is a component of the project, it is generally completed in this phase.

   The Economic Analysis and the Project Management Plan are refined and updated based on information learned in this phase. A decision paper is prepared and reviewed at the end of this phase for compatibility with overall IT plans, programs, standards and guidelines and to ensure that appropriate practices are being followed.

4. The **development phase** includes hardware/software acquisition, programming, system testing and documentation. This phase is concerned with how to implement processes in the business area. It is completed when the system has been adequately tested in a development environment and approval is given to begin acceptance testing and installation of the system.

5. The **deployment/implementation phase** includes conversion, acceptance testing, training, installation, completion of system documentation and transfer of management responsibility to the operations and maintenance managers.

6. The **operations/maintenance phase** includes the ongoing operation and support of the system, usage statistics, maintenance requirements and enhancement requests.

Source: OLO, 1995 and PTO Strategic Information Technology Plan, July 1994

The participation level of technical staff, budget staff, users, management and policy or elected officials shifts as a project moves from one phase to the next. Elected officials and policy makers generally have the greatest involvement in the early phase of a project where decisions are made that have a greater influence on overall project size, cost and budget. Project size and complexity and the level of experience with the technology also determine when and how management and users participate in a project. Appendix C shows how user participation may vary through the life of a project.

2. Costs, Benefits, Schedules

Early project management systems emphasized bringing projects in on time and within budget. They focused heavily on cost-benefit analyses and return on investment evaluations. Declining prices in computer power, automated approaches to systems development, and the ability of technology to redefine organizations and their missions make these approaches less useful today. Although a traditional approach may be less applicable in situations where technology provides a competitive advantage through a redefined business scope or another hard to quantify benefit, developing defensible cost estimates and measurable benefits are still important elements of a project management system.

3. Risk

In addition to estimating project costs, resource requirements and delivery dates, an essential component of project management is risk assessment. According to Cash et al, many of the problems that information technology projects continue to experience are due to three serious deficiencies:

- Failure to assess the individual project implementation risk at the time a project is funded;
- Failure to consider the aggregate implementation risk of the portfolio of projects; and,
- Lack of recognition that different projects require different managerial approaches.

The continually changing nature of technology makes risk more important than it would be in other more predictable environments. Three project dimensions that influence risk are project size, project structure, and an organization's experience with the technology. One way to deal with project risk is to continually assess a project's progress, making adjustments as necessary. This technique, referred to as the ongoing assessment approach, is effective at reducing uncertainties by anticipating problems, continually assessing uncertainties and identifying alternative paths. Appendix D includes a questionnaire developed by a company for assessing project implementation risk. Ideally, the questions are answered by both the project leader and the key user(s) of a project prior to senior management's approval of the proposal, as well as several times during project implementation.

B. Examples of Information Technology Project Management Systems

OLO compiled and reviewed many examples of information technology project management systems including manuals from the Department of Defense and the Patent Office, evaluations of Mobile Data Terminal projects from Washington State and the City of Vancouver, and descriptions of project management approaches from the General Accounting Office and the Canadian Government. The key features of four examples, including two from the Army, are outlined below. The Patent Office example and one example from the Army present a traditional project management model, the "project lifecycle" approach. The Canadian Government example and the other example from the Army describe a newer project management model, the "Functional

Economic Analysis." This approach ties the evaluation of a technology project more directly to agency mission and to the business activities that the technology is intended to improve.

1. The Patent and Trademark Office Life Cycle Management Process

The Patent Office defines Life Cycle Management (LCM) as:

> The process of managing and controlling an Automated Information Services (AIS) project over its entire life, with emphasis on strengthening decision processes that influence AIS costs and utilities. These decisions must be based on full consideration of functional requirements and economic and technical feasibility in order to produce an efficient AIS.

The Patent Office uses the six generic phases of the LCM process. The manual states that in each phase, a well defined set of information system work products is created or modified. Patent Office policies explicitly state that the Initiation and Concept phases may not be combined and must be completed in their entirety. Less than a full process requires a waiver from the Chief Information Officer.

The Patent Office LCM process provides for two operational assessments after a system has been implemented. The near term assessment which must take place no later than one year after the project is operational evaluates whether business needs were met using the performance measures identified in the Requirements Document. It also verifies the capacity and performance estimates of hardware and software and the operational support required. The assessment also determines the effectiveness of training, operations, maintenance, facilities, operational continuity, and documentation and evaluates the effectiveness of Life Cycle Management processes.

The Long Term assessment, which must occur no later than 5 years after the system is operational, evaluates the need for new technology in addition to all the items included in the Near Term Assessment.

Roles and Responsibilities in the Patent Office LCM Process

Under Organization Responsibilities for Automatic Information Development Project Management and Technical Oversight, the manual identifies 12 organization entities or positions and their roles. These are summarized in Figure 12. Many written reports and papers are produced throughout the LCM process. The five key documents are summarized in Figure 13.

FIGURE 12. ROLES AND RESPONSIBILITIES IN THE LIFECYCLE MANAGEMENT PROCESS FOR THE PATENT OFFICE

1. **Business Council:** Makes recommendations to the Commissioner on key cross cutting issues. Reviews and approves projects at each LCM milestone. Approves PTO Strategic Information Technology Plan.

2. **Chief Information Officer:** Principal adviser to the Assistant Secretary and Commissioner on the application of IT. Develops strategic IT plans and operating budgets. Develops, operates, and maintains information systems.

3. **Program Sponsor:** Responsible for overall project management. Defines customer requirements. Makes resources available to support the project. Reviews the progress of projects.

4. **Milestone Decision Authority:** Reviews the continuing need for AIS projects and the risks to the project at each milestone. Authorizes the commitment of resources and management support to the next LCM phase at each milestone.

5. **Steering Committee:** Performs the duties of or assists the program sponsor when a project will cross organizational boundaries.

6. **Project Manager:** Oversees the effort to achieve agency business objectives. Provides daily direction, coordination, and control for the project. Directs the day to day activity of the members of the project team.

7. **System Development Manager:** Designs, develops and deploys the automated information system for a project. Ensures that the AIS is consistent with the agency's strategic information technology plans.

8. **Business Process Reengineering Manager:** Facilitates the analysis of PTO business practices. Researches, analyzes and recommends new processes. Develops plans to transition to reengineered business processes.

9. **Dept. Of Commerce Major System Oversight Council:** Reviews and approves major AIS projects.

10. **Technical Review Board:** Evaluates the interfaces and products of AIS projects.

11. **Production Manager:** Oversees the use of a project to achieve agency business objectives. Coordinates the operation, maintenance, and modifications of an AIS.

12. **System Maintenance Manager:** Develops and deploys enhancements to an AIS. Corrects defects in an AIS.

Source: PTO Strategic Information Technology Plan, July 1994

FIGURE 13. DOCUMENTATION FOR THE PTO PROCESS

The Statement of Need The Statement of Need is prepared by the Program Sponsor and identifies the part of the current business situation that must change, why this change is necessary, and what is expected to be gained by the change in order to justify the exploration of alternative solutions. The paper must describe the scope of the project in terms of its impact on business performance. It must address the proposed project's consistency with both the Long Range Strategic Plan and the Strategic Information Technology Plan of the Patent Office. The statement of need must include a discussion of constraints such as operating cost limits, timing of the need, operational or organizational considerations and potential interfaces to existing automated information systems. Finally, the paper must estimate the range of project costs.

Project Management Charter After the Statement of Need is approved, the Program Sponsor or Business Council appoints a Project Manager with a formal Project Management Charter. The charter delineates the authority and functions of the Project Manager. It is tailored to the scope of the project and serves as a written understanding of the project scope and expectations between the project Manager and the Program Sponsor or Business Council. Preparation of a Project Manager Charter by contractors is prohibited.

Project Management Plan The initial Project Management Plan shall be prepared as the first step in the Concept phase and will be refined throughout the project life cycle. The Plan serves as a tool to direct the definition, design, development and deployment of the project through the life cycle in an efficient manner. It shall be reviewed by the CIO and presented to the Program Sponsor or Business Council for approval.

The Requirements Statement In this statement, the essential properties of the system and the development project must be clearly stated to ensure that the Program Sponsor, Business Council, CIO and Comptroller reach consensus on what the system must do, when it must be available and the estimated cost. Documentation in the requirements statement must address:

a. The mission for the system as related to that of the PTO defining the near and long term mission, goals, objectives and critical success factors.
b. Performance measures that provide indicators of business outcomes from the customer's perspective and that can be used to track progress toward achieving goals and objectives.
c. Basic functional needs, as perceived by the user, captured as requirements by functional analysts. These requirements are used as the basis for determining feasible alternatives.
d. Constraints and assumptions concerning the business environment in which the system will operate, the technology that may be used and the execution of the project, including the budget, schedule, project facilities, acquisition considerations, completion criteria and system development process.

The System Decision Paper After the evaluation of alternatives is complete, the Project Manager prepares a System Decision Paper. The paper must summarize the need for the AIS, the user requirements, and the performance measures that will be used to evaluate the project. The paper must report all alternatives considered. The evaluation of each alternative should center around its operational and technical aspects. The statement of costs must include all costs from concept through completion of deployment. The paper must also identify the full range of benefits that the project will provide. The CIO must review the Concept System Decision paper to ensure compatibility with PTO plans, programs, standards and guidelines, to prevent duplication of effort and to ensure that appropriate LCM procedures are being followed. Approval of the Concept System Decision Paper by the Program Sponsor or Business Council authorizes the project to proceed to the detailed analysis phase.

Source: PTO Life Cycle Management of Automated Information Systems Manual, 1995

Risk Management

The Patent Office LCM process defines risk as a lack of resources, information or control and states that the Project Manager must assess all identified risks relative to a project. Risks that affect the project but are not under the control of the project must be assigned to a Project Sponsor or the Business Council. Risk must be considered in each milestone decision and the overall project risk profile must decrease as the project lifecycle advances.

Since risk in information technology projects is also due to the multi-agency or changing nature of the project itself, the Patent Office has established a Managed Evolutionary Development Approach. This approach basically divides a big project into smaller projects. By providing for the iterative definition, development and deployment of subsystems and modular system architecture, this approach combines evolutionary development strategy with incremental delivery.

Generally, this approach is used when existing business processes will be altered considerably by an AIS or a full set of functional requirements cannot be reliably defined early in the development cycle. It must be used when:

- The future system will affect many organizations or functional areas within PTO;
- Existing business processes will be dramatically redefined and close coordination between IT development and the business culture change is required;
- The required technology is advancing rapidly; or,
- The solution requires a multi-year project.

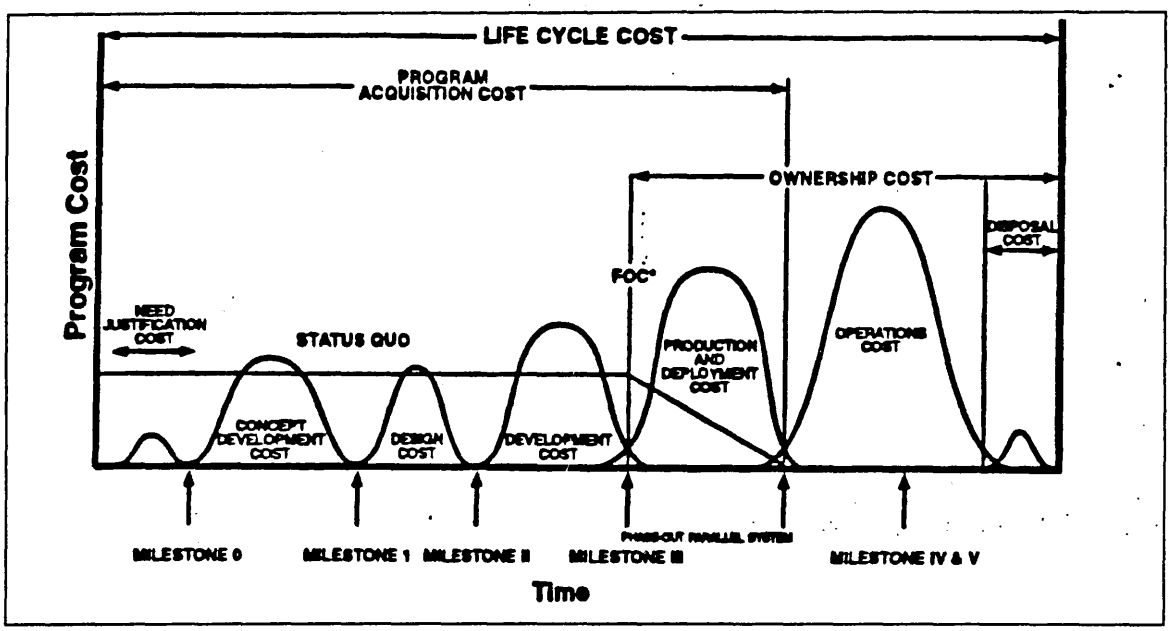
2. The Army's Economic Analysis Model

The Army is currently using two project management systems to manage the development and deployment of its technology projects. The Economic Analysis model is based on the Life Cycle Management approach. The Functional Economic Analysis described in Section 4, beginning on page 38, follows the business case approach.

Cost Estimates

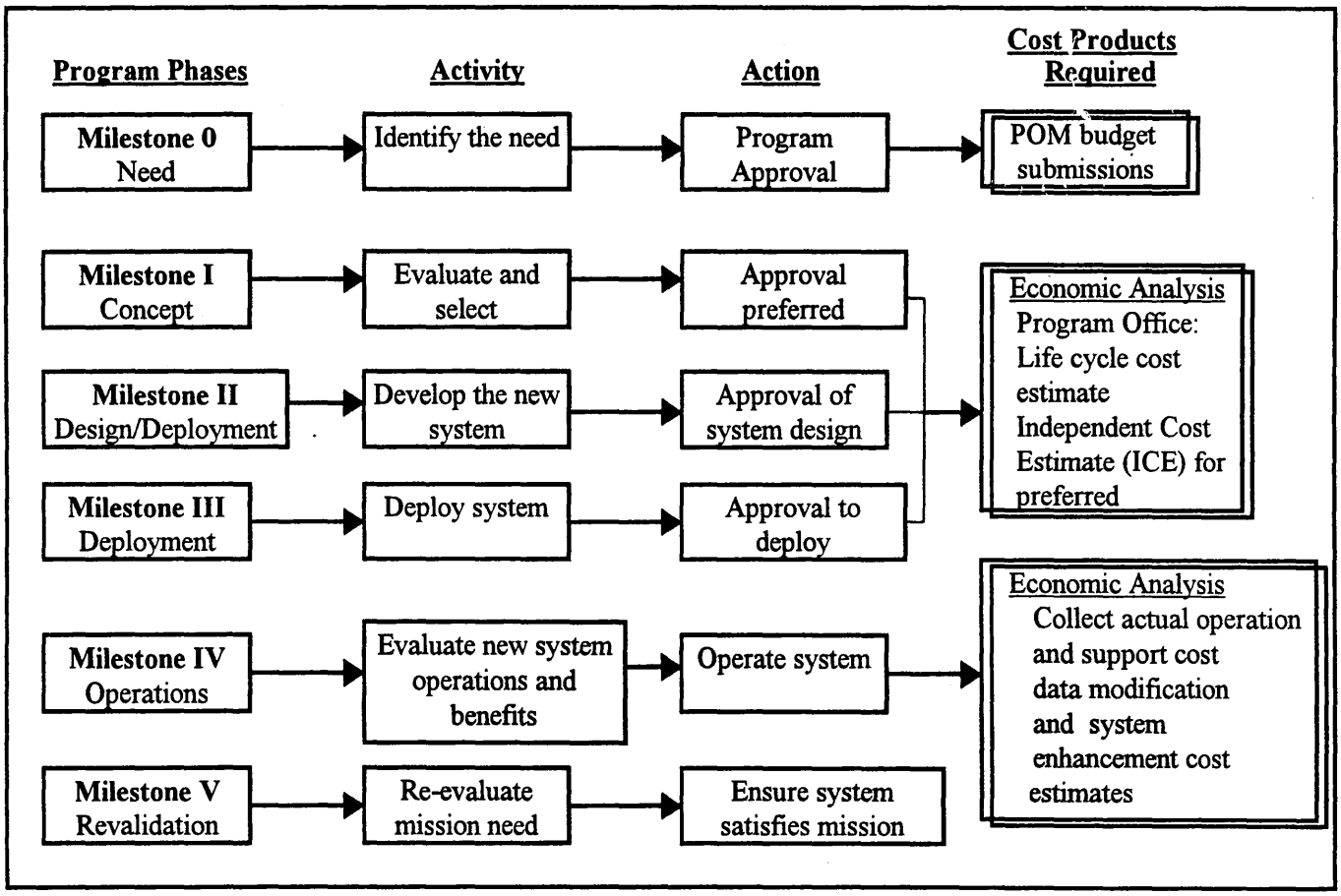
As its name implies, this project management model focuses heavily on the development and analysis of cost information. Figure 14 from the Army's Economic Analysis Manual illustrates how the life cycle cost elements are distributed over the project decision points. This graph underscores the importance of considering lifecycle costs and not just acquisition costs in deciding to move forward with a project. As a rule of thumb, Miriam Browning, Director of NAPA's Center for Information Management, notes that the Defense Department typically assumes acquisition costs represent only 30 percent of the lifecycle project costs. The three major cost elements in this model include Investment, System Operations and Support, and Costs to Phase Out the System being replaced. Costs for system operations and support are calculated for ten years after the system is operational.

FIGURE 14. AUTOMATED INFORMATION SYSTEM LIFE CYCLE



Source: Economic Analysis Manual, Dept. of the Army, U.S. Army Cost and Economic Analysis Center, July, 1995

FIGURE 15. MILESTONE REVIEW COST PRODUCTS



Source: Economic Analysis Manual, Dept. of the Army, U.S. Army Cost and Economic Analysis Center, July, 1995

An interesting practice in the Army model is the use of an Independent Cost Estimate (ICE) to verify the cost estimate prepared by the Program Manager. The ICE is a complete and fully documented life cycle cost estimate for a system, developed independently of the acquisition component. This estimate is used to test the soundness of the program manager's estimate and provide a second opinion of the system's cost.

Figure 15 on page 33 summarizes the phases, activities, actions and cost products required in the Economic Analysis model. Most of the steps and information required are similar to the Patent Office model.

3. The Information Technology Business Case Strategy - the Canadian National Government

The Working Group on Justifying Investments in Information Technology has prepared a guide for managers in the Canadian government. The Guide offers a blueprint for examining and evaluating information technology investment decisions from a business case perspective. Many of the ideas in this approach are equally applicable to the portfolio management approach described in the discussion of agency decision structures in Chapter III.

The Approach

The process outlined in this guide has seven steps as summarized in Figure 16 on page 35. This approach replicates many of the initial steps in the Life Cycle Management model; however, the business case model pulls together more directly the business benefits of the project, the required inputs and the expected impacts and risks.

Documentation

The summary document for the business case strategy approach is the Logical Framework Analysis. This approach assists organizations by stating:

- why an investment is being undertaken;
- what factors external to the investment constitute risks or sources of uncertainty;
- how investment activities and outcomes are related to ultimate goals and purposes; and,
- what the investment will achieve once it is complete.

The LFA provides a concise summary of the major elements of the investment and their interrelationships. It also links the project plan for the investment to the business case, ensuring that project activities are contributing to the results projected in the business case.

The LFA can be used to summarize the characteristics of alternatives considered as part of the options analysis or it can be used to document a selected option. Appendix E presents a Logical Framework Analysis completed for a project in the Canadian Human Resources Development Department.

FIGURE 16. STEPS IN THE BUSINESS CASE STRATEGY APPROACH FROM THE WORKING GROUP ON JUSTIFYING INVESTMENTS IN INFORMATION TECHNOLOGY

1. **Structure the Investment Decision:** The Working Group recommends using an options analysis framework to structure the evaluation of the comparative and level of service advantages of an information technology investment. The kinds of analysis should be determined on the basis of the level of organizational impact that the project will have. Key issues the evaluation should address include how the investment relates to departmental objectives, how it will enhance service to the public, the results that will be achieved in overall program performance, and who the stakeholders are.

2. **Identify IT Investment Options Based on Business Justification:** Address options for purchase or lease and use of common systems and consider innovative financing approaches.

3. **Identify and Plan How to Realize the Anticipated Benefits:** Areas to consider when assessing the benefits of an information technology investment include the establishment of a base case, the identification of level of service criteria, the identification of both quantitative and qualitative benefits and a plan for how the benefits will be realized. What return on investment do you project in timeliness, productivity, cost savings, cost avoidance, improved quality and improved service?

4. **Estimate the Full LifeCycle Costs of Acquisitions, Application Development and Five Years of Operation:** The costs that should be identified and considered in the business case analysis include direct up front costs, direct ongoing costs, indirect costs and client costs.

5. **Identify and Address Risks and Examine Other Issues such as Technical Risk, Project Risk, Your Procurement Plans:** Address whether the investment involves the innovative use of technology and, if so, what are the risks in proceeding.

6. **Pull Together the Assessment of the IT Investment:** A cost benefit analysis supplemented by a multi-criteria approach provides the quantification for the analysis. A Logical Framework Analysis is used to document the results of the analysis. The use of a project champion and pilot demonstrations may be necessary to market the proposal.

7. **Plan for and Manage Investment Reviews:** Investment reviews provide an opportunity to review the impact of the investment.

Source: Justifying Investments in Information Technology, May 1995

Costs

The report discusses the importance of examining all of the costs associated with a project, regardless of to whom they accrue. Four cost categories are identified:

> **Direct up front costs --** Out of pocket expenses incurred by the organization during implementation of the project. These costs cover several categories. The main ones are hardware and peripherals, software (packaged and customized), initial data collection, telecommunication equipment, user specification costs, initial user training and quality assurance.

Direct Ongoing costs -- Out of pocket expenses for recurrent services or materials that extend over the life cycle of the investment period. These costs include salaries for staff, costs for software upgrades, computer supplies, user costs, continuous training, overhead and quality assurance and monitoring costs.

Indirect or hidden costs -- In some cases, hidden costs may exceed direct costs. For distributed IT investments in local or wide area networks, hidden ongoing costs can amount to three times the direct ongoing costs. Factors that may drive hidden costs include initial productivity losses, poor corporate support (i.e., regularly underfunding maintenance and support) and unanticipated corporate overhead and human resource costs.

Client costs -- Information technology projects can impose significant costs on the clients or customers whose lives are being improved. A common example of client costs are those in which one level of government pays to be compatible with a system implemented at another level where both participate in the delivery of services. Estimates of client costs are generally limited to out of pocket expenses that are dictated by the system because it is possible that clients may be acquiring technology for other reasons than the new technology projects.

Benefits

The Working Group Report recognizes that there are many types of analyses that can be used to quantify the benefits of IT investments. The report identifies the nine evaluation approaches listed below.

- Cost Effectiveness
- Option Value
- Research and Development
- Work Value
- Level of Service Improvements
- Cost of Quality
- Business Objectives
- Cost Displacement
- Technical Importance

The report states that the two key determinants of when to use the different analysis are the complexity of the investment and the level of the impact on the organization. Explanations of these from the Report are summarized in Figure 17.

Risk Management

The Working Group report states that each investment should undergo an assessment of the critical factors that may affect the success of the investment. The common practice of discounting the expected net gains and assuming the prospective paybacks are safe is unreliable. Instead, risk assessments need to address the unique characteristics that make technology projects inherently risky.

For example, risks tend to be higher with large complex information technology investments that are developed and implemented over long time frames because large projects are more likely to be subject to delays, cost overruns and contractual liabilities. Risk also tends to be higher for projects with multiple stakeholders because it is difficult to get consensus and keep everyone happy.

The Working Group states that risk factors can be divided into those that are internal to the project and can be controlled and those that are external, or beyond the control of the project. Financial risks can be minimized through sound investment management and incremental, results

oriented funding. Clear objectives and guidelines for decision making can also reduce some of the differences and confusions that result during an investment.

FIGURE 17. TYPES OF ANALYSIS USED IN AN EVALUATION OF BENEFITS FROM THE BUSINESS STRATEGY MODEL

Cost Effectiveness This approach demonstrates the improvement in performance/service delivery in financial terms. It determines whether the benefits outweigh the costs.

Analysis of Displaced or Avoided Costs This approach compares the proposed systems' costs to those it would displace or avoid. It may justify the proposal on a least-cost basis if it can be assumed that the benefits of the new system are not less than that of the current system.

Work Value Analysis This approach predicts cost savings that arise over time from shifts in work value. It requires an analysis of work patterns through the organization and how IT would enable readjustment in the number and types of skills required. It assumes that additional work needs to be done, that management allocates resources efficiently and that workers allocate time efficiently.

Cost of Quality Analysis This approach estimates savings from a project that reduces the cost of quality assurance. It can include costs that are internal or external to the organization.

Analysis of Option Value This approach estimates the value derived when a project enables but does not obligate the organization to pursue opportunities at a future date that would not be possible without the project. It requires the use of decision trees and a probability analysis. The option value may be the cost savings on future projects, portions of benefits of future projects or reductions in risks associated with future projects.

Analysis of Technical Importance The analysis involves justifying an infrastructure investment on the basis that a large IT project could not proceed without it. It assumes that management is committed to pursuing the largest projects which presumably have been evaluated with the costs of this essential infrastructure included. A potential problem may arise if, in fact, the larger project has been accepted in the absence of full cost information.

Alignment with Business Objectives When an investment can be shown to contribute directly to the strategic objectives of the organization, a value can be placed on the contribution of that investment. If the two are not well aligned then IT can only help the organization move in the wrong direction faster.

Analysis of Level of Service Improvements This approach estimates the benefits to clients of increases in the quantity, quality or delivery of services. It must be undertaken from the client's view.

Research and Development This approach is a variant of the option value analysis where the option is to invest in a large project pending the outcome of a pilot project. It is most useful for high risk endeavors where R&D can assess the likelihood of failure and either abort the larger project or better manage its risks. Management must accept the consequence of failure, i.e. that the funds invested in the pilot are a reasonable expense in determining the viability of an IT project.

Source: Justifying Investments in Information Technology: Guide for IT Managers and RC Managers, (Final Report), (Information Technology Business Case Strategy), Prepared by the Working Group in Justifying Investments in Information Technology, May 1995. Sponsored by the Government of Canada

4. The Functional Economic Analysis - The Department of Defense/Army

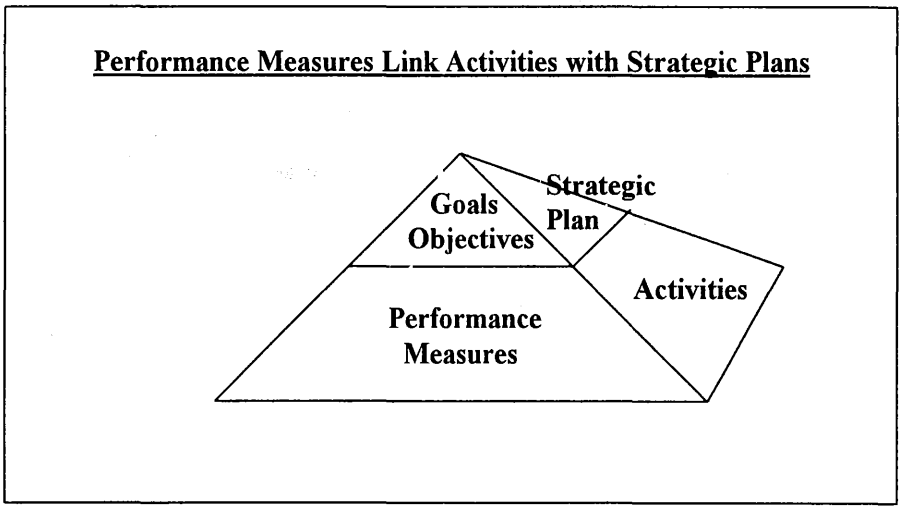
Information on the Functional Economic Analysis is taken from the Functional Economic Analysis Guidebook prepared by the Army. The Functional Economic Analysis used for Information Technology projects is a specific application of the Functional Process Improvement Program, a structured approach for identifying, evaluating, and implementing improvements to current Department processes.

Whereas the Lifecycle Management process described earlier focuses on an information system project, this approach evaluates changes to a function or program area. As such, it is the program manager who makes substantive decisions in this process, such as selecting the alternatives to be evaluated. The role of the information technology professional is to ensure that critical issues are addressed by the methodology.

The Approach

The starting point of the Functional Economic Analysis approach is provided by DOD's strategic plans. The Guidebook states that top management provides performance measures through goals and objectives contained in strategic plans. Figure 18, taken from the Guidebook, shows the relationship between strategic plans, activities and performance measures.

FIGURE 18. RELATIONSHIP BETWEEN STRATEGIC PLANS, ACTIVITIES AND PERFORMANCE MEASURES



Source: Dept. of Defense, Corporate Information Management-Functional Economic Analysis Guidebook Version 1.1, 1993

Documentation

The Guidebook states that the Functional Economic Analysis document evolves through three stages- the Preliminary, Final and Update FEA.

The Preliminary FEA, prepared by the functional manager's joint functional/technical team, is used to conduct an initial rough order of magnitude assessment of the proposed alternatives to the existing process, data and system baselines based on readily available financial information. The goal is to identify preferred alternatives, based on cost and risks, that merit more detailed functional, technical and economic analysis. This document may also suggest that no alternative merits further consideration.

The Final FEA contains a more precise analysis based on a refinement of the cost and schedule data included in the Preliminary FEA. It takes into account information from data management and technical management planning. The degree of precision in a Final FEA is determined by the magnitude of the decision it supports and the requirement for confidence in the results of the evaluation. The functional manager secures all necessary advance coordination and forwards the Approval Decision Package to the Functional Steering Committee for review.

The package then is submitted to the OSD Principal Staff Assistant for final approval to proceed with implementation of the recommended process improvement alternative. Any automated information system changes that are part of the approved alternative must still be approved in an LCM milestone review. The FEA is an essential part of the System Decision Paper that is provided for approval of the Automated Information System changes.

The **Update FEA** is used by the functional manager to monitor the progress during the execution of the project. It serves as a periodic progress report on the approved alternative through which actual costs and performance improvements are compared with projected costs and performance. It is the management control mechanism that indicates whether the anticipated cost savings and performance objectives are being met. (It is comparable to the Requirements Statement in the LCM model.)

The Update FEA provides current decision monitoring and oversight information for managers conducting program evaluation at key decision points to determine if any redirection is appropriate. If costs are escalating, milestones are being delayed or performance improvements are not being realized, a review should be held to re-evaluate the original program.

Cost Analysis

The foundation of the Functional Economic Analysis is the cost analysis procedure. This process is used to estimate the current cost of doing business (the baseline) and to estimate the future cost of business if business process reengineering and/or information technology projects were implemented.

The Guidebook states that several methods can be used to estimate the cost changes associated with an initiative and that the appropriate choice depends on the initiative. The approaches include best practices, analogy, expert opinion, prototypes and parametric cost estimating. Figure 19 portrays an activity cost worksheet completed for the baseline cost estimate. The baseline is the cost of accomplishing the known and projected workload, using the existing functional process with no changes. Similar worksheets are completed for each alternative.

FIGURE 19. ACTIVITY COST WORKSHEET FROM THE ARMY'S FUNCTIONAL ECONOMIC ANALYSIS MODEL

Cost Baseline ($ millions)						
Cost Element	**FY94**	**FY95**	**FY96**	**FY97**	**FY98**	**FY99**
Recurring Costs *						
Personnel	$366.9	$360.2	$353.5	$346.9	$340.2	$333.5
Info. Tech.	$7.0	$6.5	$9.9	$13.4	$16.8	$20.3
Facilities	$67.2	$66.1	$65.0	$64.0	$62.9	$61.8
Material	$2,332.3	$2,295.0	$2,257.7	$2,220.3	$2,183.0	$2,145.7
Other	$154.2	$145.8	$137.4	$140.4	$142.0	$142.0
Total	$2,927.6	$2,873.6	$2,823.5	$2,785.0	$2,744.9	$2,703.3
Investment Costs **						
Personnel						
Info. Tech.	$15.1	$18.0	$21.0	$12.5	$5.5	
Total	$15.1	$18.0	$21.0	$12.5	$5.5	
Total Cost	**$2,942.7**	**$2,891.6**	**$2,844.5**	**$2,797.5**	**$2,750.4**	**$2,703.3**

Source: Dept. of Defense, Corporate Information Management-Functional Economic Analysis Guidebook Version 1.1, 1993

* Recurring costs are day to day costs associated with conducting operations.

** The investment costs represent planned expenditures of procurement dollars to acquire programmed replacements for existing automated systems.

Comparison of Alternatives

The information provided in the activity cost worksheets is summarized in three ways to compare alternatives to each other. The first calculation is the ratio of Operations to Maintenance and Support Costs, or the "tooth-to-tail" ratio for each alternative. This ratio is used because a goal of the Defense Management Review is to reduce the costs of DOD functions while maintaining the operational capability of the Department. Alternatives that reduce the Management and Support costs by proportionately more than the Operations cost in most cases support this goal. This calculation is based on a series of judgments about the percentage of each activity that is devoted to operations.

The second factor incorporated into the comparison addresses risk. The functional working group that developed the alternatives is responsible for developing estimates of the risks associated with each alternative. The Functional Economic Analysis computer model will generate a range of cost estimates based on this information. Finally, the Functional Economic Analysis evaluates the streams of costs that unfold over time using discounting and a discount rate. Following the evaluation of the cost information, the FEA Model calculates the risk-adjusted discounted cash flow (RADCF) savings. These results can be used to answer the following four questions about each alternative:

What are the savings in function costs? The expected RADCF savings results can be used to rank alternatives by their savings.

What is the risk associated with the savings estimates? The high and low RADCF values can be used to evaluate the relative risk of the alternatives under consideration.

Is there an increase in managerial efficiency? An alternative that increases the tooth-to-tail ratio is probably doing more with less management overhead.

Is an alternative affordable? Comparing the total costs for an alternative with the costs in the current FYDP can determine whether the alternative will fit within current funding operations.

V. COUNTY AND BI-COUNTY AGENCY TECHNOLOGY PROJECTS AND PRACTICES

Over the next few years, the Council will be faced with multiple budget and policy decisions on initiatives related to the application of telecommunications and technology in Montgomery County. In addition to having a significant fiscal impact, these initiatives raise threshold issues related to the future use of voice, video, and data both within and across the County and bi-County agencies.

This chapter looks at the projects the County and bi-County agencies expect to implement and the systems the agencies use to make technology decisions. The first section of this chapter summarizes information about the technology projects in the County and bi-County agencies, compiled for a memorandum report distributed by OLO in May 1995. The second section reports on Council actions to establish a Technology Innovation Fund and to re-establish an Interagency Technology Policy Coordinating Committee. The third section describes how the County and bi-County agencies are currently organized to manage information technology resources.

A. TECHNOLOGY PROJECTS IN THE COUNTY AND BI-COUNTY AGENCIES

1. Methodology

OLO met with staff in each agency to discuss how best to identify technology projects needed in the next two to three years. OLO found, that with a few exceptions, most agency staff do not have an "off the shelf" source of all technology and telecommunications plans readily available. Agency staff note that the constantly changing nature of technology makes it difficult to identify and plan for projects beyond a year or two.

Since there was no existing list of projects, OLO developed a future technology projects database using multiple sources. These sources included recommended agency operating budgets, the capital improvements program, project applications submitted for funding through the Technology Innovation Fund (TIF), reports identified in the minutes of Council meetings and Committee worksessions, and surveys completed by information technology staff in the agencies.

Highlights about information technology projects in the five County and bi-County agencies are summarized below. More information about the project list can be found in the discussion of individual agencies later in the chapter, beginning on page 49 and in the May 1995 memorandum report available from OLO. In reviewing the highlights, the reader needs to keep in mind that the project list is not complete and all cost estimates provided are less precise than cost estimates decision makers will see when a project is submitted for approval.

2. Overview of the County's Technology Projects

The five agencies have a total of 87 technology projects with an estimated cost of about $190 million. Forty four of the projects would each require a minimum investment of $250,000. The most expensive projects are the Global Access project ($71.3 million), the Public Safety Radio System project ($27.2 million), and the Fibernet project ($19.4 million).

Several projects reflect an industry trend away from mainframe based systems towards networks of personal computers. Most networks are being implemented within existing departmental or agency boundaries. However, interdepartmental and interagency projects are proposed for public safety, criminal justice and health and human services. Projects to consolidate

functions across agencies are generally not under consideration, although some Councilmembers have expressed an interest in this use.

Table 2 shows estimates of equipment currently in use in each agency and Table 3 shows the County's anticipated investment in information technology by program area. Based on the currently available cost information, the key program areas include Education, Public Safety and Technology Infrastructure.

TABLE 2. SUMMARY OF TECHNOLOGY EQUIPMENT BY AGENCY

Type of Equipment	County Gov't	MCPS**	College	M-NCPPC	WSSC	Total
Mainframes	1	1	2	0	1	5
Mini-computers	40	0	7	6	17	70
Local Area and Wide Area Networks (LANs and WANs)	73	54	26	10	10*	173
Personal Computers (PCs)	2,350	22,800**	3,215	360	934	29,659
Cable Plant	1	0	0	3	0	4
Mainframe Terminals	150	**	410	10	563	1,133
Telephones	7,300	4,800**	1,405	758	2,380	16,643
Voice Mailboxes	4,000	**	0	758	796	5,554
Radios	3,500	200**	0	432	661	4,793
Pagers	1,100	400**	96	112	406	2,114
E-Mail Users	2,400	5,000**	550	360	0	8,410

Sources: OLO and agency staff, November 1995, updated April 1996.

* LANS only

** MCPS notes: The Personal Computer (PC) estimate includes 2000 administrative PCs and 20,000 computers installed for instructional purposes. Many of these are computers from Giant or Safeway and many are very outdated (Apple IIe, and 286 or less PCs). Mainframe terminals are included in the PC estimate. The telephone estimate is the number of lines. A voice mailbox system is being implemented. The radio estimate includes administrative and other users. The E-mail estimate is the number of licenses, not the number of users.

TABLE 3. ANTICIPATED TECHNOLOGY INVESTMENT BY PROGRAM AREA IN MONTGOMERY COUNTY AND BI-COUNTY AGENCIES (IN MILLIONS OF DOLLARS)

Program Areas	Estimated Program Costs
Education	$97.2
General government	$10.0
Health and human services	$1.7
Public safety	$34.3
Technology infrastructure (fibernet, GIS)	$32.9
Transportation	$5.3
Water and sewer services	$2.6
Other	$5.8
Total	$190.0

Source: OLO, April 1996

B. COUNTY LEGISLATION RELATED TO TECHNOLOGY

Recognizing the importance of information technology in Montgomery County, the Council has taken steps to encourage planning and long term funding for information technology projects. In 1994, the Council:

- established the Technology Innovation Fund to pay for certain technology projects, and,
- re-established the Interagency Technology Policy and Coordination Committee so that coordination among the agencies on technology issues could keep pace with the increasing demand for technology projects.

1. The Technology Innovation Fund Program

On June 30, 1994, the Council adopted Resolution 12-1713 to authorize the creation of a Technology Innovation Fund (TIF) program. As set forth in the resolution, the purpose of the program is to fund technological investments that will increase the productivity of tax-supported County agencies. These include the County government, Montgomery County Public Schools, Montgomery College, Maryland-National Capital Park and Planning Commission, and the Housing Opportunities Commission.

The TIF program is comprised of two funds: a Technology Innovation Grant Fund and a Technology Innovation Loan Fund. Some projects may be eligible for a combination of loan and grant funds.

The **Grant Fund** is intended to fund pilot, demonstration, or start-up efforts and assists small departments/units that could not otherwise afford new technology. These projects should provide a foundation for future revenue enhancement, cost savings, or cost avoidance. The resolution states that the County should attempt to direct at least 20% of the Grant Fund monies to technology projects for small departments.

Pilot projects should be funded for a limited period not to exceed two years and evaluations of pilot projects should be conducted before additional County funds are budgeted for them. Once productivity improvements have been demonstrated through a pilot TIF grant, every effort should be made to use funding from sources other than TIF to implement the project.

The **Loan Fund** is to fund projects that are expected to earn revenue enhancement and/or savings sufficient to enable the department to pay back the loan. The department/agency must be able to pay back the loan even if the expected revenue or cost savings from the project is not realized.

Project Criteria

Resolution 12-1713 establishes several general eligibility criteria for TIF projects, as well as criteria for the grant and loan funds. In general:

- Priority will be given to projects that contribute significantly to productivity improvements in the form of revenue enhancement, cost reduction or cost avoidance. Productivity improvements in the form of service enhancements may also be considered although this is clearly of secondary importance to projects that will have a positive fiscal impact on the County.

- All else being equal, priority will be given to projects that include multiple agency or multiple department participation.

- TIF funds will rarely be used to fund replacement equipment, staffing, or maintenance costs. No ongoing operating expenses or maintenance will be eligible. All costs should be one-time, rather than on-going expenditures which should be funded through the operating budget.

All projects must have a plan for implementation and complete description of potential productivity improvements. Additional criteria used to evaluate the projects are discussed below.

Roles and Responsibilities

Resolution 12-1713 authorized the establishment of an interagency Loan/Grant Committee to review all applications for TIF funding and make recommendations to the Executive on the amount and period of a TIF loan. The Committee includes a business representative and representatives from the County Government, the Housing Opportunities Commission, Montgomery College, MCPS, M-NCPPC and WSSC. The Council confirmed the Executive's appointments to the Committee on June 30, 1994. The roles and responsibilities of participants in the TIF program are summarized in Figure 20.

FIGURE 20. ROLES AND RESPONSIBILITIES IN THE TIF PROGRAM

Participant	Responsibilities
County Council	• Exercises general legislative oversight through review and approval of capital program and operating budgets and periodic briefings. • Approves supplemental appropriations for projects over $250,000. • Confirms Loan/Grant Committee members. • Appropriates project funding through the budget process.
County Executive	• Makes final allocation decisions for loan and/or grant projects less than $250,000. • Appoints Loan/Grant Committee members. • Approves policies and standards used by the Loan/Grant Committee.
Loan/Grant Committee	• Assesses loan/grant applications. • Recommends terms of loans and grants.
Office of Management and Budget	• Conducts initial application review. • Staffs Loan/Grant Committee. • Provides independent recommendations to CE for consistency of application with County objectives and policies. • Administers Loan and Grant Funds as well as individual project loans and grants. • Administers loans and grants.
Department of Information Systems and Technology	• Assists Loan/Grant Committee and OMB with technical assessments.
Agencies and Departments	• Prepare applications. • Negotiate terms. • Administer approved projects. • Repay loans, if any, according to the terms of the agreement.

Source: OLO, 1996

The Office of Management and Budget has established a process that agencies or departments must follow to obtain TIF funds. The steps are outlined below:

Department Requirements Analysis and Preliminary Feasibility Assessment- The TIF application process begins with a needs assessment and preliminary feasibility assessment by the department or agency seeking funds. The purpose of the assessment is for agency staff to describe why the technology project makes sense, why it is needed and how it could be implemented. This assessment, which is not submitted as part of the application package, is for internal information purposes and generally is not reviewed by OMB.

Application Packet- A department or agency which decides to pursue TIF funds must submit an application to OMB. The application packet includes a detailed description of the project and the planning process that the department will follow to implement it.

Application Analysis- An OMB analyst reviews the submitted application to determine whether it complies with the requirements of the TIF Policy Resolution. This review is followed by informal work with the OMB analyst, the submitting department, and DIST personnel to refine the application packet. Many iterations of the application are often produced before it is in final form.

OMB and DIST evaluate the application to determine whether the project satisfies the eligibility criteria of Council Resolution 12-1713, as well as the readiness and competitiveness criteria shown in Figure 21.

FIGURE 21. CRITERIA USED TO EVALUATE PROPOSED TIF PROJECTS

Readiness criteria	Competitiveness criteria
1. Satisfies eligibility criteria in Council Resolution 2. Clearly identifies and quantifies fiscal benefits 3. Clearly identifies and quantifies productivity improvements 4. Clearly describes service enhancements and benefits 5. Application is complete and includes: • Project Implementation Plan • Interdepartmental Coordination • Technical completeness and sufficiency • Cost estimate and expenditure schedule • Policy compliance and legal consistency	1. Consideration of competing /alternative uses of TIF funds for other TIF projects 2. Yields highest return on investment to obtain following benefits: cost saving, cost avoidance, revenue enhancement and service improvements 3. Leveraged by State, Federal or other matching funds and has acceptable operating budget impact (6 year projection required) 4. Project complements overall Information Technology goals of County government

Source: OMB and OLO

OMB returns applications that do not satisfy the above criteria with comments on how to improve the application. The department may edit the application, rethink the project and submit a new application, or drop the project. All of the projects approved by OMB are presented to the Loan/Grant Committee for review.

Loan/Grant Committee Review- The Committee uses the TIF application to determine if the potential payoff of the project is worth the risk. The Committee will review the application and classify each project as approved, approved with modifications, returned for refinement and

resubmission, or denied. The Committee makes recommendations to the Executive regarding the amount of the loan and the period of the loan.

Approval- The Executive has the authority to approve projects that cost less than $250,000 through an Executive Order prepared by OMB and signed by the County Executive. The Council may review these projects during the CIP budget process.

If the project has a total cost greater than $250,000 the Management and Fiscal Policy Committee must review the project and the Council must approve it. The Council appropriates TIF designated reserves through a supplemental appropriation request. Departments must repay TIF loans whether or not the expected cost savings are achieved.

2. The Interagency Technology Policy and Coordination Committee

On July 26, 1994, the Council adopted Resolution 12-1758 to reconstitute the Interagency Technology Policy and Coordination Committee (ITPCC). The Committee had originally been established in 1984 as the Interagency Technology Coordination Committee (ITCC) with two subcommittees, one for policy and one for technical issues. The efforts of the ITCC had fostered the coordination of county computer systems, information processing and the purchase of computer hardware and software. The ITCC had also provided valuable budget recommendations to the County Council. Over time, the technical committee continued to meet regularly; however, the policy committee did not.

With the reconstitution of the new ITPCC, the Council indicated its desire that Committee activities continue to expand to keep pace with the need for planning and coordination. The new ITPCC is composed of the Montgomery County Chief Administrative Officer, the Superintendent of MCPS, the President of Montgomery College, the Chairman of the Montgomery County Planning Board, the General Manager of WSSC, and the Staff Director of the Montgomery County Council, as an ex-officio member. The Executive Director of the Housing Opportunities Commission has also been attending meetings.

The new Committee's responsibilities and general duties are:

- To promote and enhance the coordination of technological innovation;
- To create a communication vehicle by which the various agencies of government can assist the Council and each other to develop sound and efficient policies to evaluate alternative uses of technology;
- To facilitate the coordinated implementation of such countywide policies through the mutual development of plans, proposals and recommendations for individual agency expenditures; and,
- To provide a discussion forum for the sharing and evaluation of information pertaining to new technologies.

The adopted resolution, including the specific duties and responsibilities for 1995, is in Appendix F. In its first year, the ITPCC provided comments on individual technology projects to assist the Council with its review of the budget. Committee members specifically chose not to rank all of the projects collectively. The Committee also prepared a report for the Council on the issue of telecommunication towers and monopoles.

C. TECHNOLOGY PRACTICES IN THE COUNTY AND BI-COUNTY AGENCIES

Technology and telecommunication services are organized and managed differently in each of the five County and bi-County agencies. OLO interviewed staff in each of the agencies to develop a better understanding of the management practices in place. For each agency, this section describes organizational structures, recent strategic plans or assessments, the list of ongoing and future projects, how technology projects are selected and managed and how maintenance and replacement costs are treated.

1. County Government

The County government has experienced significant decentralization in the management of technology since FY 1988. The Department of Information Systems and Telecommunications (DIST) and other major departments, which have developed automated systems to deliver services over the years, share technology management responsibilities. There are approximately 150 technology staff positions in the County government: 95 of these are in DIST and 56 are distributed throughout the other major departments. The other major departments and offices include Transportation, Health and Human Services, Finance, Police, Management and Budget and Procurement. The DIST total includes staffing for the telecommunications function (radio and telephone) as well as administrative, data entry, computer operations, and other support personnel; the departmental total includes only those technical staff positions whose primary focus is information systems (Automated Systems Managers (ASM), Information Systems Support Specialists (ISSS), Computer Analyst Programmers (CAP) and Office Automation Administrators (OAA)).

Organizational Structure

The County Government's Department of Information Systems and Telecommunications (DIST) has a budget of $9.5 million. This is the second largest budget of the five agencies' information technology offices, however, this amount does not include the cost of the staff in other departments who have technology responsibilities.

DIST is organized into three divisions: a computer center, an information systems division and a telecommunications division. The management of the County's telecommunications services is centralized in the telecommunications division. As noted above, the management of information services is decentralized among several major departments.

The Information Systems Division in DIST is responsible for supporting the office automation/information systems needs for the departments. It is organized into the following five teams:

- Geographic Information Systems (GIS);
- Computing Information Center/User Support;
- Finance/Administration (includes Human Resources);
- Human Services/Public Safety; and,
- Revenue System.

DIST reports that its team leaders have a strong association with the departments and maintain a continuing dialogue about departmental requirements.

Assessments and Strategic Plans

DIST and the Corporate Partnership for Quality Government have completed assessments of the County's information technology systems.

DIST - The Strategic Plan for Information Systems and Telecommunications

In October 1990, DIST published a Strategic Plan for Information Systems and Telecommunications- FY 91-93. The plan presented the department's goals and objectives for information technology and telecommunications and outlined a three year work plan based on these objectives. The work plan described a number of tasks to be completed each fiscal year. The strategic plan also included a mainframe capacity plan. No cost estimates were included in the strategic plan. In November 1992, DIST published a strategic plan in briefing format, which assessed the state of Information Technology in the County government and established broad objectives. Summary updates of this plan were published in August and December 1993.

The Corporate Partnership on Quality Government Report

The September 1995 report from the Corporate Partnership on Quality Government included an assessment of technology in the Police Department by the Corporate Partner, Nation's Bank. Four key areas were assessed: Information, Technology, Processes and Support Infrastructure. The study group recommended that Police develop and implement a countywide technical architecture. This recommendation was based in part on the following finding:

> The study group did not find an adequately defined technical support infrastructure within the Department of Police or the County. Information Systems responsibilities and accountabilities are unclear, inconsistent and conflicting. There is no approval body or mechanism for central project oversight, approval, prioritization and resource allocation. A standard project methodology does not exist and the selection criteria for non-sworn personnel is undocumented. This type of environment often results in duplication of effort, funding of identical but incompatible systems, and ultimately, "the reinvention of the wheel."

The following list represents technology related planning that has taken place to address a number of the technology deficiencies noted in the Corporate Partnership report.

- A much closer relationship has been established between the Police Department and the Department of Information Systems and Telecommunications (DIST). This is due to extensive communication between DIST and police management and staff, especially in the areas of public safety communications, police records management, and police office automation projects.

- A strategic planning seminar was held in March, 1996 to define the Police Department's technology direction and needs. Attending that seminar were key personnel from DIST.

- The National Academy of Public Administration's technology implementation model is being used as the basis for such joint DIST/Police projects as the Public Safety Voice Radio and Mobile Computing Systems.

- Much of the planning associated with the above mentioned projects acknowledges the need for re-engineering of Police field data gathering and records management processes.

- To facilitate the successful implementation of the public safety communications and records management projects, a Systems Integrator RFP is being prepared for release.

- With respect to records management and office automation, the Police Technology Division is working closely with DIST to define, procure, and implement standard network products.

- Inter-agency coordination is continuing in the area of imaging technology to ensure compatibility.

- Basic compatibility technology standards decisions are being implemented in the Criminal Justice Information System project.

- The knowledge, skill and ability (KSA) requirements for Police technical staff positions have been developed, with the assistance and concurrence of DIST, the Office of Human Resources, and other information systems personnel. These KSAs have been developed to focus the selection process on identified Department needs.

- The selection process for the Director of Technology position is progressing with the development of the KSAs as described above.

- All of this planning is being accomplished within the developmental framework established by the Department over the past several years.

Projects

Table 4, on page 52, lists projects with cost estimates over $250,000 in various stages of approval in the County Government. It is a list of projects underway or under consideration in the County taken from the approved Capital Improvements program, applications made for Technology Innovation Funds and other plans and budgets. The list does not reflect projects that may be in the planning stage but not yet approved by the County Executive. In addition to the projects listed below, the background information for the office automation contract indicates that the County anticipates needing approximately 74 servers and 6,000 workstations over a five year period to meet the requirements of approximately 35 departments and offices of County Government.

The list shows that there are several interdepartmental projects and that responsibility for project management is distributed among several departments. The total estimated cost for the projects listed is $70 million, however, the cost estimates for several projects are not complete.

TABLE 4. COUNTY GOVERNMENT TECHNOLOGY PROJECTS OVER $250,000

Project Name	Lead Dept.	Multiple Depts?	Phase
1. Advanced Transportation Management Systems	DOT	No	Impl.
2. Central Office Automation Server	DIST	Yes	Operating
3. Circuit Court Automation	Circuit Court	Yes	Impl.
4. Community Services Workstation	HHS	Yes	Concepts
5. Computer Aided Dispatch	DFRS	Yes	Operating
6. Core Business Systems		Yes	Impl.
7. Criminal Justice Information System Upgrade	Police	Yes	Design
8. Fibernet	DIST	Yes	Concepts
9. Ground Control Network	DIST	Yes	Impl.
10. Interagency Facility Scheduling System	CUS	Yes	Need*
11. Mobile Data Terminals	DIST	Yes	Need
12. Performance Improvement Project	Finance	No	Need*
13. Permit System Development	DEP	Yes	Concepts
14. Public Safety Radio System	DIST	Yes	Acquisition
15. Ride On Radios	DOT	No	Operations
16. Telephone Systems Modernization	DIST	No	Operations
17. Wang Replacement-Legislative Branch	Council	Yes	Impl.
18. Wang Replacement-Health Department	HHS	No	Impl.
*Projects identified in 1994 TIF Application Process			

Source: OLO, 1995

Project Selection and Management Practices

The County uses the budget process to review, evaluate and approve major technology projects. Projects may be proposed by a department as part of their budget or they may emerge after discussions between DIST and the program department. When a department proposes a project, DIST generally works with the proposing department on technical specifications, cost estimates and other project elements. (Note: As part of the procurement process DIST signs off on all technology purchases to ensure that technology purchases meet DIST standards and fit into a Countywide information architecture.)

When DIST proposes a project, a department's willingness to consider it depends on several factors including the availability of funds, how the proposal ranks among other departmental priorities and how management in the department views technology. For example, when DIST recognized that the FAMIS system was becoming difficult to maintain and constraining other systems, it initiated discussions with Finance about replacing the FAMIS system. The former director did not see FAMIS replacement as a high priority so the Finance Department did not submit the project for budget approval until after the current Director was appointed.

On September 12, 1995, the Chief Administrative Officer distributed a memo to all County departments asking for project and working group profiles on current technology efforts. The CAO designated DIST as the Executive branch focal point for all technology projects and stated that DIST will provide guidance, evaluation and assistance across the project life cycle. Based on an analysis of the Project and Work Group Profiles, DIST will recommend to the CAO the basis for a strategic information technology planning process.

Budgeting for Maintenance and Replacement Costs

To meet the ongoing support needs of the County departments, DIST recently set up agency wide contracts for office automation, technical consulting services, and maintenance. The contracts not only help departments obtain these services more easily but also centralize the provision of these functions. Although DIST administers the maintenance contract, the costs are charged back to the department and funded through individual departmental budgets.

The County does not have an institutionalized mechanism for identifying or funding departmental computer equipment replacement costs. Replacements are budgeted by individual departments consistent with departmental requirements and priorities. The PC maintenance contract requires DIST to maintain an equipment inventory that is updated on a quarterly basis, however this inventory is limited to model numbers and brands. It does not include information on when equipment was purchased or might need to be replaced.

2. Montgomery County Public Schools

OLO's May 1995 memorandum report noted that the MCPS budget for the Department of Technology, Planning and Data Operations at $8.8 million was comparable to the County government's budget; however, this figure did not include the budget for Global Access, a major technology initiative at MCPS.

Organizational Structures

Since the OLO memorandum report was issued, the management of technology in the Montgomery County Public School system has been reorganized. Prior to the reorganization, the management of information technology and telecommunications was shared between the Department of Planning, Technology and Data Operations and the Department of Educational Media and Technology. The reorganization eliminates these two departments and consolidates all educational and administrative technology services in the new Office of Global Access Technology.

In addition to a newly centralized technology department, MCPS has a Leadership Team and a Technology Steering Committee. The Leadership Team includes the Deputy Superintendent, Associate Superintendent and key department directors. This team is developing a strategic plan in conjunction with the reorganization that is taking place. The Technology Steering Committee includes select technology staff from the Technology Department. It coordinates all technology procurements and sets standards and policies.

Assessments and Strategic Plans

In 1994, the Corporate Partnership on Managerial Excellence issued a report on information technology issues at MCPS. This report was a follow-up to the original CPME report issued in 1993. The IT Panel was asked to look at information technology as it affects all of the operational departments. While this report predates the reorganization of technology, some of the team's findings may still be relevant. Key findings included the following:

- Issues confronting MCPS in technology, which are prevalent throughout the IT community both in the public and private sectors, include (1) increased demand for information often resulting in a backlog of information systems development activities; (2) overworked staff that must deal with overly mature application systems to address current information reporting requirements; (3) keeping abreast of emerging technologies with a limited training budget; (4) increased demands for further reductions in the information systems budgets; and (5) users not satisfied with either the extended response time to their request for changes or the support provided by Management Information Systems (MIS) to their department.

- The perceived lack of support by MIS has spawned several departmental information systems initiatives using local staff and computing resources to develop solutions.

- The MCPS MIS function lacks a well-documented articulated view of how to manage current information resources and new technologies.

- The lack of a published and integrated strategic plan for the management and deployment of information technology within MCPS:

    - limits effective communication within the MCPS management team;
    - encourages redundant information technology initiatives;
    - encourages decisions based upon today's requirements;
    - promotes a higher level of data redundancy versus moving toward more efficient data integration and reuse; and,
    - prolongs the decision making process as priorities change for competing information initiatives.

CPME's complete list of conclusions and recommendations is in Appendix G.

The CPME urged continued focus in two areas:

- A strategic overhaul of the information system to incorporate a long term view in the planning and implementation process, and

- The continuing evolution of a new leadership style in which elected officials and school executives focus on long term planning, significant policy issues, accountability of managers for results, removal of barriers to continuous improvement, and support of the bottom up approach to continuous improvement.

Projects

Table 5 summarizes information provided to OLO about projects with cost estimates over $250,000.

TABLE 5. MCPS TECHNOLOGY PROJECTS OVER $250,000

Project Name	Lead Division	Multiple Depts?	Phase
Budmaps	Office of Management, Budget and Planning	No	Operating
Educational Tech: Global Access	Office of Global Access Technology	Yes	Implementation
Educational Tech: Learning Hubs	Office of Global Access Technology	Yes	Operating and Implementation
Educational Tech: SIMS	Divisions of School/Office Applications and Wide Area Network and Engineering	Yes	Operating
Elimination of Personnel Master File System	Office of Global Access Technology	Yes	Design and Implementation
Fleet Fuel Management	Dept. of Transportation	No*	Need Assessment
Logistics Materials Mgmt	Dept. of Materials Management	Yes	Implementation
SES Accountability System	Deputy Superintendent for Instruction	Yes	Implementation
Special Education Information System	Office of Global Access Technology	Yes	Design

Source :OLO, November 1995.

* Currently talking with M-NCPPC, EMOC, and the City of Rockville about the possibility of a shared venture.

Project Selection and Management Practices

Similar to the County government, MCPS also uses the capital programming and the budget process to structure the technology approval process. Three system development teams in the Technology Department develop technology projects proposals for review by the Leadership Team. The Leadership Team makes recommendations to the Superintendent who, in turn, presents the budget to the Board of Education. Through the budget process, the Board sees program mission statements, goals, and spending plans for each department. The Board reviews this information, raises questions, and generates discussion on new technology projects.

The school system routinely does prototypes of projects before approving, funding, and implementing a full project. It is also standard practice to consult with advisory groups made up of future system users. As noted above, all MCPS procurements are coordinated by the Technology Steering Committee.

Budgeting for Maintenance and Replacement Costs

The school system uses in-house staff to maintain its equipment. The maintenance budget for a Personal Computer is $10 per year. MCPS is currently about 3 weeks behind on responding to maintenance requests because they lack adequate personnel to keep up with the need for repairs.

In the early nineties, MCPS proposed a capital program to fund replacement of technology equipment; however this fund was not approved by the Council due to budget constraints.

3. Montgomery College*

Montgomery College has an information systems office budget of $5.4 million that includes all academic and administrative costs, on-going staffing and operating costs, and telephone costs. There are over 3,000 workstations at the College with over 2,000 used for instructional and academic support. The growth in personal computers and student demand for academic computing has created an overwhelming demand for more technical and fiscal support, resulting in less support for mainframe requirements.

The College's need for and use of technology differs from other County agencies. The key academic areas that define technology needs for the College include:

- preparing students for transfer to other institutions for four year degrees;
- providing training for certificate programs to satisfy business needs; and,
- supporting the Continuing Education program which offers many short focused courses on one subject to complete life long learning opportunities.

In addition to the distinct needs of these academic programs, the College uses technology to maintain its Student Information System and to meet several administrative requirements unique to higher educational institutions. The Student Information System maintains data on student admissions, financial aid, registration and scheduling to meet state and federal student requirements and to support analysis for the College's internal needs and reviews. The data bases to support these key systems require that student records be available for a period of time that far exceeds a single semester or annual student count. Administration and faculty must be able to access this system throughout the year for student advising, grade reporting, counseling, changes in schedules and financial aid information. This is a key reason for completion of the infrastructure throughout the College and will then permit instructional expansion.

The Student Information System serves as the College foundation for other administrative systems that are also unique to the needs of higher educational institutions. These include alumni and development systems, library systems, Internet, student placement systems, planning and research reports designed for higher education, and systems to manage campus bookstores and other services, child care facilities and the process for curriculum development .

The College must abide by extensive and detailed analysis by national regional organizations for accreditation. In the information technology areas, the availability of labs, computer workstations, library requirements and technology facilities as well as technology training are a part of these self study and peer evaluations for accreditation and comparisons to other institutions.

*** For specific comments from Montgomery College on this section of the report, see Chapter VII.**

Organizational Structure

The management of information technology is centralized in the Computing Services Unit at the Rockville campus. This unit provides computer services to the College administrators, and faculty staff and students at each of the campuses, develops information technology strategic plans, and oversees and reviews departmental project planning. The Computing Services Unit is a central point for the procurement of hardware and network operations and the assignment of all surplus computers.

There are 45 staff in the Computing Services Unit. Approximately one-fourth of the staff are assigned to the campuses, one-fourth are dedicated to maintaining administrative systems. Twelve staff support operations, the academic labs, and computer support functions and 4 staff maintain the networks.

As of July 1, 1996, the College is planning to combine all technology units into one organization designated as "Information Technology." This organization will include computing, voice, data, video, library, learning resources, and stand-alone systems that are part of the current budgets, but sometimes operated separately. The concept of a single point for all technology related activities will allow the College to examine all initiatives, projects, hardware and software, staffing and facilities during budget and planning cycles.

Assessments and Strategic Plans

The College has developed a number of plans in the past, including nine major documents that define the technology structures through FY 98. In 1991, the administration, the Board and all three campuses approved a collegewide Information Resources Plan (IRP). The College has used this document over the years to develop detailed tactical and operational initiatives.

Instructional and academic areas have experienced the greatest changes since 1991 and are the focus of College efforts to develop updated plans for FY 98-99. The Computing Services Unit is developing instructional and academic Computing Plans for each of the campuses. In addition, the College has retained consultants to evaluate and propose infrastructure changes to implement the updated concepts and plans set forth in the new campus Computing plans.

The Campus plans reflect the unique issues on each of the campuses and Continuing Education through use of Collegewide resources for sharing of staff, equipment and facilities. New updated plans have been completed for Germantown, Takoma Park and Continuing Education. The plan for the Rockville campus and an updated telecommunications plan should be completed by May 1996.

The new infrastructure plans describe the Collegewide networks, Internet and intranet access as tools to be used to accomplish College goals. In June 1996, following College, administration, and board review, the campus plans and the infrastructure plans will be consolidated into one overall plan that will describe Collegewide technology policies, processes, responsibilities and accountability, as well as campus specific technology requirements. This overall plan will be available for ITPCC and Council review after College approval in June.

Projects

Ongoing and future technology projects for the College will be defined through the overall consolidated plan. This consolidated plan will identify specific technology initiatives that will be the basis for projects to convert the strategic and tactical plans into operational activities. On an on-going basis, work requests, grants, new products and student and customer demand will permit a dynamic plan with provisions for updating and approval.

The preliminary discussions of this plan have identified one overall College technology project with three phases. The total cost of this overall plan is estimated at $26 million, with $3 million for the first phase capital infrastructure costs and approximately $7 million for high priority projects in phase two that will use the completed infrastructure. On-going costs and staffing are calculated into all College projects and remain a concern as budgets are tightened and resources may not be available.

Project Selection and Management Practices

The selection of technology projects is made largely through the budget process, which begins in the fall with the development of unit plans. Approximately 50 units develop plans that describe their strategic direction, critical objectives and cost estimates for the year. In addition to developing a unit plan for Computing Services, the Director of Computing Services also reviews the program recommendations in all of the other unit plans to identify technology needs. Unit plans are reviewed by the Deans and Provosts on each campus in order to develop the annual budget that is reviewed by the CAO/President and the Board prior to being submitted to the County Executive and the Council.

The College has an existing on-going project management system required for all technology actions. At the beginning of each project, staff from Computing Services and the appropriate program or area develop a project plan. The project plans include a statement of what the project will and will not do, a list of user requirements, an evaluation of alternatives, capital and operating cost estimates, an implementation schedule, a discussion of risks and risk avoidance, and a sheet for tracking project progress. Projects are reviewed and agreed to by Computing Services and the user representative. Status reports are produced during the project on a regular basis. There are usually over 300 projects described and developed and on project lists updated on an on-going basis. The project methodology used by the College has resulted in excellent project completion within the time frames and budget agreed during the project initiation.

Budgeting for Maintenance and Replacement Costs

Montgomery College has a complete inventory of their information technology. A college-wide system was developed that indicates the number, kind, and location of all hardware and software on the network. Maintenance funds are included in the budget of the Computing Services Unit, but budget constraints restrict some projects and create the need for alternative methods including outsourcing or contracting many of the tasks and maintenance. The College does not have a replacement fund, but recognizes the need for replacement funds especially with the short life cycle of instructional and academic computing demands.

4. Maryland-National Capital Park and Planning Commission (M-NCPPC)

The Maryland National Capital Park and Planning Commission has the smallest information technology office budget of all of the agencies - $2.5 million. The Commission has experienced decentralization in the past, particularly with the entry of data at remote sites, and staff expects further decentralization to continue in the future.

Organizational Structure

Management of information technology at M-NCPPC is split among three departments- Parks, Planning, and Central Administrative Services. Each department has a separate information technology unit that manages information technology and coordinates procurements.

Like MCPS, M-NCPPC is undergoing a reorganization that may affect the management of information technology. The reorganization would merge the information technology units of the Parks and Planning Departments. As of September 1995, initial information about the merger suggests that the coordinated use of technology would be a major benefit of joining the two departments. Decisions about how technology might be organized under a new department are still pending.

In the late 1980's, M-NCPPC instituted a bi-County Steering Committee for technology issues. It is chaired by the Secretary/Treasurer of the Commission and staffed by technology staff from the Parks and Planning departments in each County. The purpose of the standing Committee, which meets monthly, is to share information about new initiatives and major purchases, discuss major policy issues, and set hardware and software standards.

Assessments and Strategic Plans

The Parks and Planning departments and Central Administrative Services department each have a strategic information technology plan. In 1990, following a Department head retreat, the bi-County Steering Committee was asked to study the implementation of a Wide Area Network (WAN) to serve the entire Commission. A study, completed in 1991, identified the long range technology needs for each department in order to develop requirements for the WAN.

Following a study of alternatives, the Steering Committee approved a network operating system project, however, funding responsibility for implementing the WAN falls back to each individual department. With the implementation of the WAN, all Commission staff who are hooked in participate in an agency-wide E-mail and calendar scheduling system. The Wide Area Network Plan serves as the strategic plan for Central Administrative Services.

In 1991, Arthur Andersen developed a Five Year Computer Systems Plan for the Parks Department. The plan includes a review of the department's strategic systems direction and systems implementation plan.

The Planning Department developed its strategic plan in 1992. It includes a summary of proposed five year expenditures and discussions of database management systems, desktop computing, computer mapping, telecommunications, and transportation analysis models.

Projects

Table 6 provides a list of M-NCPPC technology projects over $250,000. The total cost estimate is about $7 million although this includes several incomplete cost estimates.

TABLE 6. M-NCPPC TECHNOLOGY PROJECTS OVER $250,000

Project Name	Lead Dept. **	Multiple Depts.?	Phase
GIS Acceleration of Work Program	Plng	No	Need*
GIS Simulation Modeling for Master Plans	Plng	No	Need*
LANs/WANs for Parks	Parks	Yes	Need*
MCMAPS	Plng	Yes	Impl.
Public Access for GIS	Plng	No	Need*
DAP Systems Upgrade	Plng	No	

Source: OLO and M-NCPPC staff, 1995
*From 1994 TIF applications
** The proposed M-NCPPC reorganization may alter the Lead Dept. responsibilities.

Project Selection and Management Practices

Decisions about technology projects for the Planning and Parks Departments in Montgomery County are made through the budget process. In the Planning Department, the Director of Research prepares an updated budget each year based on the Information Systems and Telecommunications Plan prepared in 1992.

The proposed FY 96 budget categories show a gradual increase in information systems and telecommunications spending through FY 2000, reflecting management guidance to hold technology spending constant. The budget categories include existing rents and leases, maintenance and support, supplies and materials, and hardware and software for four categories of computers: database management systems, desktop computing, computer mapping, and transportation analysis. Maintenance and support is projected to experience the largest increase over the six year period.

The Planning Department makes frequent use of the Internal Service Fund (ISF) which is the Commission's established method for handling the purchase of capital equipment. The purpose of the ISF is to spread the cost of an asset over its useful life instead of burdening any one fiscal year with the expense of long lived equipment. In addition, the ISF makes it easier to buy rather than lease capital assets.

The Parks Department selection of technology projects is determined by the needs assessment completed as part of the WAN study in 1991. Parks Department technology staff indicate that they are still implementing the first year of their five year plan. Technology projects in the Parks Department typically encounter strong competition from other equipment and program needs both in the budget process and for the use of Internal Service Funds.

The distribution of personal computers in the Parks Department has been slow. Some of the consequences of this slowed growth in automation are the inability to participate on the WAN. It is also difficult to look at re-engineering processes when there is not a common level of automation.

The project management system for technology projects at M-NCPPC is shaped by the requirements of the procurement system in each of the three divisions.

Budgeting for Maintenance and Replacement Costs

Central Administrative Services has a Commission-wide fixed assets inventory to track M-NCPPC's technology equipment. Central Administrative Services budgets for maintenance in its operating budget, but does not have a replacement fund. The Planning Department budgets for maintenance and replacement in its operating budget. The level of replacement funding assumes personal computers will be replaced every five years. The Parks Department also budgets for maintenance in the operating budget, and replacement of equipment has not been funded on an on-going basis.

5. Washington Suburban Sanitary Commission (WSSC)

WSSC has the largest central information systems budget of the five agencies. The total FY 1996 budget of $12.5 million includes $11.0 million (including salaries) for the Information Systems Division and $1.5 million (including salaries) for communications and telephones in the Instrumentation and Communications Section in the Facilities Maintenance Division. WSSC computer operations are currently centralized in the Information Systems Division and WSSC does not anticipate that the

function will be decentralized in the future since WSSC staff believe that decentralization generally results in redundancy and adds to total costs.

Organizational Structure

Except for the development and implementation of the GIS project ($2,176,200 in FY 1996), which is handled out of a separate office, WSSC's management of information technology is split between the Facilities Maintenance Division and the Information Systems Division.

The Facilities Maintenance Division, Instrumentation/Communications Section, in the Bureau of Maintenance is responsible for telephone systems (telephones, switches, ACD's and voicemail), operational automated systems (a computer-based HVAC energy management system instrumentation and process control systems, SCADA (Supervisory Control and Data Acquisition System) for remote unattended facilities), communications (mobile radio fleet and base stations, the pager system, cellular telephones, and the microwave system- the transmission medium used to convey various forms of information between major facilities and depots), and the installation and maintenance of LAN and WAN cabling.

Except for those systems identified as operational automated systems above, the Information Systems Division (ISD) in the Bureau of Administrative Services is responsible for managing all Commission information systems resources (hardware, software, and support activities); for coordinating the acquisition, installation and use of automated systems; and, for providing leadership to all of WSSC in the use of automated equipment. ISD provides information systems necessary for the Commission to function; i.e., payroll processing, customer billing, maintenance, supply and accounting functions.

To date, ISD has been organized into two sections: an Applications Software Section and a Technical Services/Operations Section. The organization of the Applications Software Section maps the organization of the Commission so that each branch/bureau within the Commission has one representative in the Information Systems Division. As a customer service representative for end users in the Commission, this staff person is responsible for helping users to identify technology needs and coordinate the installation, maintenance and repair of computer equipment. Support staff is also assigned to each branch/bureau.

Revised organizational structures for ISD are currently being considered. The focus of the final structure will still be on customer service, but will provide for long-range information technology planning and for transitioning to a network-centric, client/server based computing environment over the next five years.

The two divisions determine their own equipment and systems needs once a budget has been approved and forward them to the Commission's central procurement office for processing, with ISD responsible for the agency's information system acquisitions and FMD responsible for telecommunications equipment. The two divisions work closely together and coordinate activities when a joint effort is required to implement a project.

Assessments and Strategic Plans

The Facilities Maintenance Division uses its Microwave System Plan as their strategic plan because all of the Division's current technology projects involve additions or changes to WSSC's microwave system. The Information Systems Division is currently developing an Information Services Master Plan.

Projects

Table 7 summarizes WSSC's technology projects over $250,000. There are 10 projects with a total cost of almost $20 million. Improvements to the GIS systems require about $7.4 million. About $2 million is needed for ongoing upgrades to the microwave system. The remaining costs are for information system projects, however many of these cost estimates are not complete. FMD does not classify items in its budget as 'projects' per se.

TABLE 7. WSSC TECHNOLOGY PROJECTS OVER $250,000

Project Name	Lead Dept.	Multiple Depts.?	Phase
GIS Implementation		Yes	Impl.
WSSC Wide Area Network	ISD	Yes	
Project 2000	ISD	No	
Financial Info System	ISD	No	
CAD and Drafting	ISD	No	
Microwave System Upgrade	FMD	Yes	Oper.
Brown's Corner	FMD	Yes	
Seneca WWTP	FMD	Yes	
Potomac Water Filtration Plant	FMD	Yes	
Damascus WWTP	FMD	Yes	
Consolidated Lab	FMD	Yes	

Source: OLO and WSSC staff, May 1995

Project Selection and Management Practices

The selection, review and approval of information technology projects occurs as part of the budget process. Each year, the Information Systems Division and the Facilities Maintenance Division prepare budgets which describe the work to be accomplished during the fiscal year. The FMD budget includes personnel, materials, and services requested to meet the desired level of maintenance. The ISD budget includes resources to meet desired service levels and to fund projects. The budgets are reviewed by management and the Commissioners who then forward revised/approved budgets to the County Councils of Montgomery and Prince George's Counties as part of the overall Commission budget.

The focus of the Facilities Maintenance Division budget is on the continued enhancement of the existing equipment and controls. The microwave system, which was implemented in 1987, is being expanded to eventually connect all major facilities and the central administration building. As this occurs, the telephone systems are converted to the standard system and connected to the microwave system for easy (no cost) communication with all other major facilities.

The budget request for FMD includes the costs of system acquisition, implementation, and maintenance costs for the budget year, but not future maintenance costs. FMD maintains extensive supporting documentation for budget items and provides this to management upon request.

In an effort to structure its project management system, ISD has identified a list of items that should be addressed in any user proposed projects. They include a description of the proposed system/project, solution alternatives, recommended alternative, justification, resource requirements, and proposed implementation plans and funding alternatives.

Budgeting for Maintenance and Replacement Costs

Both ISD and FMD must figure out how to meet increasing operating and maintenance expenses that are incurred when they implement a new system or expand an existing system. Although each division maintains equipment inventories, including the age of the equipment, the annual budget process does not include set aside funds for the future maintenance or replacement of equipment. Also, although projects are frequently justified because they will result in cost savings, user managers are the present means for ensuring that those savings are in fact sought and realized. A more measured process is expected in the future.

VI. SUMMARY OF FINDINGS, OBSERVATIONS AND RECOMMENDATIONS

County and bi-County agencies use technology equipment and infrastructure extensively to deliver services to citizens and businesses in the County and to manage agency business systems. Each of the five major agencies plans to acquire additional information technology equipment in the next few years. As a result, the Council could face $190 million in funding requests to pay for ongoing and future projects, in addition to $40 million requested annually for technology operating budgets.

Historically, the County Council and the agencies have used the budget process to frame technology decisions, and requested additional special studies on an as needed basis. Since 1994, the Technology Innovation Fund program and the re-constituted Interagency Technology Policy Coordinating Committee have provided additional structure to some technology decisions. Table 8 at the end of this chapter summarizes the current technology management practices in the County and bi-County agencies.

OLO's examination of the approaches that private and public sector agencies use to structure technology decisions concluded that organizations with effective technology decision structures address technology issues at two levels: the agency level and the project level.

At the agency level, organizations manage the investment of their technology dollars. Organization executives regularly provide policy, guidance and overall direction for technology decisions through sponsorship of specific projects, establishment and participation on an Investment Review Board, initiation or implementation of a strategic plan, and the use of mission related performance measures to evaluate, compare and monitor technology investments.

At the project level, organizations use project management systems to analyze business problems; to determine whether new technology is warranted; to define and evaluate alternative technology solutions; to identify and manage risks; to provide a framework for participation by management, technical staff and future users; and to define performance measures.

The examples of decision structures used in other places suggest that there are several opportunities to improve the Council and the agencies' technology decision structures and technology management practices.

Finding #1

Management systems in an organization greatly influence the effectiveness of an agency's technology decision structures.

Recommendation #1

Before addressing suggestions to implement or improve specific technology decision structures, OLO recommends that the Council convene an overview discussion with the executives in the County and bi-County agencies concerning the relationships between an agency's management systems and its technology decision structures.

In particular, the Council should ask the agency executives to address:

- how they perceive the role of technology in their organization's mission;
- how they provide leadership for technology decisions within their agencies; and
- how technology decision structures are linked to other management structures in the organization.

Finding #2

Executives and decision makers in organizations with effective technology decision structures know how much the organization spends on information technology even if technology staff and equipment are broadly distributed throughout the organization.

Organizations report expenditures to maintain, replace and acquire technology for the entire agency even if the management, administration or distribution of technology are decentralized. Executives know how much will be needed to meet these costs in the future and may regularly set aside funds now to meet these future costs. Specifically, organizations with effective technology decision structures know how much is being spent:

- to replace outdated equipment,
- to maintain existing systems, and
- to develop, acquire and train users on new systems.

The conclusion in the Fairfax County strategic plan assessment underscores the importance of reporting maintenance and replacement costs in addition to new project costs. Fairfax County found that it had a two-pronged technology problem because it was not investing to maintain its existing equipment at the same time it was underfunding future acquisitions.

Recommendation #2

The estimate that the Council could face $190 million in funding requests for ongoing and new projects identifies only a portion of the County's future technology expenditure needs. The Council should ask the agencies to provide information on the costs of maintaining and replacing existing technology equipment so that the Council understands the extent to which current technology equipment is maintained and kept up to date and ensures that the Council does not unknowingly fund new initiatives at the expense of existing operations.

The Council should request information from each agency that:

- shows how the assumptions used to budget for maintenance compare to actual maintenance costs;
- addresses whether maintenance costs are expected to increase or decrease over the next five years and how the maintenance and replacement requirements for the proposed projects will affect the agencies' overall maintenance and replacement budgets;
- describes how the actual age and proposed replacement schedule for each type of equipment in the agency compares to industry standards; and,

- identifies the specific service delivery and business functions that are put at risk if maintenance is deferred and whether the effect is measured in terms of productivity loss or increased risk of operational failure.

Finding #3

Organizations with effective technology decision structures use agencywide management systems to make sure technology investments are aligned with defined agency mission(s).

Table 9 at the end of this chapter defines four agency management structures and summarizes the examples presented in the report. Examples of specific planning or funding approaches include a strategic planning process specifically for technology, a portfolio management approach and an information resource management system.

The County and bi-County agencies generally rely on the budget process to evaluate and select projects; however, decision making is centralized to different degrees within each agency. Using the budget process to centralize decisions and set technology priorities works most effectively in those County and bi-County agencies where the management of technology is centralized. Under this arrangement, one department compares and evaluates projects so that decision makers can establish and fund agencywide priorities across departments or divisions.

Using the budget process to set and fund technology priorities in a decentralized management environment has some limitations. Specifically, it is difficult to match an agency's priorities to its technology funding because the budget process tends to evaluate projects by department or division and to focus primarily on cost. This approach results in deferred funding of projects that have agencywide value but are less of a priority to the department, or premature funding of projects that are important to one department but less critical to the agency as a whole.

Montgomery College and WSSC currently have centralized management structures, and MCPS and M-NCPPC are undergoing reorganizations that are expected to centralize technology management. The County Government operates with a technology management structure shared among DIST and several other major departments.

Recommendation #3a

The Council should ask the agencies to address what strategies the agencies will implement to ensure that the funding of technology projects more closely supports the agency's mission and reflects the priorities of the entire agency.

Specifically, the agencies should describe:

- how they ensure that money spent on technology matches agencywide priorities; and,
- what project selection approach they believe is most appropriate for their organization.

Using the budget process to set priorities and make funding decisions across the agencies limits the Council's decision-making as well. Although the establishment of the TIF program and the re-establishment of the ITPCC has enabled the Council to consider projects more collectively, further discussion of a workable approach is warranted.

Recommendation #3b

Along with the discussion of how the agencies could improve the project selection process within their agencies, the Council should decide a similar set of issues for the County as a whole.

In particular, the Council should address the merits of the following approaches either individually or together:

- Prepare a countywide strategic plan for technology focused on management issues starting with the strategic plans currently being prepared by many of the agencies (similar to Fairfax County).
- Create separate subfunds for maintenance, replacement, infrastructure and priority projects (Fairfax County).
- Adopt policies, guidelines and project evaluation criteria and have the Council function as an Investment Review Board (federal OMB).
- Adopt policies, guidelines and evaluation criteria and designate an independent staff position to review and package technology applications for all of the agencies (the State of Minnesota model).

Finding #4

Organizations with effective technology decision structures use project management systems to manage the design, development and delivery of technology projects.

In addition to ensuring that projects are delivered on time and within budget, these systems structure the participation of executives, technology professionals and end users in project decisions, document key project milestones, and systematically identify and evaluate project cost, benefits and risks. The project management models described in the report demonstrate that agencies adopt different approaches to project management depending on the reason for the system. The traditional lifecycle model uses specific phases and clear documentation requirements to control costs, schedule and project performance. The business case approach uses project management systems to analyze business problems; to determine whether solutions can be achieved through organizational or management changes or whether new technology is warranted; and, to define performance measures that are used to monitor the project. Table 10 at the end of this chapter summarizes the approaches and examples presented in the report

The Council reviews most technology projects through the capital program or operating budget. For the Council, the TIF program has established elements of a project management system, particularly for projects over $250,000 that require Council review and approval. Except for TIF projects, the amount of information the Council sees about a project and/or whether a project is reviewed outside of the budget cycle varies.

Recommendation #4

The Council should adopt guidelines or parameters for a project management system to strengthen the Council's oversight functions. The project management system guidelines should give the agencies guidance on the steps that should be followed in the development and delivery of a project; what project phases require Council review and/or approval; how project decisions should be documented; and what assumptions or guidelines should be used to evaluate costs, benefits and risks.

In particular, the Council should discuss:

- What types of information the agencies need to compile and report. The agencies may wish to provide details about the information that is already prepared for either an agency's project management system or for the agencywide selection process. This would allow the Council to build on existing information and practices. Alternatively, the models described in the report may provide a useful basis for developing project management guidelines that are acceptable to all agencies.

- The value of packaging project management information in a summary document and how it might be done. Possible options include by the agency as part of its budget submission, by OMB for all of the agencies or by the ITPCC.

- Whether some information technology projects warrant more frequent reviews and, if so, what criteria should be used to determine which ones and how often. Several places require more frequent review for high risk projects or for more expensive projects.

- Whether it would be useful to modify the TIF program and/or application process.

Finding #5

In organizations with effective technology decision structures, the business side of the organization regularly and routinely provides policy, guidance and overall directions for technology decisions.

Organizations use a combination of strategies to link executives to technology professionals and end users, or to tie decisions about technology projects into other management systems. Some of the strategies organizations use to establish more effective links between an organization's technology investment and its management decisions include:

- the use of a Chief Information Officer,
- management sponsorship of specific projects,
- establishment of an executive level Investment Review Board,
- initiation and/or implementation of a strategic plan, and,
- use of a business case approach and/or performance measures in the management systems used to manage individual information technology projects.

To date, Executive leadership or exposure to technology issues in the County and bi-County agencies has occurred through Executive participation in the budget process or through the re-established ITPCC. While agency executives have demonstrated a willingness to participate in technology discussions, members are still exploring how they can contribute most effectively.

Recommendation #5

The Council should schedule a discussion of the GAO Report with the ITPCC to identify opportunities to strengthen executive leadership in technology management issues in the County and bi-County agencies.

TABLE 8. Technology Management Practices in the County and Bi-County Agencies

	County Government	MCPS	Montgomery College	M-NCPPC			WSSC	
				Central Administration	Parks	Planning	Information Systems	Facilities Maintenance
1. Does the agency have an IT strategic plan? (year)	Yes (FY 91-93)	Under development (by fall '96)	Yes (FY 95)	Yes, the Wide Area Network Plan serves as the division's strategic plan	Yes (1991)	Yes (1992)	No	The Microwave System Plan serves as their strategic plan (FY 95)
2. How are IT procurements coordinated?	DIST signs off on all procurements	Steering Committee	Coordinated through the Computing Services Division	Coordinates Central Administration procurements	Coordinates Parks procurements	Coordinates Planning procurements	ISD coordinates information system technology procurements	FMD coordinates facilities maintenance (telecommunications, microwave) technology
3. Is the management of IT centralized?	Management of telecommunication services is centralized, information systems is not	Yes	Yes, under the Computing Services Division	Centralization anticipated through a proposed reorganization	Centralization anticipated through a proposed reorganization	Centralization anticipated through a proposed reorganization	Management of information systems technology is centralized in ISD	Management of telecommunications is centralized in FMD
4. Is there an equipment inventory?	Partial inventory	Yes	Yes	Yes, this division maintains a fixed asset inventory for the whole agency	Yes	Yes	Yes	Yes
5. Who is responsible for maintenance and/or how is it funded?	DIST administers a maintenance service contract. Departments pay maintenance costs	Maintenance is done staff when possible and by contractors when necessary	Maintenance is included in the operating budget of the Computing Services Division	There is a fund in the budget for maintenance and a Commission wide contract with Hewlett Packard do perform maintenance	Maintenance is funded in the operating budget and the service is contracted out	Maintenance is funded in the operating budget of the Research Division	Maintenance is included in the ISD budget	Maintenance is included in the FMD budget
6. How are replacement costs funded?	No replacement fund	No replacement fund	There is no organized central replacement fund at this time	No funds are available for replacement	Replacement is not funded on an on-going basis	Replace PCs every 5 years	No replacement fund	No replacement fund
7. How does top management review/approve IT projects?	Through the budget process	Board of Ed. reviews projects through the budget process	President/CAO review plans, budgets, and major projects for approval and the Board of Trustees	MCPB reviews projects through the budget process	MCPB reviews projects through the budget process	MCPB reviews projects through the budget process	WSSC reviews projects through the budget process	WSSC reviews projects through the budget process

TABLE 9. Agency Decision Structures

	Strategic Plan	Portfolio Management	Information Resources Management	Federal Government Oversight Programs
Description	Identifies goals and objectives, describes what technology equipment currently exists and how it is used, defines future business directions and the IT needed to support it, articulates an action plan	Assembles and analyzes information from project management systems. Applies techniques to evaluate, manage, and control individual projects to all information technology projects in an organization.	The process of managing information resources to accomplish business objectives. Requires an understanding of the business and resources needed to carry out the business before solutions are selected	Regularly reviews high-risk projects and programs and incorporates risk analysis as a standard step in the project evaluation process
Example	**Fairfax County Strategic Plan** **Fairfax, VA** The Information Technology Advisory Group assessed the County's technology in 1993-1994. As a result of the study, the ITAG proposed 25 policy and technical recommendations. To improve the use of technology the County must: make an ongoing commitment to funding IT; resume multi-year strategic planing; restore IT training funds; consolidate and reorganize all IT in the Dept. of Information Technology; create a CIO position; adopt planing procedures to identify, evaluate and approve projects; establish a strategic management steering committee; establish a separate fund to strengthen centralized management of available resources and consolidate investment in major projects; establish a computer replacement program; and establish a Technology Infrastructure Services Subfund to ensure regular upgrade of equipment.	**OMB Investment Guide (Draft)** **Federal Government** The federal OMB is preparing an investment guide that describes their oversight expectations in the technology area and how to reduce risks and maximize net benefits from technology investments. The guide discusses how agencies should manage project selection and control project implementation. OMB's four step project selection process involves (1) screening and analyzing all projects, (2) ranking projects and creating a priority list of investments, (3) determining the right mix of projects to be funded, and (4) making final funding decisions. Controlling project implementation is an ongoing activity to review new and existing projects and systems. It includes reviewing the projects in the portfolio, taking actions to correct any problems or deficiencies, and measuring the progress of ongoing projects against their projected costs, schedule and benefits.	**Information Policy Office** **State of Minnesota** The IPO sets policies and standards to help state agencies: (1) develop information systems; (2) establish techniques for planning and managing information systems; (3) set standards and guidelines; (4) establish information needs analysis techniques; (5) develop contracts for the purchase of equipment and services; and (6) train personnel. IPO evaluates technology projects for state funding using six critical success factors. Agencies should work to: (1) improve executive leadership; (2) develop an IRM infrastructure with policies, guidelines and standards that allow repeatable processes; (3) develop a continuously updated agencywide implementation/ migration plan; (4) use information models that describe how agency data and technology support business functions; (5) develop an organization structure with authority to manage all aspects of the agencies IT projects; (6) develop an effective skills base.	**Federal OMB's High Risk Program** Identifies federal projects at risk for abuse, fraud, and waste and suggests corrective actions (not limited to IT projects) **GAO's High Risk Series** Reviews and reports on federal programs considered to be high risk (includes information system modernization as a high risk area) **GSA's Time Out Program** Focuses attention on the largest and most important federal IT acquisitions that have experienced problems and establishes a means to restrict or cancel the procurement authority of the lead agency until an independent assessment is complete.

Source:OLO, 1996

TABLE 10. Project Management Systems

EXAMPLES	Approach	Structure	Documentation	Cost	Risk
PTO Life Cycle Management Process	Traditional life cycle approach	**6 generic phases-** justification, concepts/alternatives, design, development, implementation, operations	**5 key documents-** Statement of Need, Project Management Charter, Project Management Plan, Requirements Statement, System Decision Paper		Risk must be considered in each milestone decision. **Managed Evolutionary Development approach-** divide a large risky project into smaller projects
Army's Economic Analysis Model	Traditional life cycle approach with a focus on development and analysis of cost information	**6 milestones/ lifecycle cost elements -** need justification cost, concept analysis cost, design cost, deployment cost, operations cost, operations/revalidation cost	**POM Budget Submission, Economic Analysis-** lifecycle and independent cost estimates, Economic Analysis- actual operations and support cost data, system enhancement cost estimates	**3 Major Cost Elements-** investment, system operations and support, cost to phase out the system being replaced	**Independent Cost Estimate-** life cycle cost estimate developed independently of the of the acquisition component to verify the cost estimate prepared by the program manager
Canadian National Government Information Technology Business Case Strategy	Ties project evaluations to agency mission and business activities	**7 Steps-** structure the investment decision; identify IT investment options; identify and plan how to realize benefits; estimate life cycle costs of acquisition, application development, and operation; identify risks; assessment of the IT investment; plan investment reviews	**Logical Framework Analysis-** why an investment is being undertaken, what constitutes risk, how investment activities are related to ultimate goals, what the investment will achieve once it is complete	**4 Cost Categories** associated with projects that must be examined- direct up front costs, direct ongoing costs, indirect or hidden costs, client costs	Assess **internal** and **external** risk, and **financial risk** of each investment
Department of Defense/Army Functional Economic Analysis	Approach emphasizes identifying, evaluating, implementing improvements to current department business processes	Provided by **DOD's strategic plans**, involves strategic plans, activities, and performance measures	**Preliminary FEA-** identifies alternatives that merit more detailed analysis **Final FEA-** a more precise analysis, refines cost and schedule data **Update FEA-** monitors progress during execution of the project	**Activity Cost Analysis Procedure-** estimates the current cost of doing business and the future cost of doing business if the projects were implemented	Must develop an estimate of the **risk associated with each alternative**

Source: OLO, 1996

VII. DEPARTMENT/AGENCY COMMENTS ON THE REPORT DRAFT

On March 5, 1996, OLO circulated a draft of this report to the County Government, the Montgomery County Public Schools, Montgomery College, the Maryland-National Capital Park and Planning Commission, and the Washington Suburban Sanitary Commission. The technical corrections received by OLO are incorporated in the final report in chapter 5 (beginning on page 42) and on table 8 on page 70. Written comments, including policy comments from the County Government and Montgomery College, are included in their entirety beginning on page 74.

OLO once again expresses thanks to the many individuals who contributed to the development of this report.

OFFICES OF THE COUNTY EXECUTIVE

Douglas M. Duncan
County Executive

Bruce Romer
Chief Administrative Officer

MEMORANDUM

April 18, 1996

TO: Sue Richards, Program Evaluator
Office of Legislative Oversight

FROM: Bruce Romer, Chief Administrative Officer

SUBJECT: Office of Legislative Oversight DRAFT OLO Report 96-5, A Study of Information Technology Decision Structures

Thank you for the opportunity to comment on the DRAFT OLO Report 96-5, A Study of Information Technology Decision Structures. This report is an excellent reference document on how organizations make decisions about information technology spending and projects. As presented in Sections II. "An Information Technology Management Framework" and III. "Agency Management Practices," it is the leadership and personal commitment of top executives in public and private organizations that ensures the effective use of information technology. As Council follows up on this report, there should be a continuing dialog with the Executive Branch and the other agencies on implementation of these recommendations. The goal of this dialog should be enabling the Council to focus on the citizen service and productivity advantages of information technology.

I offer the following response to several of the recommendations and comments to correct or clarify the data presented in this report.

Comments on Recommendations:

Recommendation 2:
The report recommends that the Council request information on technology maintenance and replacement requirements in order to "ensure that the Council does not knowingly fund new initiatives at the expense of existing operations." The situation within the County government does not appear to warrant this level of effort. Information on the impact of major projects on operating budget requirements is already portrayed on the Project Description Form (PDF) for Capital Improvements Program (CIP) and Technology Innovation Fund (TIF) projects. DIST is responsible for major hardware systems (e.g., the mainframe, Computer Aided Dispatch (CAD) processor) and budgets for replacement systems on a life cycle basis and proposes acquisitions as needed to provide capacity or replace obsolete equipment. The same procedures apply to radio

and telephone systems. Forecasting of maintenance costs for office automation (OA) equipment is easily done because DIST maintains central contracts used for the overwhelming majority of OA equipment. Forecasting of replacements for departmental computers (PCs, servers, minicomputers, etc.) could be enhanced within the Executive Branch by centralized management and funding. DIST has proposed a Desktop Modernization program. OMB and DIST are working together to develop an approach to this program.

Recommendation 3:
The report recommends that Council evaluate a variety of approaches to project selection; however, as presented in the report, executive branch agencies have this responsibility. The County budget process provides a context for central comparison and evaluation of technology funding proposals in a manner that permits priority ranking of funding recommendations consistent with the County Executive's objectives while permitting the County Executive to evaluate these expenditure requirements in the larger context of multiple programmatic needs Countywide. DIST has initiated a strategic planning program which will provide the basis for greatly improved and more integrated information technology planning, evaluation and coordination within the Executive Branch and among the other agencies. The Council should support the County Executive's strategic planning initiative rather than establishing duplicative project evaluation systems.

Recommendation 4:
The report recommends that the Council adopt guidelines for a project management system to strengthen the Council's oversight functions. In the implementation of this recommendation, the Council should identify specific information requirements essential to legislative oversight and avoid the creation of a reporting system for operational information more appropriate to the Executive Branch.

In summary the report is an excellent reference document and I encourage dialog on it. I specifically initiated a discussion of the draft report during a recent Interagency Technology Policy and Coordination Committee meeting. The other members of the committee have agreed to continue this discussion at our next meeting. Considering the ITPCC's responsibilities and general duties, the Council might want to look to the ITPCC for its leadership on the issue of technology decision structures.

Comments to clarify or correct data:

Page 50, C.1., County Government:
"The County government has experienced significant decentralization in the management of technology since FY88 and this trend is expected to continue." The words "and this trend is expected to continue" should be deleted. The County Executive has made no decision on further decentralization. This question is expected to arise during the development of the Information

Technology Strategic Planning Program, a DIST initiative. Concerning technology staff positions, this paragraph also states: "95 of these are in DIST and 56 are distributed throughout the other major departments." This is a misleading comparison and the following clarification should be added: "The DIST total includes staffing for the telecommunications function (radio and telephone) as well as administrative, data entry, computer operations, and other support personnel; the departmental total includes only those technical staff positions whose primary focus is information systems (Automated Systems Managers (ASM), Information Systems Support Specialists (ISSS), Computer Analyst Programmers (CAP) and Office Automation Administrators (OAA))."

Page 50, C.1., Organizational Structure, 3d par:
"The Information Services Division" should read "Information Systems Division."

Page 51, DIST - The Strategic Plan for Information Systems and Telecommunications:
At the conclusion of this paragraph, add: "In November 1992, DIST published a strategic plan in briefing format, which assessed the state of Information Technology in the County government and established broad objectives. Summary updates of this plan were published in August and December 1993."

Page 51, The Corporate Partnership on Quality Government:
While this was an accurate statement in September of 1995, the Police Department has come a long way since the report was issued. The following bullets represent technology related planning that has taken place to address a number of the technology deficiencies noted in the Corporate Partnership report.

- A much closer relationship has been established between the Police Department and the Department of Information Systems and Telecommunications (DIST). This is due to extensive communication between DIST and police management and staff, especially in the areas of public safety communications, police records management, and police office automation projects.

- A strategic planning seminar was held in March 1996 to define the Police Department's technology direction and needs. Attending that seminar were key personnel from DIST.

- The National Academy of Public Administration's technology implementation model is being used as the basis for such joint DIST/Police projects as the Public Safety Voice Radio and Mobile Computing Systems.

- Much of the planning associated with the above mentioned projects acknowledges the need for re-engineering police field data gathering and records management processes.

- To facilitate the successful implementation of the public safety communications and records management projects, a Systems Integrator RFP is being prepared for release.

- With respect to records management on office automation, the Police Technology Division is working closely with DIST to define, procure, and implement standard network products.

- Inter-agency coordination is continuing in the area of imaging technology to ensure compatibility.

- Basic compatibility technology standards decisions are being implemented in the Criminal Justice Information System project.

- The knowledge, skill and ability (KSA) requirements for Police technical staff positions have been developed, with the assistance and concurrence of DIST, the Office of Human Resources, and other information systems personnel. These KSA's have been developed to focus the selection process in identified Department needs.

- The selection process for the Director of Technology position is progressing with the development of the KSA's as described above.

- All of this planning is being accomplished within the developmental framework established by the Department over the past several years.

Page 51, Projects:
Add the following sentence: "This list was gleaned from approved budget documents and TIF applications but does not reflect projects that may be in the planning stage but not yet approved by the CE."

Page 52, Table 4 County Government Technology Projects Over $250,000:
Projects 2, 7, 10, 12, 14, 16, 18, 19 and 23, which were submitted in the 1994 TIF application process, no longer appear to be under active planning or development in the form indicated and should be deleted. The lead department for Project 11 (Fibernet) should be DIST. The Phase for Project 17 (Mobile Data Terminals) should be "Needs." The Phase for Project 22 (Public Safety Radio Systems) should be "Acquisition." The Phase for Project 24 (Ride-on Radio) should be "Operations." Telephone Systems Modernization should be listed as a project in the Operations Phase.

Page 53, 1st par., last sentence:
The following "Because the former director did not support technology projects" should be changed to read "The former director did not see FAMIS replacement as a high priority and..."

Page 53, Budgeting for Maintenance and Replacement Costs, 2d par:
In the first sentence, the words "replacement costs" should be changed to read "departmental computer equipment replacement costs." After the first sentence, insert: "replacements are budgeted by individual departments consistent with departmental requirements and priorities." In the second sentence, insert "PC" before "maintenance contract."

We appreciate the opportunity to comment on this draft report. We look forward to participating with the Council in its review of this report.

BR:rsd

Distribution:
Don Evans, Director, Department of Information Systems and Telecommunications
Robert K. Kendal, Director, Office of Management and Budget
Carol Mehrling, Chief, Department of Police
CAO Chron File
OLO Report File

Montgomery College

TO: Sue Richards, Program Evaluator, Office of Legislative Oversight

FROM: Dick Leurig, Director Computing Services

DATE: April 18, 1996

SUBJECT: Office of Legislative Oversight draft report 96-5: A Study of Information Technology Decision Structures

Dr. Robert Parilla, President, Montgomery College, assigned me the coordination of the draft report comments with your office. Dr. Parilla and Dr. Nunley, CAO for the College, read the report and supplied many comments for the detail response. We appreciate your timely responses to questions on various aspects of technical and policy sections. Please call me at 251-7203 for any questions and comments.

During our review of the draft, we felt there needed to be additional policy discussions and emphasis on some unique aspects of the College technology environment. These are referenced in our response to the draft discussing the technical status and plans. This memo refers to some of the overall policies and situations to help understand how the College is developing the policies and the College environment to fit student and other customer needs.

The College is in a competitive marketplace with other learning and educational centers for students graduating from high schools, training and retraining of the County work force, personal development and advancement by County residents. Methods of serving students and corporate customers include certificate programs, continuing education and life-long learning courses, and transfer of credits to four year institutions. Each of these has a strong effect on the use of technology and the need for dealing with changing technology requirements. If we fall behind in technology it will affect the number of students attending the College and the ability to respond to changing economic and business development needs.

Lack of budget for acquisition, staffing and on-going support has created problems for many incoming students using College computers having less capabilities than they have used in the public schools or at home. College high quality programs in physics and math are struggling with older 286 and 386 models to prepare students for vocations and advanced education. Lack of adequate technology in computing has jeopardized acceptance of programs for transfer to the University of Maryland. Lack of resource funding has slowed the effort of the College to provide education and training to other County units because of the initial cost of equipment for GIS and in support other units, such as Global Access training.

Montgomery College

It is difficult to compare computing and technology costs at the College to MCPS or other County agencies and units because of our mix of administrative and academic programs, many unique to higher education. There is a high emphasis on student success within the College, and often that success depends on adequate technology and informed faculty and lab assistants in the use of technology. Student successes are needed to continue attracting new students.

Academic programs and requirements are a key to understanding the College need for technology and are different from other County units. The diversity of programs to fit student needs requires faculty research and development, design of instructional courses and programs to fit those needs, various types of facilities to accommodate those courses, and current technology tools to enable a high degree of student success.

In line with most recent plans in higher education, Administrative and academic technology needs have come closer together with new network designs. The technology structure is needed to provide student advising and access to open labs and shared facilities. College technology plans describe Collegewide policies, processes, responsibilities and accountability, and campus specific technology requirements. Instructional activities and technology applications replace the older terms of academic and administrative as the network and use of technology continues to expand and offer multiple options at a single workstation. In addition to Collegewide technology plans, campus plans reflect the unique issues on each of the campuses and Continuing Education through using resources for sharing of staff, equipment and facilities.

The College is combining all technology units under one organization designated as "Information Technology". This includes computing, voice, data, video, library, learning resources, and stand-alone systems that are part of the current budgets, but sometimes operated separately. The concept of a single point for all technology related activities allows the College to examine all initiatives, projects, hardware and software, staffing and facilities during budget and planning cycles. This approach enables us to use resources more effectively and provides a single point of contact for the County units.

Thank you for the opportunity to respond to the draft. We anticipate continued involvement in the various technology discussions while retaining on-going and developing special technology needs of the College and students. The College is a natural source of technology information through our faculty and programs. We also represent a logical location for providing education to County units. We will continue to explore possible training and sharing of information with other County units as the overall County technology plans evolve.

CC: Dr. Robert Parilla, President, Montgomery College
Dr. Charlene Nunley, CAO, Montgomery College

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Rockville Campus
51 Mannakee Street
Rockville, MD 20850
(301)279-5000

Takoma Park Campus
7600 Takoma Avenue
Takoma Park, MD 20912
(301)650-1300

Continuing Education
51 Mannakee Street
Rockville, MD 20850
(301)279-5188

3. Montgomery College

Montgomery college has an information systems office budget of $5.4 million including all academic and administrative costs, on-going costs, and staffing. Telephone costs are also in this budget. While the budget may appear to be about two-thirds the size of the information systems budget in County Government or MCPS, those budgets do not include the total technology costs in other units or reflect Global Access. The College maintains a centralized operation. and operates under project management systems.

The instructional uses of computing using the Personal Computer (PC) platform operating under local area networks (LANs), Collegewide networks (MCNet), and as stand-alone classroom and labs sites has exploded and is now the largest platform. There are over 3,000 workstations at the College with over 2,000 used for instructional and academic support. Other platforms are on IBM mainframe, client-server, H-P, and Wang. The growth and student demand for academic computing has created an overwhelming demand for more technical and fiscal support, resulting in less support to replace mainframe requirements.

Lack of budget for acquisition, staffing and on-going support has created a problem for many incoming students described in our cover memo. We also stated some general policy and unique requirements of the College in the memo. The academic programs are a key to understanding the College need for technology and are different from other County units.

Many College courses are in the evening and weekends throughout the year, resulting in two shift operations for technical staff and facilities. Distance learning, distributed learning, instructional television, courses using computer e-mail techniques and other alternative learning methods offer opportunities for students who cannot attend during working hours.

Organizational Structure

The management of information technology is centralized in the Computing Services unit housed on the Rockville campus. The unit provides computer services to the College administrators and to each of the campuses, develops information technology strategic plans, and oversees and reviews departmental project planning. The Computing Services unit is a central point for the procurement of hardware and network operations and the assignment of computers.

There are 45 staff in Computing Services . Approximately one-fourth of the staff are assigned to campuses, one-fourth are dedicated to maintaining administrative systems. twelve staff support operations, the academic labs and computer support functions and 4 staff maintain the networks. When the new Germantown HTSC building is completed and phase I of the planning to complete the infrastructure is completed, newer technologies require a broader knowledge of all voice, video and data capabilities in a central location and redistribution of staff. Training of the staff in

the new releases of hardware and software and the necessity of being available during the class and lab schedules have an increased impact on future staffing, since by industry standards the College is understaffed for the systems.

Assessments and Strategic Plans

The College has developed a number of plans in the past, including nine major documents driving the technology structures through FY98. The larger plans have been presented and reviewed by County organizations in the past, including an update to the Council in 1994. An Information Resources Plan (IRP) was developed Collegewide by active groups having input into the plan and was approved in 1991 by campuses, administration, and the Board. The document is used to develop detailed tactical and operational initiatives. Other plans included the Broadband Network Requirements plan by Educational Support Services using internal input and outside consulting focused on television and video needs; Integrated College Network plan used to prepare costs and detailed plans for the infrastructure phases currently funded; an extensive Germantown High Technology Science Center plan being used to complete the technology portions of the building and the networks; Continuing Education technology plans; telephone system plans; Montgomery College Network (MCNet) for the Collegewide backbone and extending services to all campuses and appropriate buildings and rooms; and various campus instructional and academic plans.

The rapid changes in technology resulted in parts of the plans becoming obsolete and the time to update the five year plan created an opportunity for review and assessment of the past and view toward the future. The new plan would consolidate the various plans with updates on a dynamic review schedule as the requirements and the technology industry continued to change. College plan will be expanded later to consider the interfaces with Global Access and Fibernet projects.

Computing Services is developing updated Computing Plans for each of the campuses while the technical consultants develop network and access plans. To develop these instructional and academic plans, technology staff conduct multiple interviews to identify teaching needs, desired student outcomes and other result areas. The long range plans identify the major priority technology projects for each campus. New updated plans have been completed for Germantown, Takoma Park, and Continuing Education. The plan for the Rockville campus and an updated telecommunications plan should be completed by May 1996. Collegewide plans will be consolidated in June 1996 following College, administration, and board review. These plans will be available for ITPCC and Council review in September 1996 after College reviews.

On an on-going basis, work requests, grants, new products and student and customer demand will permit a dynamic plan with provisions for updating and approval. Preliminary discussions of this plan anticipates three phases, with the initial phase the completion of the infrastructure that will occur over FY97-98. The remaining two phases show priorities and possible future uses based on current knowledge. This overall plan was estimated at $26 million total costs as a

request for some comparison to MCPS Global Access plan, with $3 million being the first phase capital infrastructure costs and Phase II of approximately $7 million for high priority projects using the completed infrastructure. On-going costs and staffing are calculated into all College projects and remain a concern as budgets are tightened and resources may not be available.

Projects

The College has one large Collegewide project over $250,000 after the decision to combine all capital projects under Information Technology projects for the College The combined project includes the old Facility Wiring for Cable project originally shown as $8.7 million to establish a broadband fiberoptics telecommunication distribution system for voice, data and audio applications among campuses. The Instructional Computing Equipment project originally shown as $2.7 million for computer equipment in classrooms and instructional labs on three campuses has been included in the overall capital plan. Projects for gradual replacement of hardware at the end of their useful life based on the College's annual updated Five Year Plan for Computing Services is also included in Phase I and Phase II of the overall plans. The remaining Phase III is an estimate based on currently developed plans and will be updated prior to any budget requests in order to reflect technology changes.

The emphasis during the first phases are in the completion of the technology infrastructure and instructional needs. Long term plans anticipate more open student labs and new methods of teaching and learning. However, the academic and administrative applications must also be updated to stay in line with student needs and success. Academic applications include assessment centers, writing and reading labs, language labs, facilities for special student needs, libraries, training and development centers, and placement and career facilities.

Administrative systems and faculty advising are key system components to the College and are tied to various administrative applications. The Student Information System is unique to higher education and is the College foundation for other administrative systems. The system must be responsive to student admissions, financial aid, registration and scheduling. This large system must also respond to state and federal student requirements and analysis as will as for internal needs and reviews. Because of the mixture of students, schedules, and specific student needs, the data bases to support these key systems require that student records be available for a long period of time, so the computing and technology storage and retrieval and access to data far exceeds a single semester or annual student count. Advising of students and access to the system for grade reporting, counseling, changes in schedules and financial aid information requires access by administration and faculty throughout the year. This is a key reason for completion of the infrastructure throughout the College and will then permit instructional expansion.

Alumni and development systems, library systems, Internet, student placement, planning and research reports designed for higher education, campus bookstores and other services, child care facilities and the process for curriculum development and approvals represent other applications different from most other County units. Financial systems and human resources systems have

been nationally developed for higher education to accommodate the need for part-time and full-time faculty, tuition and payment of telephone registration and fiscal policies for dropping and adding courses with financial aid and student employees impacting the basic systems. The College must abide by extensive and detailed analysis by national and regional organizations for accreditation. In the information technology areas, the availability of labs, computer workstations, library requirements and technology facilities are a part of these self study and peer evaluations for accreditation and comparisons to other institutions.

Project Selection and Management Practices

The selection of technology projects is made largely through the budget process, which begins in the fall with the development of unit plans. Approximately 50 units develop plans that describe their strategic direction, critical objectives and cost estimates for the year. The Director of Computing Services also reviews the program recommendations in all of the other unit plans to identify technology needs. Unit plans are reviewed by the Deans and Provosts on each campus in order to develop the annual budget that is reviewed by the CAO/President and the Board prior to being submitted to the County Executive and the Council.

The College has an existing on-going required project management system. At the beginning of each project, staff from Computing Services and the appropriate program or area develop a project plan. The project plans include a statement of what the project will and will not do, a list of user requirements, an evaluation of alternatives, capital and operating cost estimates, an implementation schedule, a discussion of risks and risk avoidance, and a sheet for tracking project progress. Projects are reviewed and agreed to by the Computing Services and the user representative. Status reports are produced during the project on a regular basis. There are usually over 300 projects described and developed and on project lists updated on an on-going basis. The project methodology used by the College has resulted in excellent project completion within the time frames and budget agreed during the project initiation.

Budgeting for Maintenance and Replacement Costs

Montgomery College has a complete inventory of their information technology. A college-wide system was developed that indicates the number, kind, and location of all hardware and software on the network. Maintenance funds are included in the budget of the Computing Services unit, but budget constraints restrict some projects and create the need for alternative methods including outsourcing or contracting many of the tasks and maintenance.. The College does not have a replacement fund, but recognizes the need for replacement funds especially with the short life cycle of instructional and academic computing demands..

OLO REPORT 96-5

April 30, 1996

A STUDY OF INFORMATION TECHNOLOGY

DECISION STRUCTURES

Appendices

Office of Legislative Oversight

100 Maryland Avenue, Rockville, Maryland 20850, 301/217-7990

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APPENDIX A

Summary of Suggestions for Senior Executives

General Accounting Office, Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology, Learning From Leading Organizations, May, 1994.

APPENDIX A

Summary of Suggestions for Senior Executives From the General Accounting Office's Executive Guide on Improving Mission Performance Through Strategic Information Management and Technology

1. **To assess and make the case for business change,**
- Initiate a thorough review of current performance, information systems spending projected versus realized results and major information management problems;
- Benchmark information management practices against leading organizations—preferably chosen according to objective data or recognized criteria.

2. **To increase line management accountability for the mission impact of information management decisions,**
- Establish an organization-wide information management steering committee chaired by the chief executive and led by senior line management;
- Identify executive-level sponsors for each major information systems project.

3. **To initiate an improvement program and maintain its momentum,**
- Educate senior line management through a combination of conferences, training, co-location and rotation programs at all levels and joint visits with information management professionals from organizations that use technology well;
- Identify an informed, committed opinion-leader to be a champion in supporting information management improvement.

4. **To begin linking information systems more closely to customer needs and mission goals,**
- Choose at least one major mission area to specifically define customer groups and needs and integrate with strategic business and information plans;
- Choose one major information system initiative and determine if its key requirements will meet both external and internal customer needs.

5. **To assess the mission value of information management,**
- Identify outcome-based measures of accomplishment for a major mission area and benchmark performance against a comparable organization, public or private;
- Charter senior management teams to develop measures that specifically assess the contribution of information systems investments to mission performance and the performance of the internal information management organization.

6. **To begin focusing strategic resources on process innovation in the context of an architecture,**
- Task a senior management team to lead a high-level process analysis of the organization and identify and sponsor a major process improvement opportunity;
- Appoint both a business and an information architect—reporting to the information management steering committee—to facilitate the design and maintenance of an organization architecture (e.g., processes, information flows, and technology).

7. **To hold line managers more accountable for project selection, delivery and rigorous reports reporting,**
- Task a team to develop decision criteria for selecting and evaluating major information systems projects;
- Institutionalize a process to propose, select, develop and evaluate the results of all information investments.

8. **To begin integrating all the elements of an integrated strategic planning cycle,**

- Choose one critical mission area, if possible limited in scope, to fully integrate business and information planning, systems planning, budgeting and performance evaluation;
- Task a senior management team to design and implement an annual information management performance report as an input to strategic planning.

9. **To get line and information managers working together,**

- Institute a regular survey of line management's satisfaction with the information management's organization's quality, cost, and responsiveness;
- Require every information systems project team to define line and information management roles throughout the entire project life cycle.

10. **To articulate information management's role in mission improvement,**

- Recruit a CIO and task the CIO to participate in a line management effort that identifies major opportunities to use information systems to enhance performance.

11. **To upgrade information management capability,**

- Systematically identify information management skill targets and gaps for both line managers and information management professionals;
- Fully integrate skill and knowledge requirements in performance evaluations and promotion criteria.

Source: GAO, Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology. May 1994.

APPENDIX B

Budget Request Requirements and Statewide Information Resource Management Policies

State of Minnesota, Information Policy Office, 1996-97 Information Resource Funding Recommendations, February 1995.

APPENDIX A:

1996 - 97 INFORMATION RESOURCE FUNDING REQUEST RECOMMENDATIONS

(Sent to agencies May 18, 1994)

The Information Policy Office (IPO) is required by Minnesota Statute 16B.41 to review all state agency information resource budget requests before they are submitted to the legislature.

The objectives of the budget reviews are to help agencies invest wisely and complete successful projects. For the FY 1996-97 biennial session, all project requests will be measured against a set of standards based on policies developed by IPO. The standards are consistent with past budget request requirements.

The standards are grouped into six critical success factors:

- Executive leadership and involvement;
- An information management infrastructure built around policies, standards and guidelines;
- Planning that includes agency-wide implementation plans, project plans, cost/benefit/risk analyses, and project scopes;
- High-level information resource models that collectively describe agency functions, data, data distribution and technology;
- An organizational structure that manages all aspects of the organization's information resources; and
- An effective skills base.

Each critical success factor has one or more standards against which agency funding requests will be measured (Figure 1). Agencies must provide several products to demonstrate compliance with the standards. Agency requests must also include a one-page summary of the purpose of the request, which must include the business needs the request will meet, and the potential risks to organization stakeholders if those needs are not met.

Any agency expecting to submit a request for review must contact IPO no later than June 15, 1994. Agency requests must be submitted to IPO no later than October 31, 1994.

Agency requests must incorporate public information policy requirements mandated by Minnesota Statutes Chapter 13 (Minnesota Government Data Practices Act); Chapter 15.17 (Official Records Act); Chapter 138.17 (Government Records Act); and all other state and federal statutory requirements relating to data practices and records management. IPO will provide agencies with examples of the required products and will conduct meetings with agencies to clarify the requirements and answer questions.
For additional information or to have questions answered, call Greg Peterson at 296-6397.

FY 1996-97 Agency Information Resource Budget Request Requirements

Project Summary

Agencies must provide:

- A one-page summary of the project that includes the purpose for the project and the business needs and risks the project will address, including the risks to stakeholders if business needs are not met.

Critical Success Factor 1: Executive Leadership and Involvement

Information management requires the active support of top level management, who must assume responsibility for managing and developing the information resources under their control. Because information resources have agency-wide and statewide value, managing them requires authority and accountability that only executive level management can provide. Agency leadership is required for projects to achieve their potential.

Funding Request Standard 1.1: Agencies must identify an executive with the responsibility, authority and accountability to manage the organization's information resources.

The executive must have the authority and responsibility to:

- Establish policies, standards and guidelines.
- Ensure that adequate information resource models are established and maintained.
- Ensure that an implementation/migration plan is established, maintained and followed.
- Ensure that the management of information resources is linked to business plans, goals, objectives and strategies.

Agencies must provide:

- Name and title of the executive responsible for information resources; and
- A list of the authorities and responsibilities of that person; for example, a position description.

Funding Request Standard 1.2: Agencies must establish an information resource steering committee that advises the executive on managing the organization's information resources. The information resource steering committee must have representatives from top management, information system professionals and users of systems. Agencies must take into consideration the size and complexity of the organization involved when determining the makeup of the committee.

Agencies must provide:

- A policy establishing the information resource steering committee and defining its responsibilities;
- A list of the committee's members, their titles and what organizational units they represent;
- A description of the process used to consider and select projects that are forwarded to the steering committee and IPO; and
- The criteria for determining what issues will be brought before the steering committee for action.

Critical Success Factor 2: Information Management Infrastructure

Agencies need an information management infrastructure made up of policies, standards and guidelines that direct the strategic management of information resources. IPO is developing statewide policies, standards and guidelines that will provide a framework for agencies to use in developing their own policies, standards and guidelines.

Funding Request Standard 2.1: Agencies must develop information resource policies, standards and guidelines. Agency policies, standards and guidelines must address established public information policy as stated in federal and state laws, administrative rules and existing statewide policies issued by IPO.

Agencies must provide:

- A description of how the policies, standards and guidelines are adopted and communicated; and
- Existing or proposed policies, standards and guidelines.

Critical Success Factor 3: Planning

Planning must be conducted from agency and project perspectives. The agency-wide perspective ensures that the right projects are done in the right sequence. The project perspective ensures that the projects are done properly.

The agency-wide perspective is provided by an implementation plan that takes into account business priorities and ensures that projects are completed in a rational sequence. The agency-wide implementation plan determines priorities, and explains what will be replaced, modified or interfaced, and in what order.

Each project for which funding is being requested needs a scope, cost/benefit/risk analysis and a project plan.

Funding Request Standard 3.1: Agencies must develop a one- to two-year agency-wide implementation plan that identifies all projects, priorities and the sequence in which projects will be implemented.

Agencies must provide:

- The agency-wide implementation plan.

Funding Request Standard 3.2: Agencies must develop a scope for each project for which funding is requested. The project scope must link the project to an agency's mission, goals and objectives, and define project objectives and how they will be reached. It must establish boundaries to help management keep the project's complexity and budget under control. It must identify project ownership and support, joint management of project, partnerships or data community work within or external to the organization, including impact on local governments.

Agencies must provide:

- A description of the project scope.

Funding Request Standard 3.3: Agencies must complete a cost, benefit and risk analysis of each project for which funding is requested. Agencies must use Information System Life Cycle Methodology, available from IPO, when completing a cost, benefit and risk analysis . The methodology has seven categories of costs, four categories of benefits, and five categories of risk that must be considered.

Agencies must provide:

- A cost, benefit and risks analysis of each project.

Funding Request Standard 3.4: Agencies must develop a project plan for each project for which funding is requested. The project plan must clearly show how the project will be managed and controlled. The project plan must provide timetables and details on how the scope will be accomplished.

The project plan must at minimum address:

- Tasks and schedule.
- Deliverables and outcomes.
- Resource requirements.
- Compliance with established IPO statewide policies, standards and guidelines, and public policies and statutory requirements.

Additional items for agency consideration are capacity planning, maintenance and enhancements, user requirements, citizen access to electronic information, improved service to citizens, planning and coordinating work process re-engineering, quality measures and user acceptance criteria, use of existing resources, such as MNet, training, project evaluation, independent oversight of large projects, and compliance with established IPO statewide polices, standards and guidelines.

Re-engineering and quality are critical to the success of every project. Several reference materials exist that may provide some additional guidance for re-engineering of work processes: Re-engineering Your Business by Morris and Brandon; Process Innovation by Davenport; Re-engineering the Corporation by Hammer and Champy; Re-inventing the Corporation by Naisbitt and Aburdene; The Challenge of Organizational Change by Kanter, Stein and Jick; Re-inventing Government by Gaebler. Other books may provide assistance in planning and quality, such as Strategic Planning by Steiner; The Customer Driven Company by Whiteley; and books by Juran Deming and Crosby.

Agencies must provide:

- A plan for each project.

Critical Success Factor 4: High Level Resource Models

High-level information resource models help an agency manage and share its data effectively. Models collectively describe project data, technology, and their distribution, and how they are used to support business functions. The models also help identify impacts across business functions and systems. Modeling facilitates making decisions, planning and project management. They are critical to business process re-engineering and quality initiatives as well as RFP development efforts.

Funding Request Standard 4.1: Agencies must create a high level functional business model that includes a description of all functions. Each function must be a major business component that has a well-defined and cohesive role in fulfilling the organization's mission.

Agencies must provide:

- A high level functional business model that briefly describes each organizational function.

Funding Request Standard 4.2: Agencies must create a high level data model for the proposed project that shows entities and relationships. An entity is a person, place, thing, concept or event about which data are or can be recorded. A relationship is an important association between one or more entities that provides some relevant business information.

Agencies must provide:

- A high level entity/relationship diagram for the project.

Funding Request Standard 4.3: Agencies must create a high level distribution model for the proposed project. The distribution model must show the physical distribution of project entities among the major business locations. The model must show the geographic locations of project data entities and user organizations.

Locations can be broad in coverage. For example, Duluth may contain multiple facilities, but could be considered a single business location. Examples of entity distribution are:

- Centralized: Entities are resident at one location; one form and one content.

- Replicated: Entities are physically duplicated at two or more locations; same form and content will be in all places.
- Partitioned: Entities are separated and distributed to two or more locations; same form will exist in each location, but content will differ.

Agencies must provide:

- A chart or diagram showing geographic locations of project entities and users.

Funding Request Standard 4.4: Agencies must create a high level technology model for the proposed project. The technology model must describe the required hardware, network links and operating software.

Hardware processors might be PC's, minicomputers or mainframes. Network links include routers, modems, lines, etc. Operating software is the software that is required to support and manage data access and transaction operation, including operating systems, database management systems, dictionaries/repositories and programming language facilities. The technology model identifies capacity and compatibility requirements, but does not identify specific vendors or products.

Agencies must provide:

- A chart or diagram of the hardware, operating software and network links required for the project.

Critical Success Factor 5: Organizational Structure

Accountability and responsibility for information resources should be agency-wide. The agency should be structured so that resources can be appropriately managed and shared. The management of information resources will require agencies to assess their organization for its readiness to develop, operate and maintain its information resources.

Funding Request Standard 5.1: Agencies must be structured to allow information resources to be appropriately managed and shared.

Agencies must provide:

- A description of the current information management structure, such as an organization chart.
- An assessment of the current structure's effectiveness for managing agency information resources now and in the future.

Critical Success Factor 6: Effective Skills Base

Investments will be needed to acquire, train and retain skilled professionals who can carry out the project and implement the resources. An appropriate skill base is a requirement for the successful completion of the project.

Funding Request Standard 6.1: Agencies must develop an assessment of skills needed for the project and a plan for developing and acquiring the needed skills.

Most projects will require individuals with a good understanding of planning and modeling techniques; business experts who understand data access tools; and builders and developers who understand modern analysis/design techniques for shared data. When assessing needed skills, consider individual and group needs for training, data administration experience, database administration experience, project management experience and overall modeling knowledge.

Agencies must provide:

- An assessment of skills needed for the project.
- A plan for developing and acquiring needed skills.

APPENDIX B

STATEWIDE INFORMATION RESOURCE MANAGEMENT POLICIES

(Issue date: May, 1994)

Introduction to Information Resource Management Policies

Information resource management (IRM) provides agency executives and line managers an effective way to get more out of their investments in information resources. Information resources are defined as data, applications, technology and associated facilities. Information resources are managed in compliance with public information policy, primarily contained in Minnesota statutes, and IRM policies, standards, and guidelines.

IRM provides the legislature assurances their investments in agencies' information resources are being implemented appropriately and in compliance with public information policy. The environment described by the IRM policies will take many years to put in place but a long journey always begins with the first step. The first step for agency executives and managers is to begin understanding IRM. Minnesota IRM policies will provide managers with a framework for managing information resources and will help them to understand the IRM direction.

In 1985, the Information Policy Council established Information Management Principles for agencies to follow when managing information. These general, strategic-level principles have guided the work of the Information Policy Council and Information Policy Office in the ensuing years. The IRM policies are a logical extension of these principles.

- Data Principle - Data is a valuable resource that is to be managed and shared across organizational boundaries. Data must be secure and privacy protected while making it available to those who need it to do their job or function in our democracy.

- Management Principle - Management of information is a fundamental responsibility of managers that cannot be delegated. Executive leadership and involvement is fundamental to the success of information management.

- Standards Principle - Standards for information technology bring agencies together to allow cooperation and more effective and efficient work.

- People Principle - Information empowers people. Government workers can do their jobs better and citizens can participate in our democracy more effectively with good information.

In order to put these principles into practice, the Minnesota Legislature established the Information Policy Office (M.S.16B.41). IPO is responsible for setting the state's direction in information resource management. Specifically mentioned in the legislation are responsibility for the IPO to, among other things, develop and establish:

- policies and standards for state agencies to follow for the development, purchase, and training for information systems;

- techniques for planning and managing information systems that ensure the needs of the agency and the state as a whole are met;

- a state technology architecture, standards, and guidelines that ensures individual agency systems do not needlessly duplicate or needlessly conflict with the systems of other agencies;

- information needs analysis techniques;
- contracts for the purchase of equipment and services;
- training of state agency personnel on these issues; and
- efficient and cost-effective methods of producing, sharing, and storing data.

In accordance with the IPC Principles for Information Management, the Information Policy Office has established a vision for Minnesota regarding information that can be reached through effective information resource management: This vision for Minnesota is:

equal and lawful access to information regardless of location.

Lawful access is defined in large part by a series of statutes administered by the Information Policy Office. These laws, M.S. 15.17 (Official Records), M.S. 138.17 (Government Records), and M.S. Chapter 13 (Government Data) pertain to data practices and records retention and disposition. In addition, there are numerous other statutes that provide agencies and programs with their policy purpose, responsibilities, and detailed guidance on handling government data. It is imperative that agency executives understand and manage issues related to lawful access and other public policy requirements that affect government data.

IPO will be issuing standards and guidelines related to the IRM policies in consultation with the Information Policy Council to help agencies with their journey to the IRM environment. For these IRM policies, standards, and guidelines to be effective, the legislative policy purpose, agency business objectives, and data practices, access, privacy, and retention considerations must be clearly identified and articulated by agency executives.

The legislature and the federal government formulate public policy that directs state agencies in the conduct of their business and the handling of information. It is within this body of public policy and public information policy that IRM is conducted. In our democratic society, there is a necessary tension between IRM and public policy. On the one hand, IRM requires government to optimize the use of its information resources through sharing to avoid unnecessary duplication of data, applications, and technology. On the other hand, public policy and public information policy requires government to safeguard its information resources -- especially data resources -- and sometimes limits the sharing of and accessibility to data. It is this paradox of making information accessible and sharable while protecting it and managing its use that absolutely requires executive leadership and involvement.

1 Managing Information Resources as Valuable Assets

Organizations shall manage information resources and associated facilities as valuable assets critical to fulfilling their missions. Organizations shall apply appropriate management controls to their information resources just as they do to their human, equipment, facilities, material, and financial resources. Organizations shall plan, organize, measure, control and share their information resources to optimize their effectiveness while minimizing costs to those with a stake in the design and use of particular information resources. Organizations shall manage their information resources to assure compliance with statutory requirements on public access to data, rights of subjects of government data, and records management.

2 Leadership and Accountability

Responsibility and authority for information resource management (IRM) shall be established and maintained in each organization to manage all aspects of the planning, development, acquisition, maintenance, operation, evaluation and adherence to statutory policies for the information resources of the organization. The individual responsible for IRM shall hold an executive level position and be responsible for ensuring that all aspects of the organization's planning, development, and operation of information resources comply with applicable public policies and IRM policies.

3 Skill Base, Recruiting, Training

Agencies shall invest in acquiring, training, and retaining skilled information professionals to enable the building and maintenance of an effective information environment. Agencies shall provide employees with appropriate information technology tools and training that allow them to be effective. Training shall include attention to statutory policies that affect the information environment.

4 Organization

Management of internal information resources shall be a cooperative effort between the information users, senior management, and the IRM organization. An information resource steering committee composed of agency executives shall advise the organization's IRM executive on the business needs, public access requirements, rights of subjects of government data, data security and data retention considerations.

5 Data Communities

Information resources are to be shared and managed across traditional organizational boundaries. Data sharing across boundaries presents significant issues concerning privacy rights of subjects of government data that must be properly managed. Agencies have stewardship responsibilities for their information resources which shall be managed within data communities. Data communities shall be organized around common business processes and customers. Agency IRM executives are responsible for ensuring participation in appropriate data communities to optimize the use of information resources across organizational boundaries. IRM executives are also responsible to assure that use of information resources is accomplished in compliance with statutory policies that affect information sharing.

6 Investments

Organizations shall establish and maintain a funding strategy by which common, shared information resources can be developed, acquired, and operated within agencies and data communities. This strategy shall be used to eliminate financial or political disincentives to sharing data, applications, and technology within agencies and data communities. The funding strategy shall not conflict with statutory requirements and public information policy.

7 Quality

Agencies shall use information resources to add value to their services and products, reduce costs, meet customer needs, and measure outcomes. Quality management concepts shall be applied to the information management process and to the information resource development process in particular. Simple automation of manual processes or replacement of old applications without reengineering, fundamental restructuring, or streamlining shall be avoided. Attention to quality in the management of information resource development includes attention to meeting statutory requirements.

8 Security

Agencies shall put in place cost-effective controls to protect their information resources from accidental or deliberate modification, destruction, unauthorized access or illegal dissemination.

9 Policies, Standards, Guidelines

Organizations shall adhere to all statewide IRM policies, standards, and guidelines. The process for promulgating policies, standards, and guidelines shall involve, to the fullest extent practical, all organizations affected by or concerned with the issue at hand. Organizations shall develop their own policies, standards, and guidelines as appropriate consistent with statutory requirements and statewide policies, standards, and guidelines.

10 Models

Organizations shall create and continuously maintain models of their information resources. These models shall be used to help managers and workers visualize and understand how the agency's information resources relate to the public policy purpose and business objectives of the agency and the data community. The models must also address legislative policies on public accountability, public access to government data, the rights of subjects of government data, and records management. These models are the products of agency and data community strategic business planning. These models shall be kept and managed in a manner that makes them accessible to all information users.

Organizations shall use models of their information resources to identify, scope, and plan projects to develop or acquire information resources.

11 Implementation Plans

Organizations shall develop long-range implementation plans which identify potential information resource development projects. At least annually, organizations shall review the sequence and purpose of the plans and, if necessary, modify them to account for changes in business strategies or priorities, and changes in statutory policy that affect access to and dissemination of the organizations information resource. The implementation plans shall be the primary determinant of how agencies allocate their development resources and requests for legislative appropriations.

Information resource projects shall be conducted after costs, benefits, and risks have been analyzed including the effects the project will have on other units of government and privacy and other related rights of citizens. Information resource development projects shall be conducted and evaluated using appropriate project management tools, financial and schedule controls, development methodologies and tools, and policies and procedures that pay attention to the project's compliance with statutory policies and requirements.

12 Data Practices

Organizations must develop and manage government data consistent with the public information policies and requirements of the Minnesota Government Data Practices Act, to ensure public access to government data, and the protection of rights of subjects of government data. Identification of the classification of data and issues of statutory compliance shall begin during the early stages of strategic planning and data modeling. The affects of the data's classification and attention to compliance with statutory requirements shall continue through design, installation, and maintenance.

13 Data Retention & Disposition

Organizations are responsible for ensuring that data is developed and managed consistent with the Minnesota Official Records and Records Management Acts. Identification of what data are needed for public accountability and of the retention and disposition requirements of data and what data are needed for public accountability shall begin during the early stages of strategic planning and data modeling and continue through design, installation, and maintenance.

14 Technical Standards

Organizations shall use statewide technical standards that promote data sharing, interconnectivity, and interoperability when planning, designing, constructing, purchasing, and implementing information resources. Organizations shall evaluate the technical standards to assure these requirements comply with statutory policies. If products are not available that both meet the agency's business requirements and conform to technical standards, and statutory requirements, agencies should determine the best business solution and adjust their plans accordingly.

APPENDIX C

Steps and Deliverables in the Traditional System Life Cycle - User Participation

Steven Alter, Information Systems: A Management Perspective, 1989.

APPENDIX C

TABLE 16.6

Steps and Deliverables in the Traditional System Life Cycle

PHASE/STEP	DEGREE OF USER PARTICIPATION	KEY DELIVERABLE, PLAN, OR DOCUMENT	KEY PARTICIPANTS
INITIATION			
Feasibility study	high	Functional specification	User representatives, management, and technical staff
Project planning	medium	Project plan	User representatives, management, and technical staff
DEVELOPMENT			
Detailed requirements analysis	high	External specification	User representatives, management, and technical staff
Internal system design	none	Internal specification	Programmers and technical staff
Hardware acquisition and installation	none	Hardware plan Hardware operational	Technical staff
Programming	none	Individual programs debugged	Programmers
System testing	medium	Test plan Completed system test	Programmers and users
Documentation	medium	User and technical documentation	Technical staff and users
IMPLEMENTATION			
Implementation planning	high	Implementation plan	Training staff, users, and management
Training	high	Training materials	Trainers and users
Conversion	high	System in use	Users and project team
Acceptance testing	high	System accepted	Users and project team
Post-implementation audit	high	Audit report	Users and management
OPERATION AND MAINTENANCE			
Ongoing operation and support	low low high	Operations manual Usage statistics Enhancement requests and bug fix requests	Technical staff Technical staff and users Technical staff and users
Maintenance	medium	Maintenance plan	Technical staff and users
Absorption or termination	- - -	- - -	- - -

Steven Alter, Information Systems: A Management Perspective

APPENDIX D

Project Implementation Risk Assessment Questionnaire

James Cash et al., Corporate Information Systems Management, 1992.

APPENDIX D

FIGURE 10–3 Project Implementation Risk Assessment Questionnaire (sample from a total of 42 questions)

Size Risk Assessment

Risk Factor			*Weight*
1. Total development work-hours for system[a]			5
100 to 3,000	Low	1	
3,000 to 15,000	Medium	2	
15,000 to 30,000	Medium	3	
More than 30,000	High	4	
2. Estimated project implementation time			4
12 months or less	Low	1	
13 months to 24 months	Medium	2	
More than 24 months	High	3	
3. Number of departments (other than IT) involved with system			4
One	Low	1	
Two	Medium	2	
Three or more	High	3	

Structure Risk Assessment

Risk Factor			*Weight*
1. If replacement system is proposed, what percentage of existing functions are replaced on a one-to-one basis?			5
0% to 25%	High	3	
25% to 50%	Medium	2	
50% to 100%	Low	1	
2. What is severity of user-department procedural changes caused by proposed system?			5
Low		1	
Medium		2	
High		3	
3. What is degree of needed user-organization structural change to meet requirements of new system?			5
None		0	
Minimal	Low	1	
Somewhat	Medium	2	
Major	High	3	
4. What is general attitude of user?			5
Poor; against IT solution	High	3	
Fair; sometimes reluctant	Medium	2	
Good; understands value of IT solution		0	
5. How committed is upper-level user management to system?			5
Somewhat reluctant, or unknown	High	3	
Adequate	Medium	2	
Extremely enthusiastic	Low	1	
6. Has a joint IT–user team been established?			5
No	High	3	
Part-time user representative appointed	Low	1	
Full-time user representative appointed		0	

FIGURE 10–3 *(continued)*

Technology Risk Assessment

Risk Factor			*Weight*
1. Which of the hardware is new to the company?[b]			5
None		0	
CPU	High	3	
Peripheral and/or additional storage	High	3	
Terminals	High	3	
Mini or micro	High	3	
2. Is the system software (nonoperating system) new to IT project team?[b]			5
No		0	
Programming language	High	3	
Database	High	3	
Data communications	High	3	
Other (Please specify)	High	3	
3. How knowledgeable is user in area of IT?			5
First exposure	High	3	
Previous exposure but limited knowledge	Medium	2	
High degree of capability	Low	1	
4. How knowledgeable is user representative in proposed application area?			5
Limited	High	3	
Understands concept but has no experience	Medium	2	
Has been involved in prior implementation efforts	Low	1	
5. How knowledgeable is IT team in proposed application area?			5
Limited	High	3	
Understands concept but has no experience	Medium	2	
Has been involved in prior implementation efforts	Low	1	

Source: This questionnaire is adapted from the "Dallas Tire" case, No. 180-006 (Boston, Mass.: Harvard Business School Case Services, 1980).

Note: Since the questions vary in importance, the company assigned weights to them subjectively. The numerical answer to the questions is multiplied by the question weight to calculate the question's contribution to the project's risk. The numbers are then added to produce a risk score for the project. Projects with risk scores within 10 points of each other are indistinguishable in their relative risk but those separated by 100 points or more are very different in their implementation risk to even the casual observer.

[a]Time to develop includes systems design, programming, testing, and installation.

[b]This question is scored by multiplying the sum of the numbers attached to the positive responses by the weight.

Source: Cash et. al., Corporate Information Systems Management, 1992

APPENDIX E

Description of the Logical Framework Analysis

Government of Canada Working Group on Justifying Investments in IT, Justifying Investments in Information Technology: Guide for IT and RC Managers, May 1995.

APPENDIX E

Logical Framework Analysis

The Logical Framework Analysis (LFA) is a simple dynamic technique for planning, communicating and controlling the major points of an investment. It can be modified at any time during the investment as long as the Client accepts the new conditions and the Sponsor continues to fund the changes. Therefore, all the documentation pertaining to the changes should be kept. The information source for completing the LFA is the analysis discussed in this guide.

The LFA can be used for any kind and size of investment. The analysis is done on a single page which focuses everyone's attention on the essential elements of the investment and forms the basis for criteria used in each investment review. The LFA captures all the major inputs, outputs, investment impacts and goal of the investment. It uses objective results indicators with some means of verification and takes into consideration the critical conditions beyond the control of the investment.

Two dimensions of logic must be followed in constructing a LFA. The vertical logic and the horizontal logic that must be carried in the following order:

- **The vertical logic of the LFA describes the investment and the critical conditions that may have a negative impact to the success of the investment.**

  The first logic to complete in the LFA is the vertical logic. It must be done using the following steps:

  - Write a narrative summary of the GOAL for what the investment is intended and why you need the investment. The goal of the investment should be evident upon completing Chapter 2 and should remain consistent throughout the options analysis discussed in Chapter 7.

- Write a narrative summary of the objectives that the investment must meet (INVESTMENT IMPACTS) if it is to achieve the GOAL. No quantification required. The INVESTMENT IMPACTS of the investment should be found in Chapters 2, 3, 4, 5 and 6.

- Write a narrative summary of the OUTPUTS that the investment will produce to meet the objectives. The OUTPUTS of the investment should be of the option that was chosen in Chapter 7.

- Write a narrative summary of the INPUTS that are required to produce the OUTPUTS. The INPUTS for the investment should be found in Chapters 2, 3, 4, 5 and possibly, 6.

- For each of the rows (GOAL, INVESTMENT IMPACTS, OUTPUTS, AND INPUTS) identify what are the critical conditions under which no direct control can be exerted and which may have a negative impact or be a barrier to the other factors in the row. For example, what are the critical conditions that may be a barrier to using some of the inputs or what are the critical conditions that may be a barrier to the planned INVESTMENT IMPACTS? Critical conditions should be found in Chapters 5 and 6 that relate to the option chosen in Chapter 7. This is a crucial step. Often, a critical condition is not identified on the LFA because of political considerations and it is frequently for those reasons that the investment is not a success. If a critical condition is not clearly indicated, it is generally wiser not to initiate the investment. Even if it has already started, it should be cancelled. Otherwise, it may become uncontrollable.

- Before going to the horizontal logic, review all the narrative summaries and their critical conditions with the Client so that all participants have a common understanding of the scope of the investment. Don't be surprised if there is a lot of disagreement at this stage. It is normal. It takes often several tries before a consensus is reached.

- For a general example, look at the sample LFA at the end of this section.

- **The horizontal logic identifies where the verifiable results indicators of the investment can be find.**

  The horizontal logic in the LFA is carried using the following steps:

  - Identify all the OBJECTIVELY VERIFIABLE RESULTS INDICATORS for each row of the LFA. These can be found in Chapters 4, 5 and 6. This is the time for quantification. *Everything is measurable.* If something seems unmeasurable, then shift the paradigm and go beyond what is generally perceived as measurable (e.g., date, quantity, size, speed, cost, income, number of human resources, number of defects, happiness, waiting time, and ratio).

  - Identify in which MEANS OF VERIFICATION OF RESULTS can OBJECTIVELY VERIFIABLE RESULTS INDICATORS be verified (e.g., financial reports, time sheets, memos, letters, votes, and surveys). These media should be found in Chapters 4, 5 and 6. Again, this identification is for the selected option.

Work is currently underway to expand the model presented here to incorporate the assessment of risk factors, i.e., what their expected impact could be and what measures should be pursued to mitigate them.

Logical Framework Analysis **Organization:** Human Resources Development Canada
Mobile Labour Affairs Officer (M-LAO)

	Narrative Summary	Objectively Verifiable Results Indicators	Means of Verification of the Results	Critical Conditions
Goal	❑Promote a fair, safe, healthy, stable and cooperative work environment ❑Improve Service to Federal Jurisdiction Clients	Post-Implementation increase of public satisfaction by: –> 25 % (Excellent) –15-20% (Very Good) –10-15 % (Acceptable) –< 10% unacceptable	✓ Baseline public satisfaction survey completed before implementation ✓ Public satisfaction survey completed right after implementation ✓ Public satisfaction survey completed 1 year after implementation	Continued Economic Environment Commitment of federal government to deliver a Labour Program
Investment Impacts	❑More effective & efficient LAOs ❑Reduced Labour. Program Operational Costs ❑Increased internal program effectiveness ❑Reduced intervention time with Employer /Employee	Labour Program operational costs reduced by $ 660,000 per year (4 % of the total annual operational costs) Non-Labour Program operational costs reduced by $ 240,000 per year Time required for LAOs to complete assignments reduced by 28 % (41,670 hours) Number of total annual site visits increased from 17,198 to 21,699 thereby eliminating the shortfall of 27 LAOs Average cost per assignment decreased from $ 810 to $ 630 Average employer/employee intervention time decreased from 8 person hours/visit to 7.5 person hours/visit ($ 240,000 savings to industry) Opportunity to increase safety of the workplace and as a result lower employer's and public sector injury costs and losses (less accidents > less person days lost > savings to industry and governments) Annual cost to operate and maintain the mobile system of $ 300,000	✓ Current average assignment completion time and number of site visits per tier (LOIS) ✓ Post-implementation average assignment and number of site visits per tier (LOIS) ✓ Annual Labour Program expenditures ✓ Current average on-site time (LOIS) ✓ Post-implementation average on-site time (LOIS) ✓ workman's compensation board, union and health insurance reports of workplace injuries	Effectiveness of Mobile System
Outputs	❑Working System of Mobile Computing ❑Revised Delivery of Labour Program	Project completion April '98 Total project cost $ $ 4 million Project components: 1. Strategic Plan by June '95 at a cost of $ 250,000 2. Architectures by March 96 at a cost of $ 2.1 million 3. Sub-projects by Jan '98 at a cost of $ 1.6 million Revised delivery of labour program by Jan 98	✓ Project charter ✓ Status reports ✓ Final project reports ✓ Receipts	Acceptance of Mobile System Safe use of Mobile System Reliable Mobile System
Inputs	❑Funding ❑Participation by HRDC, Transport, NRC and TB	System procurement costs of $ 1.6 million within 5 % Project costs of $ 4 million within 10 % Government participation of 5 PYs	✓ Time sheets ✓ Invoices ✓ Status Reports ✓ Memorandum Of Understanding	Honest and active participation by stakeholders[1]

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[1] Government — Human Resources Development Canada, Transport Canada, National Research Council, Treasury Board
Provincial Ministries of Labour and Health i.e. OHIP, and Worker's Compensation Boards
Private Sector — Employers, Employees and Unions within the federal jurisdiction

Logical Framework Analysis, **Project: SAMPLE**

Organisation: Department XYZ. Project Manager: You Are, Date/Time: 95/05/04 11:30

	Narrative Summary	Objectively Verifiable Results Indicators	Means of Verification of the results	Critical Conditions
GOAL	- Improve services to the public.	The contributor for the improvement of the services for this project is when the Canadian population realizes that their wait time before someone answers their calls is less: - Excellent if at lease 80% of the public realize it. - Very good if it is in between 60% to 79%. - Good if it is in between 40% and 59%. - Acceptable if it is in between 10% and 39%. - Otherwise it is unacceptable.	- Base line survey done before this project is implemented. - Survey done right after the implementation of the outputs of this project. - Survey done one year after the implementation of the outputs.	- One of the priorities of the Canadian government is to improve the services to the Canadian public.
INVESMENT IMPACTS	- When the populations use the telephone to request a service, this project will reduce wait time until a human answer the caller's requirement.	- Cost to maintain the systems is $500,000 - Increase cost of long distance calls paid by the government 4,000,000 calls * 20 minutes each call is $800,000 per year. - Private Businesses opportunity. Individuals calling for services during work hours 4,000,000 calls * 10 minutes of wait time (each minute equal $1) is $40,000,000 per year. - Public sector opportunity. Operator will have less waiting time in between each call. 3,500 operators * 4 minutes less in wait time in between each call * 5,500 calls each year = $77,000,000 each year.	- MYOP - Financial Statements - Productivity reports	- The population knows that when they use the telephone they can be serviced at any time of the day for the type of service they need.
OUTPUTS	- Install a new computerized telephone controller that will re-route the caller to an available operator anywhere in Canada. - Modify the systems of the department to enable all the designated operators in Canada to give service to any Canadians calling for services.	- Cost at start of the project, $500,000 for the controller. - Cost after 3 months of development is $1,200,000 with 1/3 of the activities completed. - Cost after 6 months is $1,900,000. - Cost at implementation time is $2,600,000.	- Project charter - Status reports - Project Historic System and documentation - Final Project reports - Receipts	- The equipment and the software is reliable
INPUTS	- Treasury Board of Canada. - Private industries. - Information Technology Branch. - Communication Canada.	- $3,234,000 from the Treasury Board. - $1,666,000 from the Private industries - One Project Team of 20 persons: 1 Project Manager 1 Quality Assurance Facilitator 1 Electronic Engineer 2 Communication Engineer. 3 Systems Analysts 6 Programmers 3 Systems Users (Designated Operators) 1 Person from the production environment 1 Person representing the computerized vendor 1 Secretary/Clerk	- Invoices - Letters confirming the funding - Accounting reports - Time reports - Time sheets - Contracts	- Availability of the funds. - The private industries and the public sector work as partners so both share the risk and the benefits from the project.

Under direct control of the Project Manager

Not under direct control of the Project Manager

APPENDIX F

Montgomery County Council Resolution 12-1758:
"Reconstitution of the Interagency Technology Policy and Coordination Committee,"
Adopted July 29, 1994.

APPENDIX F

Resolution No.: 12-1758
Introduced: July 19, 1994
Adopted: July 26, 1994

COUNTY COUNCIL
FOR MONTGOMERY COUNTY, MARYLAND

By: Councilmember Praisner

Subject: Reconstitution of Interagency Technology Policy and Coordination Committee

Background

1. The County Council recognizes the importance of all forms of technical innovation, especially those rapidly changing electronic technologies such as computer mapping, telecommunications, and automated information services.

2. The County Council established the Interagency Technology Coordination Committee by resolution on July 27, 1984.

3. The efforts of the Interagency Technology Coordination Committee and its subcommittees since 1984 fostered the coordination of county computer systems, information processing and purchase of computer hardware and software, and the committee provided valuable budget recommendations to the County Council.

4. The Council desires that these activities continue to expand to keep pace with the need for planning and coordination, especially in the areas of computer mapping and telecommunications, with their emerging opportunities for interagency linkage and economies of scale.

Action

The County Council for Montgomery County, Maryland, approves the following resolution:

The Interagency Technology Coordination Committee is hereby reconstituted with broader responsibilities as the Interagency Technology Policy and Coordination Committee.

This Committee shall have the following general duties and responsibilities:

(a) to promote and enhance the coordination of technological innovation among and within the various agencies of government in Montgomery County, with particular emphasis on electronic technologies relating to telecommunications, computer mapping, and automated information systems.

(b) to create a communication vehicle by which the various agencies of government can assist the County Council and each other to develop sound and efficient public policies to evaluate alternative uses of these technologies as they proliferate and become more important to the cost and operations of government.

(c) to facilitate the coordinated implementation of such countywide policies through the mutual development of practical plans, proposals, and recommendations concerning individual agency expenditures for electronic hardware, software, equipment, and related items.

(d) to provide a discussion forum for the sharing and evaluation of information pertaining to such new technologies, including their various economic, social, and operational costs and benefits.

This Committee shall begin fiscal year 1995 with the following specific duties and responsibilites:

- to recommend, by September 30, the appropriate relationship between the ITPCC and the Technology Innovation Fund Committee.
- to recommend a procedure for the selection of the ITPCC Chairperson and the Chairpersons of the subcommittees.
- to develop a proposed committee work program for fiscal year 1995, based on perceived needs and priorities.
- to review this work program with the Management and Fiscal Policy Committee within three months from the adoption of this resolution, and to maintain general liaison with the Council through its MFP Committee and thereafter.
- to request the commitment of resources from each member agency sufficient to show significant progress in implementing this work program, with an approximate schedule of meetings of the full committee, and such similar meetings of the subcommittees as are necessary to accomplish the objectives of the work program.
- to recommend joint ventures to research and implement automation solutions, such as document imaging.
- to recommend a standard data collection spreadsheet that can collect the costs of all computing, telecommunication, and GIS activities of all agencies into standard classifications.
- to recommend a mechanism for soliciting appropriate non-agency, private sector support and input to these efforts.

The Committee shall be composed of the following governmental officials:

- The Montgomery County Chief Administrative Officer
- The Superintendent of Montgomery County Public Schools
- The President of Montgomery College
- The Chairman of the Montgomery County Planning Board
- The General Manager of the Washington Suburban Sanitary Commission
- The Staff Director of the Montgomery County Council, who shall serve as an ex officio, non-voting member

Initially, there shall be established also three standing subcommittees, called respectively the GIS Subcommittee, the Telecommunications Subcommittee and the Computer Subcommittee, which shall take direction from the Interagency Technology Coordination Committee, and which shall be composed of one member from, and designated by, each of the voting agencies represented on the Interagency Coordination Committee.

The Chairman of the Montgomery County Planning Board shall be the Chairperson of the Committee for FY95 and shall be responsible for the normal duties of a committee chairman, including the appointment of chairs to subcommittees, and such other task forces as may be appropriate from time to time.

The funds placed in the Montgomery County Department of Information Systems and Technology (DIST) FY95 budget shall be used to provide appropriate support to the Committtee and its subcommittees.

This is a correct copy of Council action.

Kathleen A. Freedman, CMC
Secretary of the Council

APPENDIX G

Conclusions and Recommendations regarding MCPS Information Technology Issues

Corporate Partnership for Managerial Excellence, "Investing in a Commitment to Quality: An Update," 1994.

In an environment in which the work exceeds available workers, the enterprise must either add resources, extend hours for existing staff or automate selected processes to improve productivity. IT provides an effective cost alternative. But without the specific and applied knowledge of available technologies, the opportunity is lost. The reduction of training budgets, while helping to meet short-term objectives, may ultimately ignore the long-term needs of the enterprise.

Conclusions and Recommendations

Based on our analysis, we have drawn the following general conclusions:

- MCPS IT capabilities are considerably behind the technology curve. Many applications exist which, if automated, would provide significant service/cost improvement to MCPS.
- Due to the disparate desktop and mainframe environments, some solutions currently in place complicate rather than simplify workload.
- Individual applications are handled individually, with limited vision for an overall and integrated system solution.
- Program priorities change significantly from year to year (or faster). Resources are often reprogrammed in mid-development. Priorities are more politically driven than technically or managerially driven.
- There are a large number of procedures, but no consistent methodology for definition of requirements, system development and user support.
- No method of measurement exists to determine the efficiency of MCPS in-house development projects.
- Major project priorities and resource allocations are tightly controlled by the Board and executive management. Application design is largely dictated by MIS and its existing architecture. Users have little influence except through politicizing the process.
- An underground development and support network has formed to satisfy demand for solutions to issues which are not being addressed institutionally. The cost of these efforts is impossible to quantify. The quality of the products is suspect. Investment in these products may not be considered in future changes and consequently is lost.
- IT department resources are devoted primarily to the present mainframe architecture and methods. While several current initiatives incorporate newer technical approaches, experience in more state-of-the-art development architectures is gained primarily through on-the-job training.
- The existing MIS departmental standards appear to have been established to limit support requirements rather than to support productivity and cost objectives. The standard product selection appears to focus more on cost than strategic value.

These conclusions led us to the following recommendations:

1. Establish a task force at the Superintendent level to prepare a strategic information systems plan covering all aspects of MCPS information needs, both instructional and administrative.

This plan should address a three- to five-year period and cover the following issues:

- how IT should be used to support MCPS mission and objectives,
- summary assessment of current computing environment/information architecture including systems, software and communications inventory and an analysis of problems and opportunities associated with the current architecture to meet those objectives;
- three- to five-year vision of the computing environment including detailed hardware, software, communications and database recommendations;
- summary project planning information including project definitions, time lines, resource requirements and implementation issues; and
- how MIS should be organized to meet MCPS goals and objectives.

The plan should be developed by key MCPS executive resources and should report directly to the Superintendent. Outside resources may be helpful in two areas: to facilitate discussions and help ensure that the evolving strategy is not artificially constrained by current practices, and to provide technical expertise to advise the task force on industry trends, evolving technologies, feasibility and cost. Such services could be provided by industry representatives to the CPME, the Montgomery County High Tech Council or some other enterprise.

The task force should be maintained as a standing body and charged with updating the plan on an annual basis.

2. Following adoption of the strategic information systems plan, appropriate standards should be established to ensure the goals and objectives of the plan are met.

These standards should provide an architectural framework to permit the maximum range of custom adaptation consistent with the strategic plan. MCPS standards should be based on current developments for open systems to ensure flexibility and forward migration. Standards should be re-examined annually after revision of the updated strategic plan.

3. Plan and budget programs on a completion (multi-year) basis.

As the federal government has realized for many years, programming major systems development or enhancement activities on an annual basis produces significant inefficiencies in the development process. The Superintendent, the Board and the County Council should investigate changes to current practice and law to permit multi-year budgeting.

4. Re-establish the Management Review Board (MRB).

The role of a User Advisory Board should be expanded for resource allocation decisions throughout the year, not just for budget preparation. The MRB can provide the basis for the dialogue that is much needed between the IT community and its users.

The MRB process can be used to coordinate reaction to mandated change and to maintain an awareness of user development initiatives.

5. *Develop a process and associated procedures that can be consistently applied to assess the costs and benefits of project proposals.*

IT investments should not be viewed solely as an expense. Business proposals by user departments should provide the basis for justifying acquisition or development efforts. This analytical process should be standardized to allow effective executive review to understand the mandate for change whether it is required by statute or decree or whether it is a profitable business investment.

6. *Invest in a continuous training program to keep staff resources current with industry technology and practices.*

MIS technical staff must maintain a clear understanding of technology and knowledge of how it can be applied to achieve the strategic objectives MCPS. Otherwise, the organization will not have the wherewithal to direct efforts in the most advantageous fashion. MCPS investments will begin to diverge from industry norms with currently observable results; staff evaluation of proposed system changes or vendor offerings will be performed without adequate vision of downstream impact; and staff morale will suffer. In an organization with high staff retention and considerable tenure in grade, there is little influx of new personnel with new skills, so the most attractive option is continuous training.

7. *Establish a technology investment plan which is funded by cost reductions achieved through application of IT to take cost out of the current process.*

Proper application of IT can provide significant cost avoidance/savings to MCPS in the provision of their services to the community. The current budget process, however, penalizes those who are successful in reducing their costs by reducing their following year's budget as well, often before those benefits are confirmed or realized. This recommendation proposes to set aside these savings into a Technology Investment Pool which can be used to fund additional IT modernization initiatives.

An example of how the plan might work follows.

- Department managers would establish cost avoidance/reduction objectives for each proposed IT modernization initiative.
- Upon project completion, an assessment would be made to determine if cost/avoidance/reductions were achieved. Actual savings from the modernization initiative would be transferred to the pool for reinvestment.
- (As an option: Share a portion of savings with individuals who were responsible for the favorable result to provide an incentive for others.)
- Technology Investment Pool funds would be tracked annually with the Board of Education/County Council as a part of the normal budget review/approval process.

8. *Develop mechanisms for improving MIS working relationships with user communities to facilitate better understanding of evolving user needs.*

The diversity of the current MIS user (customer) base presents a significant communication challenge. Not only does the user base require a variety of IT solutions, but they also tend to approach similar subjects from different perspectives. These considerations -- in conjunction with the current environment, which includes increased demands with limited resources -- can easily create an adversarial relationship between the supplier and end user of the resources. The best results are achieved when everyone is informed and working to achieve common objectives. Thus, it is important for MIS to take a proactive role in reaching out to their users to develop a better understanding of their needs and priorities while sharing knowledge of emerging technologies, applications of these technologies and the future directions planned by MIS.

Transportation

The following items summarize the actions of the MCPS Division of Transportation taken as a result of the CPME process and the status of recommendations made in the initial report. Comments also include additional steps necessary for full implementation of accepted recommendations.

Bus Replacements/Purchases

A recommendation was made that the Division of Transportation (DOT) adhere to the replacement of school buses at the 12-year point rather than request waivers from the state for extending their service in the fleet. The rationale for this recommendation was an analysis conducted which indicated increased operating and maintenance costs after the twelfth year as opposed to the average for those replaced within 12 years. The analysis indicated that MCPS would save $1 million per year in operating and owning costs (including the cost of capital and interest thereon).

A six-year bus replacement plan has been adopted by the Board of Education (BOE). Eighty-five 1980 and 1981 buses were replaced during Fiscal Year 1995. Approximately fifty-six 1982 buses are scheduled for replacement in Fiscal Year 1996. This process will be continued until all buses in the fleet are under the 12-year age limit.

Computer Assisted Routing Transportation System (CARTS)

Computer Assisted Routing was recommended as a tool which could significantly enhance the management of routing buses for MCPS. The team at DOT was already pursuing this course of action at the time of the study and had conducted significant research.

APPENDIX H

Select Articles on Information Technology Issues

Steven R. Ruth, "Leveraging the Yield on Information Technology: What Really Works and What Doesn't," The Government Accountant's Journal, Summer, 1995.

"IS Managers called on to justify IS investments," Info World, V. 15, Issue 6, February 8, 1995.

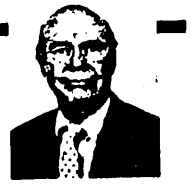
Larry Singer, "Public vs. Private-Sector IT Strategies," Government Technology, August 1995.

"The End of Delegation? Information Technology and the CEO," Harvard Business Review, September-October 1995.

Thomas H. Davenport, "Saving IT's Soul: Human-Centered Information Management," Harvard Business Review, March-April 1994.

Ian D. Temple, "The Year 2000 Does Not Compute," Government Technology, February 1996.

Stephen R. Ruth, Ph.D.
Dr. Ruth is a Professor of Technology Management and Director of the International Center for Applied Studies in Management Information Systems at George Mason University.



Leveraging The Yield On Information Technology: What Really Works And What Doesn't

This article is based on some of the real world results I have been able to observe in my work as a consultant and researcher in technology management. Its emphasis is on the things that really work - a blue collar perspective that stays away from management briefings, long term budgets, MIS strategic plans through the year 2000, speeches and concept papers.

For something to "really work" it has to offer a yield somewhere close to (preferably much higher than) the investment. And that yield needs to be obtained rapidly, in 18 months at least. For example, General Electric Aerospace (now part of Lockheed Martin, the world's largest defense contractor) decided that classroom training with instructors was old hat and instituted a $6 million program to convert about 30 seminars to the new touch screen multimedia environment. Results of this investment: retention of course concepts for employees was improved threefold, employees liked the individualized program far more than the old way and the investment paid for itself in nine months.

Andersen Consulting and many other companies have made the same successful investment with similar results. The Lockheed Martin and Andersen Consulting examples are authentic applications of low unit cost technology that leverages investments quickly, with pleasing results in the bottom line.

I will begin by defining some examples of a relatively spartan but practical approach to defining information technology (IT) success, and then suggest some examples of what really works and what doesn't, followed by suggestions about getting the payoffs that are inherent in information technology. I'll also mention some of the people who are producing the ideas that can help today's financial manager sort out the complex problems of leveraging information technology.

I must confess at the outset that I have a bias about this subject, one that goes back to my studies at the Wharton School, University of Pennsylvania, where learned professors drummed into us the importance of considering unit costs and benefits. I continue to be wary of a total cost perspective. If a computer system costs us $10 million will we be getting unit benefits that justify that cost? More importantly, is there the volume of activity to achieve that low unit cost and do we have people competent to wrest that productivity advantage?

My criteria for systems success, and the underlying themes of these remarks, are shown in Table 1. These qualities are not for the daring, adventurous IT system developer. They insist that the project already be successful somewhere, that it deliver the goods at the place where the user and the customer are - on the shop floor or in the office - and that there be multiple, proven examples of success somewhere else.

A recent consulting assignment took me to an organization that had planned to develop a major multimedia application that would serve thousands of customers. When I inquired whether the development team had visited any of the several dozen already existing similar applications of this technology to use as a referent, there were blank stares. They were going to "invent" something that had been developed successfully in the U.S. and several foreign countries in over a dozen locations.

The cost of not using these exemplars as a bench mark can only be imagined, but it is very high. Training the users is expensive. I would accept the argument that even 10 percent is not enough to devote for training in a major new system that costs $20 million. By the time the hundreds of developers are properly trained and the users given full scale, detailed training and follow-up, it would be easy to use up $2 million over a two year cycle. But there's a lot more training needed. How about customers, managers at all levels, support contractors and all the others who will be using the system? And what level of training and resolution of errors will be expected? Answer: a lot.

According to the American Association of Training Directors, the average organization needs to spend at least five percent of the payroll budget on training each year. Andersen Consulting, for example, spends about seven percent of its personnel budget on training, an average of 109 hours per employee per year.[1] For a federal agency of about 5,000 persons, that means roughly $15 million in training expense each year. On average the amount actually spent is less than half of that for many agencies. So the ideal IT project needs to have enough to leverage the users' and customers' needs. That means a hefty training budget that stays even when other budget items are trimmed.

Table 1
Recommended Criteria for New IT Investments

- Low Unit Cost
- High Unit Yield
- Proven Use in Similar Applications
- Very Little Need for Unique Hardware or Software
- 10% Of the Cost: Training Users and Customers

Some Recent Good News About IT Productivity

Let me begin with the good news about computers and productivity. After almost a decade of criticism and debate it seems clear that there is a direct link between investments in computing systems and increases in productivity. Much of the debate centered around the so-called "productivity paradox," indicating that investments in hardware, software and improved information technology were not being reflected in bottom line results.

Erik Brynjolfsson, an MIT professor, has now assembled convincing data that shows the so-called paradox was getting the wrong conclusion because the results had not been correctly measured. He demonstrates that in the aggregate things are much better. Improved services, difficult to measure in the normal productivity statistics, are an example of the sort of positive result that was not being counted before. The good news is that on average computer investments can lead to improvements in

productivity. But this good news in the aggregate does not mean that everyone is better off. While some organizations are characterized by gaining outstanding leverage from computer based automation, for a large number the improvements are illusory.

Which Matters More: People or Equipment? *The Computerworld Study of the Leading U.S. Companies*

There is ample evidence to support the view that good managers can get outstanding results whether they are highly successful computer users or not.

In academic parlance we say that high powered hardware and software are not good predictor variables; that is, there is not a high correlation between significant amounts of equipment and better performance. Every year the leading MIS weekly, *Computerworld* does an exhaustive analysis of hundreds of businesses in the United States. All the major firms, including the Fortune 500, are included, and the methodology is very specific.[2]

First, a broad range of computer-related measurements are gathered, such as: use of Local Area Networks (LAN), budget for training, computer expenses, telecommunications expenses, outsourcing data, number of information system employees, number of desktop servers, percent of software spent on new development, percent of software development for maintenance, number of years in the job of the Chief Information Officer (CIO) and many more. These are the variables that would predict if a company has good performance.

But what *is* good performance? The *Computerworld* methodology uses a calculation of return on management as the quotient of Stern Stewart and Company's popular economic value added and cost of sales, general and administrative. So it is now possible to array the companies from best to worst and see what effect investment in information technology has on results.

Table 2 gives a summary of the top one hundred firms in the array. They are large, complex and mostly multinational - most of them with more employees than a federal agency. Over a dozen had IT budgets in the range between one quarter and one half billion dollars per year.

Table 2
The Computerworld Premier 100: Effective, Highly Successful Firms

- Median annual sales: $2.6 billion
- Median employees: over 10,000
- Median PC's: 4,000
- IT budgets: up to $1 billion +

Familiar Names: Disney, Illinois Central, Coca Cola, Levis Strauss, Schwab, Solomon Brothers, Johnson & Johnson and Walmart.

- 40% have computers
- 18% connected to networks
- 5% of terminals connected to customers

In Top 10

- 3 barely use e-mail
- 5 use e-mail extensively

Source: "Computerworld Premier 100," *Computerworld* magazine, September 19, 1994, Section 2.

Table 2 also gives some of the answers to the question about a good predictor variable. A computer on every desk means better productivity? In the top 100 only 40% of the employees had a computer. Less than half of those who had computers were connected to networks. And only 5% were connected to customers.

Looking deeper it's possible to examine the Top 10, the very best return on management in U.S. firms. The companies are *Unifi, Illinois Central, Ambac, Inc., ARA Group, Inc., UST, Inc., Fluor Corp., MAPCO, Inc., MBIA, Inc., U.S. Health Care, Inc.* and *Amgen, Inc.* Three of these barely use e-mail and five use it extensively, meaning that half of these companies either use e-mail rarely, or not at all.

Before leaving these *Computerworld* survey results it's possible to get some other insights. First, these successful companies were not very impressed with some of the highly touted technologies like multimedia, 32 bit operating systems, object oriented programming and groupware. Their emphasis is on the mainstream needs - local area networks, client server and graphic user interfaces.

Second, nearly one third of the top 100 had altered the structure of their Information System (IS) departments during the past year by distributing IS tasks to business units - a major organizational change. A similarly large percentage reorganized to functional team organizations.

Third, 28 of the top 100 companies were organized so the CIO reports directly to the president or CEO, indicating a recognition of the contribution of the CIO to productive operations.

For the government executive, I think these results will come as no surprise. Effective operations arise from effective people, not a proliferation of computers. Yet the federal government, the world's largest buyer of computer equipment, has some agencies that aim for productivity keyed to the availability of new equipment. The *Computerworld* results demonstrate that to be the best does not mean having the most computer literate teams. Instead it means that the best organizations will integrate computer-related productivity increases with other opportunities that lead to excellence in each aspect of the assigned mission.

Examples of Things That "Work" in Information Technology

Since my perspective is exclusively on what works now, I can be very specific. Table 3 gives my list of the technologies and strategies that really work - ones that really deliver the unit cost advantage that is so crucial. Heading the list is Electronic Data Interchange (EDI), which has been pivotal in improving the way the organizations perform billing, updating, customs clearance, purchasing and many more functions. EDI is proven, low in unit cost and increasing as a standard for getting work done better.

Table 3
What Really Works

- EDI
- Strategic Information Systems
- Human factors engineering
- Touch screen multimedia
- E-mail and Nexis

Strategic Information System (SIS) is a term coined by Dr. Charles Wiseman to distinguish the companies that use information technology not just as a facilitator but as the basis of their success. In the Navy they use the term "main armament" to refer to the battleship's 16 inch guns. The company with the SIS perspective regards their computer system as the main armament. For SIS applications like airline reservations (especially United and American Airlines) and Baxter Health Care International, information technology is the fundamental basis of differentiation and profit. Only a handful of companies or agencies are able to employ the SIS view in their activities but those that do show handsome results.

For example, Baxter Health Care International system is so pervasive

that it is integrated to the inventory and pharmacy systems of many hospitals to the degree that hospitals use hardware and software provided by Baxter Health Care; and, there are some calendar quarters when the reservation services of American or United Airlines contribute more profit than the airlines' passenger and freight operations combined. These are companies that truly put the computer in the front line of their strategic plans.

Human factors engineering is on my list of oldies but goodies because it departs from the specs that we normally use in IT: How many MIPS? LAN Compatible? CPU cycles and Gigaflops. Human engineering is the study of the primacy of the user. When a system is developed in our traditional approach, the craftpersons who contribute are analysts, programmers, knowledge engineers, data base engineers and the like. They get the specs right and they get the files right, but the human factors engineer gets the interface right.

The interface issues can be as widely varying as the glare from the screen and the anthropomorphic style of the message ("I want you now to turn to" ... instead of "please turn to"). Many companies are now hiring human factors specialists, persons trained in cognitive psychology and computer science.

Dr. Ben Shneiderman of the University of Maryland, perhaps the best known of these specialists, estimates that the small investment in interfaces, improved messages (for example some systems still have this completely unhelpful, harsh comment: RUN ABORTED: OPERATOR NOTIFIED), user satisfaction, etc. can save deadlines and money. My estimate of the amount of money wasted by inattention to human engineering is in the range of billions of dollars per year.

I have already mentioned the astonishing success of touch screen multimedia. It is used by some of the largest and most successful companies in the U.S. as both a major improvement for most training programs and as a revenue generator. Motorola, Federal Express, Lockheed Martin, Andersen Consulting and Corning are all major players in this technology. Motorola, a winner of the coveted Baldridge award a few years ago, believes that every dollar spent on corporate training results in a leveraging effect of 30 to 1 in increased productivity.[3]

My estimate of the amount of money wasted by inattention to human engineering is in the range of billions of dollars per year.

Why is touch screen multimedia investment increasing 300% per year? Not only because employees are being trained, but it is a major technology for customers, too. For example, the Best Buy stores use touch screen multimedia modules for explaining their products - and for closing the deal, too.

Finally, in my list of the things that really work I have included e-mail and Nexis. E-mail is everywhere and if managed properly can help in all parts of the organization. As I will mention soon, it doesn't always work, but that's usually more a managerial problem than a technological one. Nexis is a phenomenon, a marvel. It allows searches of the most complex data bases imaginable and gives the user an equally vast group of search tools. Newspapers, patent lawyers, students and businessmen and women rely on it. Its unit cost is very high but the unit yield is higher still.

The Dark Side: Popular Applications and Technologies That May Not Work Very Well for Users - In Spite of Publicity

The reader may want to skip the next few heretical sentences if he or she is already in the midst of applying Computer Assisted Systems Engineering (CASE) tools, Business Process Reengineering (BPR) and other such popular approaches because I do not think they have made major improvements in bottom lines - with some notable exceptions. As a consultant to governments, businesses and universities all over the world, but especially in the U.S., I have seen very little payoff from the group of activities listed in Table 3, and there is a growing literature that backs up this view.[4]

I may be considered a heretic by many, but this list, from my perspective, is a group of approaches that will only work well for a relatively small number of organizations. What's the problem? A sine qua non for success in all of them is a presumption that is true in perhaps one organization in 10: the ability to achieve a continuing trajectory of change and improvement in procedures, relationships, work expectations and attitudes.

Table 4
What Only Works for Special Organizations

- Business process reengineering
- Groupware
- CASE tools
- Learning organizations
- Distance learning
- Matrix organizations
- Teaming strategies that omit responsibility for results

Nearly all large organizations use the CASE approach but if success is measured as major improvement in the unit cost of developing a new application, there are only a few that are successful. I find the same about BPR, learning organizations and all the others. For special, well prepared and trained, motivated groups, it's possible to get special results and these results deserve the headlines and the praise. For most organizations though, it is difficult to achieve anything like the double and triple digit percentage productivity improvements of the few that get the headlines.

Some Unintended But Serious Effects

There are some other problems that occur in implementing information technology, even if the applications are the ones that really work.

As a researcher, I have the opportunity to look beyond the glitter of some of the new computer offerings and try to figure out what is really happening. A *New York Times* article recently described a State Department official as lamenting the fact that they still were forced to use 15 year old Wang computers that were unable to link to Internet or even rudimentary local area networks.[5]

Table 5
Problems That Can Happen Even in Good Organizations

- Unintended conflict
- Unexpected distrust
- Transference behavior
- New maintenance burdens
- Loss of creativity
- Lowering of productivity
- Brinkley phenomenon

Table 5 lists some of the problems that are occurring in organizations as they try to improve productivity with information technology. Unintended conflict and distrust are possible with many new technologies, especially e-mail. Since e-mail is democratic and

omnipresent it offers an unparalleled temptation to violate the chain of command. It also permits the remarks that could only be whispered in the cafeteria to be broadcast to a much wider audience. Shoshona Zuboff, a sociologist at Harvard Business School, has studied the problem for decades. She has chronicled real world cases where managers allowed e-mail to become a method for airing grievances, complaining angrily about a variety of company issues and publicly violating the authority levels that are part of all large organizations. She quotes one of the company executives as saying that the e-mail system "was like a disease that must be walled off and contained."[6] It was obviously too late for that.

> A *Fortune* columnist found that 55% of Americans "are resistant, even phobic when it comes to taking advantage of the technology in their daily lives."

Creativity is often a casualty of the implementation of new computer systems. Imbedded intelligence is one of the most popular services offered by new technology. For example, most decisions about credit worthiness are made by expert systems or software involving so-called fuzzy logic.

When you call American Express for a credit card or visit your bank for a home loan the intelligent software is doing most of the heavy lifting. This "de-skilling" - replacing a human decision activity with a computer-based expert system - is also to be found in college selection processes, tax analysis, purchasing, insurance claims and hundreds of other applications. Unless care is used in helping to ease the transition, the affected employees may never be the same.

Stated differently, unless employees are given a chance at "re-skilling" - improving their capacities to do other, higher level work - their productivity could be permanently reduced. Maintenance of new IT applications is very similar to that for a car or a house. If not budgeted for, there are nasty surprises.

When an IT is accepted, its cost must be understood. The World Wide Web is an excellent case in point. Tens of thousands of organizations and individuals have established a presence in cyberspace with a "home page" on the World Wide Web. The president of the U.S. has a Web page, the CIA has several and nearly all federal agencies have flourishing applications on the Web. They are not alone. Florists, pizza companies, book stores, mail order houses, delivery companies like Federal Express and most of the world's universities and research centers are major Web users.

The federal government has a problem not shared by some of the others. Their Web pages are very expensive to maintain. Not only do these pages have to be updated frequently but most of them automatically connect the users to dozens of other Web pages which also need to be updated. None of this has to be a problem but most agencies budget for a Web page and not for the maintenance that is an inevitable, and necessary, added cost.

As people become more and more accustomed to getting information from the Web page, the penalty for poor maintenance will be far more severe, since the constituents will be on-line and have much better means of airing their complaints - and directing them to elected officials - who will also be on line.

David Brinkley, the television anchor, recently made a comment on his weekly program that most people have computers but few really know how to use them. His message was that most of us don't leverage the technology very well. This Brinkley phenomenon can be observed in some of the best and worst run companies and agencies.

Every person in the organization has a $7,000 suite of networked, 100 megahertz, PC's with a gigabyte of memory, quadruple speed CDROM, 28.8 KB modem and a full range of software options for data base spreadsheets, chart making, multimedia generation and graphics. For many of the persons given this suite of hardware, it is more of a trophy or symbol of belonging than a response to a need. A Fortune columnist found that 55% of Americans "are resistant, even phobic when it comes to taking advantage of the technology in their lives."[7] This figure is probably low. As the *Computerworld* studies suggest, hardware and software do not predict success - capable people and good management do.

Transference behavior is a term used by behavioral scientists to describe a person who blames a nearby object for frustration, whether the object is at fault or not. When a pitcher is having a bad day and the manager takes him out of the game, it is not unusual to see the pitcher throw his mitt at the wall or even kick the water cooler in the dugout.

In some organizations the computer system is the water cooler, the easiest thing to kick. The problem with this behavior is that it allows the computer system to become the excuse, the scapegoat, for problems that may have to do with competence, experience or some other individual failings. In no way should the computer be exonerated, since it is often the culprit. Good management can demand high quality computer systems and highly motivated persons using them.

Recommended Gurus for the Near Term

Just as some of us have a favorite stock broker or columnist, I have a group of persons whose work is so close to my own thinking on these subjects that I want to recommend them. They are listed in Table 6. Even if you don't agree with them, you will find their ideas in the mainstream of the subjects I have brought up. At MIT, Dr. Nicholas Negroponte continues to be the source of many of the most intriguing and commensensical ideas about dealing with the trillion bytes per day on public networks.[8] He is the author of several best selling books and also propounded the now-famous Negroponte shift - the concept of shifting the signals (especially TV) now going on satellite and other non-directed media to wires (fiber, twisted pair, etc.) and letting the rest, especially telephone signals, use the satellites and microwave facilities. Also at MIT is a young professor named Erik Brynjolfsson, who is the author of the seminal article that reversed the old views about the IT productivity paradox. He will continue to give us interesting insights on this fascinating question. If I had been writing this 30 years ago I would still have named Peter Drucker of Claremont Graduate School in California. This prolific writer continues to clarify the role of the manager in the IT milieu and has recently sug-

Table 6
Some Significant Contributors

- Shoshana Zuboff
- Nicholas Negroponte
- Eric Brynjofsson
- Peter Drucker

gested a new way to assess IT performance, which is mentioned below.

Evaluating IT Performance - Measuring What Really Makes a Difference

I began by promising some suggestions that will help the busy manager get more leverage from the things that really work and thereby not being confused and distracted by the things that don't.

In Table 7 I have listed some ideas that may help. A good beginning would be a recent *Harvard Business Review* article by Peter Drucker titled "The Information Executives Really Need." [9,10]

Table 7
Measuring the Things that Really Matter

- •Drucker's diagnostics
- •Not the same old things - the problem areas
- •Positioning for the future
- •More subjective metrics
- •Match the strategic plans with resources

In it, he describes the impact of the changes from cost-based accounting to activity-based accounting. He recommends four kinds of diagnostic information: *foundation information, productivity information, competence information and resource-allocation information.* These can all be applied to the federal agency easily from the industry context he uses.

Second, many organizations deal with static IT information like transaction volumes, rather than focusing all attention on what's *not* working well. But tenacious reporting of the bad news and letting the routine information go by, is not only in the tradition of the modern manager but also in the spirit of management by exception. This has its ancient roots in the advice given by the priest (and management consultant) Jethro to the busy, overloaded leader, Moses, in *Exodus*, chapter 18.

Measurement that aims the organization toward next month or next year is interesting but not of high utility. If success or failure depends on meeting a trajectory that covers a several year span, the metrics used should reflect that trajectory.[11]

For example, if the long term goal is to be completely connected with all customers or clients by EDI, e-mail and the World Wide Web at unit costs that are one tenth of today's, that broad goal has to permeate and insinuate itself into everything else. Obviously many of these metrics will be subjective, that is, described in terms like "make a quantum improvement in" or significantly enhance the relationships between."[12] Measurement along these more subtle dimensions can be just as tough and demanding, but the criteria are not quite as specific.

Finally, I have deep respect for the many federal managers I have worked with, and I would like to recommend that all senior managers be released from what strikes me as the bane of their lives - the functional strategic plan. I have seen dozens of them and been a direct consultant on at least 10, mostly in information technology. The good part about them is that they set broad goals - the problem is that the implementation strategies tend to be ad hoc, dramatically under funded and promise what they can never deliver.

My recommendation is to go back to the ideas I have mentioned in this section, particularly Drucker's approach to management, and allow the organization's long term goals to be subjected to the kind of shift he recommends: from cost-led pricing to price-led costing. Whatever approach for measuring IT activity is selected, it is likely to be more reasonable than the current system as I observe it.

The high competence of today's governmental financial managers will be the catalyst for the new and exciting ways we deal with the scarce resources that we have.

Endnotes

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IS managers called on to justify IS investments

Quantifying the benefits of client/server systems proves to be an elusive task at best

BY DOUG VAN KIRK

When it comes to computers, you get what you pay for. Or do you? IS managers are increasingly being called upon to justify their investment in hardware and software and to explain how computer systems benefit the overall corporation.

Cost justification used to be exclusively a corporate issue. Typically, the chief information officer set goals, decided the fate of projects, and convinced upper management of the need to embark on new development efforts. IS managers and network administrators carried out the marching orders and were kept far from corporate budget battles.

However, as client/server architectures and networks moved budget responsibilities down through the IS ranks, more network administrators, help desk managers, and electronic mail gurus are being asked to demonstrate their contribution to overall profitability. Will a new application save the company money or expand its business? Converting a VSAM database to SQL may produce better response times and make it easier to build applications, but if the activity doesn't generate profits for the corporation, there may be no reason to proceed. It's not enough to keep mission-critical applications running 99 percent of the time, distribute timely upgrades, and outfit everyone on your staff with beepers for around-the-clock support.

Ironically, the demands to justify application costs are occurring just as corporations are finally accepting PCs as an essential component of business.

PC cost justification isn't so important anymore, says Greg Klein, MIS manager of Sara Lee Corp.'s personal products division, in Winston-Salem, N.C. The benefits of PCs have been demonstrated to management, and prices are low enough that most PC purchases are approved without question.

Applications and support are another story. A recent study by Nolan, Norton & Co., in Boston, indicates that annual spending on PCs can reach up to $6,500 per user. With unanticipated factors such as development cost overruns, that amount can double.

Private and institutional studies of productivity show little or no gains in the office as a result of personal computer technology. And IS budgets continue to grow, despite the rapidly declining costs of commodity hardware and software.

MEASURABLE GAINS. New types of workgroup applications may blunt much of the criticism now leveled at PC and LAN spending. Workgroup products such as Lotus Notes have the potential to change business processes, says Christopher Teeter, an associate partner with Andersen Consulting, in Chicago. Current desktop technologies, such as word processing and spreadsheets, have made individuals more productive but added little to the bottom line. The computer industry is learning to focus on group productivity, he adds, and the next generation of products will leverage LANs and information to improve organizational rather than individual goals.

Many companies need to reassess how they measure desktop productivity as these LAN-based systems move into the computing mainstream. Sara Lee Corp., for example, tries to determine the impact of new systems not only on direct users, but people likely to be affected downstream. However, MIS manager Klein admits that many of the processes used to evaluate mainframe systems, such as post-implementation reviews, are not well developed in the client/server arena.

While it's always easier to justify your existence when management is on your side, there are ways to determine if LANs are beneficial to your company.

First, attempt to associate system costs with specific business activities. Too many computing activities are expensed as overhead and that makes them easy targets for cost-cutters.

Second, avoid using technical measures of system productivity. Improvements in response time, for instance, don't mean very much to management. On the other hand, the chief financial officer will be very interested to hear that the system can now handle an additional 400 trades per hour. That's an asset that can be put into use immediately.

Finally, don't attempt to cost-justify a technology. The results will be narrow and fleeting. Instead, look at the process. Recognize the enabling power of LAN technology to alter business processes, and sell management on the improvements that come from such a change.

Part of the problem with trying to document PC productivity gains is the way productivity is measured. "It's a very inexact science," says Darrell Balmer, vice president of the financial strategies services division of the Gartner Group, a Stamford, Conn., consulting firm. Traditional productivity measures are geared toward manufacturing, he explains, weighing inputs and outputs. This approach doesn't work well in a service-based economy because values are more difficult to quantify, and added value does not necessarily mean a higher price. In addition, activities of service companies are quickly copied by their competitors. He cites airline frequent-flyer programs as an example. The programs add value by increasing customer loyalty but aren't reflected in the price of airline tickets. As a result, there's little way of gauging the impact of such an activity on the bottom line.

Service organizations showing productivity gains generally attribute it to staff reductions. Because the only noncapital or nonfixed costs are personnel, layoffs are the only way to show an organization is more cost-effective. Carried to the extreme, the most productive IS department would be the one that shuts off the computer and locks the doors.

Balmer believes information technology's valuable contribution to the corporation is understated by traditional productivity measures. "Productivity is probably much better than it appears to be," he says.

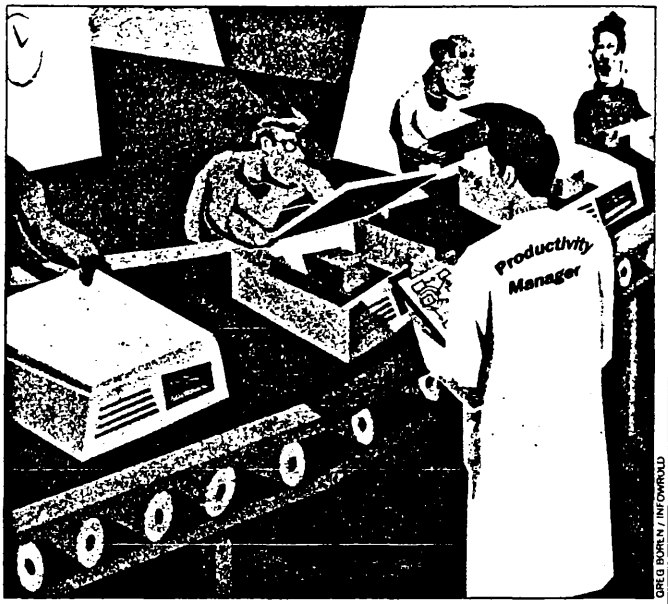
EFFECTIVE MANAGEMENT. The way computer systems are implemented and managed can greatly affect the actual and perceived usefulness of information technology. Unlike mainframes, which are generally used on a charge-back basis, LANs and client/server applications are usually capital expenditures. In the former, there is a cost associated with each transaction — it's easy to see computing costs as a component of a particular product or service. But departmental and enterprise LANs are generally treated as a common resource with a complex matrix of applications and users that makes charge-back nearly impossible.

Another reason IS productivity may appear to lag is the misapplication of technology. Aggregate productivity measures don't distinguish between effective implementations and misapplications of information technologies, notes Jim McGee of Ernst and Young's Center for Information Technology and Strategy, in Boston. McGee is coauthoring a book on effective information management.

Some organizations achieve immense benefits because they integrate technology into their business procedures and create new, more effective ways of doing things, McGee says. But companies that apply technology to existing business processes generally find that the technology makes only a minimum improvement or even has an adverse impact on the bottom line.

There are times when productivity may actually be sapped by desktop technology, Balmer says. Citing a phenomenon he calls "low-value work creep," he chastises firms for shunting administrative and clerical tasks to highly paid "knowledge workers" while eliminating less costly support staffs. This can produce an attractive bottom line but will reduce the effectiveness of professional employees and result in decreased productivity.

Like McGee, Balmer stresses that technology must be applied to appropriate business areas to achieve productivity gains. It's common-sense advice — which many companies fail to follow.



GREG BORLN / INFOWORLD

Smart ways to justify IS spending

- Clearly explain the overall impact new system will have on the business.
- Seek management support in early stages of project.
- Associate system costs with business activities.
- Avoid using technical measures, like response and processing times, to analyze performance.
- Don't build a cost-justification case around a single technology that's part of a larger project.
- Highlight non-monetary benefits (increased knowledge, better decision making).

Public vs. Private-Sector IT Strategies

There appears to be a new focus on strategic management of information technology resources in state governments around the country today. Many states — like California, Arizona, Washington, Pennsylvania and others — are searching for new chief information officers to take on this role. These and other states are engaged in a serious review of their current information technology management structures. Texas and Massachusetts are realigning their IT management organizations to promote more integrated management of their technology projects. While I would like to believe that these moves reflect a recognition of the strategic role of information technology in government, I don't think that's the whole story.

I believe that this new focus reflects the fact that political leadership is distressed by the historically unreliable estimates of performance, cost and schedule of recent information technology projects. One common response for these political strategists is to require technology managers to produce increasingly detailed information plans as a way to reduce risk. Another common response is to bring in new leadership, usually from the private sector, to run these planning efforts. While I believe in effective strategic information planning, I think that these responses are based on a basic misunderstanding of the nature of information technology projects in general and in government specifically. I feel strongly that new CIO's who have private sector successes under their belts will find the public sector to be a radically different environment. Planning approaches that worked in their old companies will not work as well in their new jobs.

Almost all of the literature on strategic planning insists that there needs to be a tight integration of information technology plans with organizational business plans. All of the leading strategic planning consultants advising business hold this view. It doesn't take a genius to understand the logic behind this most basic of concepts, and in the private sector to disagree would be foolish. But when a strategic information technology planner works in the public sector, especially state government, they have to face the harsh reality that there is almost never a published business plan to reference. In fact the political reality of our democratic form of government provides for an environment where legislative changes are constant and the senior executives' policy objectives change as frequently as newspaper headlines.

Don't expect new leadership from the private sector to be a magic bullet that cures all that ails IT in the public sector.

OPINION ANALYSIS

Our new political leadership is asserting that the strategies of their predecessors were way off the mark. While the debate over policy strategy rages on, the new information technology leadership will be expected to devise better plans for delivering projects this year and next. How will they develop information resource management plans in this volatile and uncertain environment? They will likely focus on tactics rather than strategy.

THE DISCOVERY PROCESS

Another reality that all private- and public-sector technology managers face is that implementing new technology is a discovery process. The very nature of technology projects involves uncertainty in end product performance. Managing the interrelationship among a large number of variables is the essence of good project management. Technology projects often require an iterative approach to development — a style that deals with failures by trying and then trying again. Private firms that are successful in their adoption of new technologies recognize the uncertainty embedded in these projects and provide their CIOs with the flexibility they need to innovate.

Government bureaucracy, on the other hand, provides an environment that has overly stringent rules and procedures in both budgeting and procurement that — while effective in a stable environment — make it much harder to react in the face of rapid technological and process change. This lack of flexibility will confound managers when they try to apply approaches that worked in technologically innovative private sector companies.

While information technology projects require extremely competent managers, those managers need to understand the realities of operating in a public sector environment to be effective. For effective strategic planning to take place in government, IT management cannot expect the luxury of reacting to clear business strategies that are laid out for them. To be effective these CIOs will have to be clearly integrated into the strategy formulation and implementation process. They will have to make their new bosses — governors, cabinet officers and legislators — understand that resources committed to technology projects must be considered strategic in nature, and may require long timeframes and utilize large portions of an agency's available resources if they are expected to deliver significant results.

Governors and other political leaders may lack technical sophistication and find the details of technology and technology projects to be obscure. This lack of sophistication will make it difficult for the new IT leaders to communicate the realities of multi-million dollar development and deployment projects. They will have to avoid resorting to oversimplification of the issues if they expect to play the essential public policy role of government leaders.

A key role of technology leadership is to emphasize the potential future value of new development efforts, the performance improvements in service levels. But an equally key role will be to avoid understating underlying disciplines and processes required for new technology projects. It is important that we not leave political leadership unaware of the difficulties inherent in these projects. If we allow them to remain naive, they will be surprised and non-supportive when their support is needed most — when more money or time is required to finish the project than was anticipated.

The bottom line message is: don't expect new leadership from the private sector to be a magic bullet that cures all that ails IT in the public sector. Management of this public environment is hard work and the pay is not equivalent to the same jobs in the private sector, making it hard to recruit the very best from that world. We need good management that also understands the government environment if we want to use computing strategically in the public sector.

Larry Singer — an industry expert on strategic computing — is a senior executive fellow in public policy development and management.

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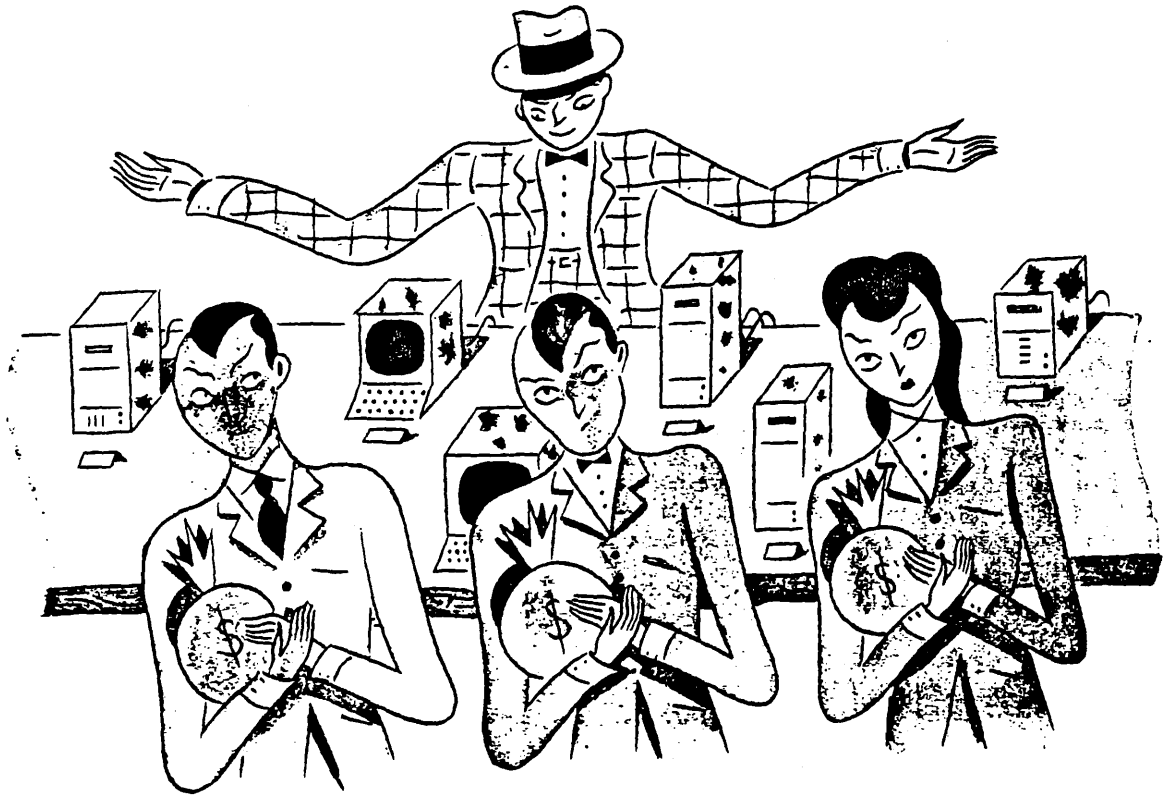
The rules of the IT game have shifted. Technology now requires general management leadership.



The End of Delegation?
Information Technology and the CEO

CEOs routinely face questions about investment trade-offs. In the case of information technology investments, however, the context for making decisions has changed in the past few years. Once, senior executives could expect their information systems managers to oversee the core processing applications of the business and to help the CEO and line managers make decisions about new IT investments–big ones (American Airlines' SABRE reservation system) and small ones (imaging technology).

Today IT plays a role in most aspects of a company's business, from the development of new products to the support of sales and service, from providing market intelligence to supplying tools for decision analysis. For a global company, the ability to take information from multiple systems and make it broadly accessible to managers and employees is critical. Many observers believe that this fact, along with the increased opportunities for using IT to achieve strategic advantage, requires that CEOs reexamine what they need to know about this resource to manage it effectively.

Which IT investment responsibilities should CEOs delegate and to whom? When they consider IT investment options, what should they look for? How do they learn what they need to know in order to ask the tough questions? What roles should other managers, such as chief information officers and business line executives, play in the decision?

Six experts who have been grappling with these questions share their views.

DRAWING BY MICHAEL KLEIN

Bob L. Martin
Before becoming president and CEO of Wal-Mart Stores' International Division in 1992, Bob L. Martin was chief information officer of Wal-Mart for ten years. He is based in Bentonville, Arkansas.

Information technology risks are becoming increasingly entangled with business risks, and it is the CEO's responsibility to distinguish between them. The CEO can no longer afford to delegate these decisions to information systems managers alone. At Wal-Mart and at many other companies, technology has become integrated with almost every aspect of the business. Once, we used technology to run core applications, such as general ledger, or to process key business information, such as sales and inventory. Those were applications that ran on big systems and stood alongside our business. Today technology plays a role in almost everything we do, from every aspect of customer service to customizing our store formats or matching our merchandising strategies to individual markets in order to meet varied customer preferences.

As technology has become pervasive in the business, it has changed the way we work at Wal-Mart. We are placing in the hands of our associates more information than ever in order for them to make decisions closer to the customer and respond quickly to competitive situations. Every company that has, like Wal-Mart, empowered a broader number of employees to make a greater number of decisions knows that this process entails changes in how, when, and where decisions get made as well as challenges in managing the associated risk. I think that CEOs increasingly recognize the impact that technology decisions have on their business and their corporate culture. As a result, they are becoming less comfortable delegating technology decisions to others.

Information technology risks are becoming increasingly entangled with business risks, and it is the CEO's responsibility to distinguish between them and not to delegate.

When I'm presented with a proposal to invest in new technology, I look beyond the financial commitment I'm asked to make today and try to understand what my follow-on commitments will be. Technology changes quickly and continually provides capabilities that we may want to take advantage of in our business. We have to know how we will get from the investment we make in today's generation of technology to the next generation.

I also push to understand how well the technology will fit the needs of the people for whom it is intended. As a general rule, a new technology is always a few steps ahead of our ability to use it, and therefore it is critical for executives to manage its impact on those people. If, a decade ago, we had had a greater understanding of the business and organizational dynamics of technology, I think we would now have an even greater payback from our investment in it. In my experience, the new systems that work best are those that are aligned not only with the business but also with the way people think and work.

Finally, we expect any proposed technology investment to reduce the complexity of our business, our processes, or our organization – not to add complexity. I want to see clearly how the capability that the technology supplies will simplify the way we make decisions or the way we accomplish activities and processes, such as moving goods, stocking shelves, or communicating with our suppliers.

For all those reasons, I see fewer investments ahead for us in computing and more – a lot more – in communications. By this I mean that we are shifting our emphasis away from processing systems that give us weekly or biweekly reports (which we have used to manage the business during the following week) and toward technologies that help us move more information out to our associates faster. We're moving away from systems that stand beside our business to technologies that are more integrated with the work of our associates.

Where do CEOs go for help in understanding how technology impacts business today? I find that technology suppliers have become much better at communicating with general managers. In the past, vendors used to send marketers to us. All they wanted to do was sell technology. Today at most of the industry-leading technology companies, the hard-nosed marketers are gone, replaced by engineers and account managers who want to solve business problems for us and are willing to be held accountable for whether or not the solutions deliver as promised. They are more business oriented than their predecessors. Executives can sound them out.

Chief information officers are in a critical role. CIOs who share the language and the vision of the CEO and have a strong link with the business will help the CEO understand the business and organizational risks of new communications technologies.

Gene Batchelder
Gene Batchelder is senior vice president and chief financial officer of GPM Gas Corporation, a Phillips Petroleum Company subsidiary that is located in Houston, Texas.

My advice to CEOs is this: Your IT function should be run by a great general manager, not by the traditional technology manager. No company can afford to overlook the role information technology can play in spurring organizational change and shaping core business processes. You can no longer delegate the IT function to the back office. Rather, you need to see it as a vital business within your business, run by people with commercial backgrounds who know how to make decisions that are based on ever changing competitive imperatives.

An accountant by education, I have had the opportunity to hold both IT and general management positions during my 25 years in industry. As an MIS manager, I delivered a sizable IT application (an executive information system) and later ran

a major corporate data center and worldwide network. More recently, I managed a manufacturing and distribution subsidiary; and now, as CFO of GPM Gas, I'm guiding the reengineering of the corporation's business and commercial processes. These roles have provided me with the unique opportunity to understand the frustrations on both sides of the IT divide. I can see the concerns of IT professionals who must deliver products and services in a strategic vacuum – with a myopic focus on cost reduction – and those of business line managers who question IT's ever escalating costs and seeming inability to focus clearly on critical business needs.

These are old frustrations. It has been six years since I was closely associated with the IT function. But I heard those complaints then, and I hear them now, from managers in my industry and from managers I talk with at other companies. For CEOs to manage information technology effectively in their organizations, they need to address those frustrations head-on – and that means understanding that the rules of the IT game have shifted and that the function now requires strong general management leadership.

Most large companies organized their IT departments to manage an infrastructure built around mainframe computer systems. IT managers and their staffs learned how to run data centers and deliver centralized processing. Today's pace of business requires on-site, on-line information, placing a premium on communications and distributed computing networks. Managers also need this information to be accessible across the business. The new imperative requires companies to integrate systems that have long been isolated from one another; to connect purchasing and manufacturing information with logistics, sales, and customer service; and to connect integrated business systems directly to customers and suppliers. It is difficult, if not impossible, to integrate today's new distributed technologies with the legacy systems that IT organizations have developed and maintained over the years. IT professionals generally don't have the technical and managerial skills necessary to help the company move from these older technologies to new ones.

Worse, they don't have the skills to integrate technology with the business. More and more, business considerations rather than technical ones drive investments in IT. Our businesses are asking, "Why not buy solutions rather than build them?" and "How can IT serve the critical needs of the business rather than those narrowly defined by accounting and human resources?" Far too many IT professionals don't know how to frame questions like these, much less answer them.

I find, in my company and elsewhere today, that it's the general manager who really is leading the changes that new approaches to IT call for. Most line managers are already running full-line businesses these days. Companies transferred bottom-line responsibilities to them

in the 1970s and human resource management in the 1980s. They are now ready to take on IT. The CEO needs to help drive this next phase of organizational growth.

We are beginning to move in this direction at GPM. We have established a cross-functional team that is, in a sense, providing general management leadership for our IT function. We refer to this group as our Business Integration Council. It's composed of plant and field operations managers, and accounting and IT staff professionals. The CEO sponsors and fully supports the council. Currently, the group is establishing an approach to systems development that will help us steer our IT in a new direction. We no longer talk about separate systems for accounting, decision support, or technical functions but about integrated business systems.

I believe that teams like ours can help companies solve complex information technology problems. Perhaps they could even manage the entire IT function. Technology and staff managers, working alongside line managers, can solve problems together that require an integrated understanding of both business and technology. The opportunity is there. Today's technology makes it possible. And teams are a tried and true management principle executives have used successfully in many different business situations.

Jonathan Newcomb
Jonathan Newcomb is president and CEO of Simon & Schuster, the publishing operation of Viacom in New York City.

As CEO of Simon & Schuster, I need to understand how information technology is changing our business, and I must ensure that our organization uses technology effectively. Consequently, I spend a lot of my time trying to understand the implications of new technologies, such as the electronic distribution of information products or software programs bundled with books. I also expect my CIO to have a rock-solid business view of technology and my line managers to demonstrate that they understand technology and are using it.

At Simon & Schuster, information technology is not a back-office operation. It is not systems. It is not telecommunications. It is a valuable source of business solutions, touching virtually every aspect of our company. We ship more than 300 million books a year from more than 4 million square feet of warehouses. The books are created from our portfolio of 350,000 active copyrights, each of which has its own complex intellectual property characteristics, such as royalties, rights, and permissions. We simply could not run our business effectively without robust systems to process orders, manage inventories, track royalties and returns, and perform all the other transaction-oriented tasks involved in publishing.

Like many companies today, we use technology to help us streamline business processes, cut costs, and manage independent work activities better. For instance, in creating a publishing product, authors, editors, and layout designers work in parallel with one another. We are installing an electronic manuscript management system that links their activities in a network and that will, among other benefits, help us control these multiple activities better and get products to market faster.

Unlike many other companies, our company is undergoing, because of information technology, a transformation – beyond just the transaction aspects of our business – in the products we create and the core economics of our business. In fact, today more than a fifth of Simon & Schuster's revenues come from technology-based products such as CD-ROMs and interactive television. To succeed in our business for the rest of the decade and beyond, we must be able to package and sell ideas, information, and entertainment in whatever format the customer desires – be it a book, a video, a stream of information and graphics over a computer network, or a combination of all three. We must be able to deliver it to customers when they want it, where they want it, and for a competitive price.

It is for this reason that I need to understand technology and what it is capable of doing. That is not to say that I view myself as a technologist. Rather, I focus on the business needs that the technology supports. I don't need to know about the latest video compression tools. But I want to understand the opportunities video compression may offer Simon & Schuster's Educational Management Group, which delivers live, interactive television to 3,500 classrooms nationwide. What impact might the technology have on the Educational Management Group's operations or on the development of new products? How will electronic manuscript management help us carry content produced for one market cost-effectively into other markets? How will we take, for example, software and curriculum material developed for an educational market into consumer markets? With words and pictures in digital form, can we leverage our creative investments across a greater number of new formats and new markets?

To ensure that I am actively involved in the give-and-take of how technology is used in our businesses, the chief information officer at Simon & Schuster reports directly to me. He has a substantial central staff and has dotted-line relationships with chief technology officers in each of our line units. (The chief technology officers report to their business unit leaders.) The CIO attends the operating reviews for all our businesses and works in partnership with line managers and their technology staffs to design and implement systems that best serve Simon & Schuster's needs and, more important, the needs of our customers. My CIO helps me understand technological advances outside and inside the company and aids me in formulating priorities for technology investments.

I also hold my line managers accountable for technology and make that accountability a part of our regular reporting processes and operating reviews. Line managers must demonstrate a clear understanding of how their own technology programs and products compare with

those of their competitors. Technology must figure into their visions for their business: They incorporate technology initiatives into their annual and five-year plans, and those initiatives become part of the management milestones by which they are judged. In other words, technology plays a key role in their strategic thinking, their planning, and, most important, the way they accomplish their goals.

My technology discussions with business unit leaders aren't always formal. I may have an informal discussion with a business unit leader about a product that could have an impact on his or her business. It may be a competitor's product or a product that another Simon & Schuster unit is making. (One of my roles is to help cross-pollinate ideas.) For instance, I might tell the head of my interactive television unit about something our school publishing operation is doing and ask if she sees any way to leverage the technology or the concept in her area.

In fact, we discuss technology actively throughout the company. Chief technology officers meet regularly to trade notes on their operations or to talk about new technology products and ideas. Employees and managers from a number of units and from functions within units come together regularly at informal forums to share information about technology they have explored and to discuss how it might be used in other units. For instance, Simon & Schuster has interactive sites on the World Wide Web. We recently drew together employees from across the company in a one-day forum to brainstorm about ways we could market, sell, promote, and deliver products in this new medium. The point is that we want the majority of our employees to be comfortable talking about technology – and to use it.

I expect my CIO to have a rock-solid business view of technology and my line managers to demonstrate that they understand technology and are using it.

New ideas for using technology may originate in the business units and flow up to the company's senior management team or vice versa. In either case, I expect managers to use business criteria to assess technology. The CIO develops multiyear plans with quantifiable objectives for his unit. For instance, he is responsible for setting and reaching rates of return for those systems that are designed to yield cost reductions. Chief technology officers and business leaders also must look at technology investments – whether for systems to help their units be more efficient or for new product initiatives – and treat them as business decisions subject to the same investment thresholds as any other business investment.

John F. Rockart

John F. Rockart is the director of the Center for Information Systems Research at the Massachusetts Institute of Technology's Sloan School of Management in Cambridge, Massachusetts.

More important than what the CEO *knows* about information technology is how he and key members of the organization *think* about it and about their respective roles in ensuring that the organization uses it effectively. The CEO of 1995 must incorporate the capabilities of IT into his "theory of the business," to use Peter F. Drucker's term ("The Theory of the Business," HBR September-October 1994). Equally important, the CEO must see to it that key managers envision their roles appropriately.

Organizations fail because their theory of the business is outdated, Drucker argues. As he puts it, the "assumptions on which the organization has been run no longer fit reality." Among the key assumptions are those on "markets, customers, competitors, core competencies, mission, *and technology*" (my emphasis). When the reality underlying the assumptions change, Drucker notes, the organization must incorporate those changes into its theory of the business. In no area are things changing faster today than in information technology. It is a primary job of the CEO to test continually and perhaps change his theory of the business in light of these changes.

In the 1990s, IT has become the fourth major resource available to executives to shape and operate an organization. Companies have managed the other three major resources for years: people, money, and machines. But today IT accounts for more than 50% of the capital-goods dollars spent in the United States. It is time to see IT for what it is: a major resource that – unlike single-purpose machines such as lathes, typewriters, and automobiles – can radically affect the structure of the organization, the way it serves customers, and the way it communicates both internally and externally.

Understanding the importance of the fourth resource and building it into the theory of the business (as well as into strategies and plans) are more important today than ever for the CEO.

First, the capabilities and potential of the technology are increasing more rapidly than ever before. During the past three decades, consumers have received about 30% more computer power each year for the same price. Competition among microprocessor companies and new advances in the technology are accelerating that rate. In communications, the story is similar, if not more striking, as worldwide deregulation, optical fiber, digitization of networks, and the opening up of more of the wireless spectrum are generating even greater increases in cost-effectiveness and capability.

Second, in an increasingly competitive world, IT is critical to the development of more effective operational and management processes. To serve customers well in 1995, companies need to be proficient in a half dozen key areas: reduced cycle times, reduced asset levels (for example, in inventories and people), faster development of new products, improved customer service, increasing empowerment of employees, and increased knowledge sharing and learning. Information technology is a critical resource for accomplishing all those goals.

Third – and perhaps most important with the advent of the "networked age" typified by the Internet, America Online, Prodigy, and the soon-to-debut Microsoft Network – there is now a whole new ball game for ordering and delivering products and services.

The CEO's own vision is the key. It sets a tone. But CEOs cannot do it all. Our ongoing research of IT management suggests that certain key managers determine how effectively IT will be used within the organization. They are line managers who recognize their responsibility for the success or failure of how the IT resource is used and business-oriented chief information officers.

Only line managers are close enough to their business to see the most effective ways to utilize IT. Only they possess the clout to embed IT into their strategies and to commit the necessary financial resources. The CEO's vision can be a catalyst, but it can be multiplied manyfold by line managers who see IT as an essential strategic resource. Thus the CEO, in reviewing strategies and plans, should look for and insist on a relevant and robust IT component.

CEOs also should hold line managers responsible for effective implementation of information technology. Although building good information systems is seldom easy, it is far easier than revolutionizing the process by which people work, their roles, reward systems, accounting systems, or the organizational structure – all of which need to be altered to install today's process-based systems. The heads of IT cannot make such changes. Changes like those are outside of the scope of their responsibility.

The companies that use IT most effectively boast, in addition to good line managers, chief information officers who have a deep understanding of the business and who are therefore capable of building strong working relationships with line management. The CIO's understanding of technology is a given. But it is through a deep knowledge of the business that the CIO can not only understand what is necessary but also build credibility with line managers – and thus build the ability to influence them to move in appropriate technical directions. The CEO's choice of a business-savvy, relationship-building CIO is critical.

Wayne P. Yetter
Wayne P. Yetter, a member of the Merck organization since 1977, is president and CEO of Astra Merck in Wayne, Pennsylvania.

I don't make decisions unilaterally about information technology. On the contrary, I rely on my people and the processes we have in place at Astra Merck to help me understand the opportunities that technology presents and the challenges it can pose. Together, we make decisions about technology investments based on the value of the business capabilities they enable.

To explain what I mean, I must first explain my organization because we are, admittedly, somewhat unusual. In 1992, we began life as a unit of Merck that took to market selected drugs from the pipeline of Astra AB. But the terms of the original licensing agreement between the two companies required that Merck would make us a stand-alone operation (eventually owned jointly by both Merck and Astra) if we reached a specific revenue trigger. By 1993, it was apparent that we soon would reach that revenue level, and we began to plan for life on our own. Astra Merck became a reality in November 1994, when Astra purchased a 50% interest in us from Merck.

Together, we make decisions about technology investments based on the value of the business capabilities those technologies enable.

Our business is to take products from Astra's research or those discoveries of other companies that are licensed to us, guide them through clinical development studies and the U.S. Food and Drug Administration regulatory process, and then market them in the United States. We had the luxury of building our organization from the ground up. We therefore were able to think clearly about the processes and capabilities we needed. So, for instance, we did not organize our business by product lines or functions but by business processes such as licensing, business development, and management of our unique package of products, services, information, and education for health care professionals, which we call pharmaceutical solutions. We arranged to have the leaders of each of our process areas sit on my executive team.

Because we were able to start fresh, we could plan our information technology strategy at the same time that we planned our overall strategy, our organizational structure, our business processes, and our culture. For instance, we looked at the steps involved in drug development and put into place a process, enabled by technology, that we think will allow us to be faster to market than our competitors. In our industry, investigators traditionally have collected data about drug studies at sites where clinical trials are performed – hospitals and universities, for instance – and have shipped the information to the drug company. It arrives as an assortment of separate manually prepared forms, reports, or files. The company must organize it, manage it, and analyze it, and eventually incorporate it in documents submitted to the government. The process has often required keying information one or more times – and it's prone to error.

We took a new approach. Investigators using personal computers and new pen-based electronic devices collect and ship data electronically from sites directly to Astra Merck on an ongoing basis. We have programmed our computers to confirm with the investigators the accuracy of their entries on the spot. In other words, we wanted to capture the critical information faster and less expensively than competitors. We also wanted to build quality assurance into our collection procedures, not let it be a backstop activity at the end of the process. With these data in digital

form, we find that we can store and manage the information more efficiently and can more quickly and easily incorporate it into required documents.

The point is that we do not consider technology investments in isolation. We look at capabilities, such as developing drugs faster or providing customers with services they can shape themselves; and if technology is necessary to make a capability work, then technology investments are part of the package. Starting the business from zero, we didn't have existing processes to reengineer, nor did we have legacy computer systems that are expensive to change and that don't integrate well with new technologies.

Our organization reflects our belief that information technology must be integrated with the business. Our IT people – we refer to them as solution integrators – live and work in the process areas that make up our business. They are not isolated in a support department. They participate in business meetings and help identify ways in which technology can make the business more efficient or more effective. They report both to business managers in the process areas and to the chief information officer. Our CIO is a full member of my executive team, but he is by no means the only technology champion in the group. Every one of my process leaders views technology as a core asset of the business to be leveraged in almost every activity.

To return to my initial point, I don't make IT decisions unilaterally. We were able from the start to put processes into place that would allow the organization to make decisions about initiatives largely by consensus. Every organization has to choose among initiatives. As we began to build Astra Merck, we, too, had to weigh our desires against our resources. First, we had to have the core applications we would need to run the business, such as payroll and telecommunications. We also had to build the capabilities – such as drug development – that would distinguish us from our competitors. We had to decide in what order we

would develop our systems and what investments we would make in each.

A program management team made up of managers who reported directly to process-area leaders looked at all the various desired projects and, keeping our resource constraints in mind, established criteria to prioritize them. We expected them to be more than ambassadors from their respective areas and to bring an enterprise-wide perspective to the table. The team also reviewed the interrelatedness of the investments and developed an overall plan for implementing them.

My executive team approved nearly all of the recommendations. The program management team had made most of the really hard decisions about which capabilities to pursue and which trade-offs to accept. They clearly understood our companywide goals and objectives. Their proposed initiatives aligned with our vision and supported our model of the business. Within the executive team, I arbitrated disagreements among my managers. But in the end we, too, arrived at our decisions by consensus.

As CEO, I ask questions just to assure myself that, in the broadest sense, the technology under consideration is appropriate for a given activity. How will the technology differentiate Astra Merck in our ability to serve customers? Can we outsource a specific activity and thereby avoid the need to invest in it? I also use my executive team as a sounding board and to ensure that the investment is appropriate and necessary to support our business goals. In the final analysis, I trust my chief information officer, my management staff, and my organization to use the processes in place to make effective decisions about information technology.

Jerome H. Grossman
Jerome H. Grossman is chairman and CEO of New England Medical Center and a professor of medicine at Tufts University School of Medicine in Boston, Massachusetts.

In today's changing health care industry, New England Medical Center must maintain research programs, teaching facilities, and high clinical-care standards, and yet also compete on price. New systems and applications are helping us balance these conflicting demands. It is my role as CEO to convey the message of change to my organization.

Historically, hospitals have not competed on price. In the past, government regulations and insurance reimbursement mechanisms created a climate in which we were paid to dispense service: The more we did, the more we earned. There was little incentive to manage costs or quality, and we fragmented our information systems to enable us to track and charge for individual units of hospital services.

Now, however, in the competitive marketplace of managed health care, the rules of the game are different and the incentives dramatically reversed. Insurers predetermine and prepay for service. At the same time, we still must deliver high-quality service to the patient. Given such imperatives, our information systems must do more than account for provided services. They also must make certain that our quality-assurance systems (for monitoring the quality of patient care) and our cost-control systems provide us with the balanced data we need to manage our conflicting missions more effectively. If we can link together our formerly fragmented systems, we can get an integrated view of patient care that will transform the way we practice medicine, organize and manage care, and relate to each other as providers and patients.

To convey this message at my institution, I have to have answers to the questions that people continually ask: Why change? Where are we headed? How do we get there? What role do I play? Like managers in most companies today, I cannot answer such questions without also talking about the critical role that information technology will play. I work with outside consultants as well as with experts inside NEMC in addressing those questions.

I actively involve several members of my senior management team and other in-house experts in all decisions about IT development and investment. Within the past year, we created the Medical Center Information Services Advisory Committee from top administrators of information services, human resources, quality support services, laboratory, pharmacy, and nursing, plus physician leaders and individuals from a number of clinical services. They are all people who, through their own interests and experience, are knowledgeable about IT applications in clinical settings. The group meets monthly and has a twofold mission. First, the committee defines IT goals and priorities in the context of the strategic plan set by the CEO, the president, and senior hospital managers. Second, the committee reviews and selects IT proposals from our many departments.

The information services department prepares an annual performance report on investments and achievements and compares it with the medical center's strategic business initiatives. We use this report to evaluate the degree to which our information technology infrastructure is helping us become a higher-quality, more effective, and more efficient service provider.

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A new approach to information promises business benefits that few managers would conceive of when focusing strictly on technology.

Saving IT's Soul: Human-Centered Information Management

by Thomas H. Davenport

Information technology has a polarizing effect on managers; it either bedazzles or frightens. Those who are afraid of it shun it, while bedazzled IT departments frequently become prisoners of their own fascination, constructing elaborate technology architectures and enterprise information models to guide systems development. Senior executives who buy into this view promote technology as the key catalyst of business change. But such technocratic solutions often specify the minutiae of machinery while disregarding how people in organizations actually go about acquiring, sharing, and making use of information. In short, they glorify information technology and ignore human psychology.

It shouldn't surprise anyone that human nature, good and bad, can throw a wrench into the best-laid IT plans, yet technocrats are constantly caught off guard by the "irrational" behavior of "end users." In fact, people who are afraid of information technology may have good reason to feel that way. Companies that ballyhoo their latest management information systems or groupware usually spend little time training employees to use them. Even those who like computers can find themselves hobbled by the rigid structure and rules of many IT shops.

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Obviously, people handle information in any number of ways, from basic data processing to gen-

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DRAWINGS BY PAUL MEISEL

erating sophisticated accounting documents to exchanging informal E-mail messages around the world. For the many diverse information users in large organizations, only one thing is certain: effective information management must begin by thinking about how people use information – not with how people use machines. While it's impossible to account for all the unforeseen consequences of information expansion and use in today's companies, the following three observations exemplify how a human-centered approach to information management contrasts with the standard IT view:

☐ *Information evolves in many directions, taking on multiple meanings.* While IT specialists are drawn to common definitions of terms like customer or product, most information doesn't conform to such strict boundaries. Forcing employees to come to one common definition, as some technologies require, only truncates the very conversations and sharing of perspectives that the technology is supposed to ensure. Rather than forcing employees to simplify information so that it will fit into a computer, a human-centered approach to information calls for preserving the rich complexity we prefer in our information diets.

☐ *People don't share information easily.* Assuming that different departments, professionals, or line workers will want to use technology to share information is one of the biggest mistakes executives make. Yet it is one of the fundamental assumptions made in planning any IT system. That is, if you build it, people will use it.

☐ *Changing an IT system won't change a company's information culture.* The presence of technology, in and of itself, cannot wholly transform a corporation. Changing a company's information culture requires altering the basic behaviors, attitudes, values, management expectations, and incentives that relate to information. Changing the technology only reinforces the behaviors that already exist. Yet in most companies, many managers still believe that once the right technology is in place, the appropriate information-sharing behavior will inevitably follow.

> Too many managers still believe that once the right technology is in place, appropriate information sharing will follow.

At one large pharmaceutical company, for example, IT managers tried to implement shared databases and other new technologies to speed up R&D, only to have their efforts foiled by significant cultural barriers. In this case, managers assumed that researchers involved in the development of a drug would pass along all information about it to the people conducting its clinical trial; if researchers had found early on that, say, the drug's effect diminished when taken with certain foods, then patients in the clinical trial could be instructed not to take the drug at meals. Such early release of data, however, rarely happens at this pharmaceutical company. Clinical studies therefore often have to be redone, delaying the drug-approval process sometimes for years.

In this company, management pushed the new databases and software, but researchers were either hostile or apathetic. The IT department was so focused on the technology that they had failed to understand the rigid rules of scientific exploration that govern how scientists think about information. Different departments couldn't agree on what constituted a "drug" or a "clinical trial" – or even what font they should use for research reports. In this case, the rate of technological change far outstripped the pace of change in the culture as a whole. Instead of instituting new technologies, executives should have instituted a program of cultural change to convince highly competitive scientists that they wouldn't be penalized for sharing early and perhaps incomplete results.

Technology, after all, is neither the savior nor archdemon of the information age. At its worst, it distracts and misleads us. But at its best, new systems can support the kind of information use that results in real business change.

What's Wrong with the View from IT?

Since the first business applications of computers in the mid-1950s, planning and control have dominated systems development in large companies. In particular, the concept of "information architecture" has overshadowed a human-centered view of information. IBM created the first structured approach in the 1960s and has defined the field ever since. Originally named "business systems planning" (BSP), later versions came to be called "strategic data planning" and "information architecture."

The analogy to an architectural blueprint, in which the location and uses of different rooms are

works as far as it goes. But information architecture was invented to specify computer systems and databases unambiguously. Systems planners believed that information environments could be designed for the entire organization, without reference to particular individuals. Many planners still assume that organizations have a core of invariant pieces of information – such as customers, products, and business transactions – around which key systems can be developed.

Most managers don't rely on computer-based information to make decisions.

This approach has several potential strengths. Such blueprints attempt to structure the sharing of data across multiple computer applications. In addition, since information storage has been a scarce resource until recently, executives hoped that information architecture would help minimize redundant data. And one nontechnical benefit has been widely touted: after a successful planning exercise, executives can supposedly make decisions based on common information.

But information architecture has never achieved its promise. Enterprise models of information types, uses, and responsibilities are too broad and arcane for nontechnical people to comprehend – and they can take years to build. One study of enterprisewide BSP efforts found that few of the systems projects identified in the plans were ever implemented; another concluded that most strategic data plans were shelved without implementation.[1] Given today's rate of business change, even if an enterprise model is finished in a year or two, it's likely to be outdated.

The primary reason for information architecture's failure, however, is that few companies have undertaken such planning with any concern for how people actually use information. (See the insert, "The Information Facts of Life.") For one thing, most approaches have addressed only a small fraction of organizations' information – that found on computers. Yet evidence from research conducted since the mid-1960s shows that most managers don't rely on computer-based information to make decisions. The results of these studies are remarkably consistent: managers [illegible] of their information from face-to-face or telephone conversations; they acquire the remaining third from documents, most of which come from outside the organization and aren't on the computer system.[2]

When technical approaches to information planning are applied broadly, not only do they fail to encompass all of a company's information, they also undercut business change. Rank Xerox U.K., for instance, began a major effort in the late 1980s to redesign its business processes with the help of information architectural techniques and computer-based modeling tools. The idea behind this was that once the new business processes were designed, then the very same models could be used to generate code automatically for a new set of supporting information systems and databases.

After several years, however, a new managing director asked for a simple model that could describe the old and redesigned processes. Not one could be found; all that existed were very detailed data models that reflected the status quo. The technicians had lost the objective of business change in the details of modeling. Now Rank Xerox uses simpler approaches to do process modeling, such as flow charts and cost buildup charts, and has made some successful changes; for example, it has saved $11 million annually in sales-order processing by eliminating approval steps and better integrating the sales force with the entire order-management process. Now the company uses information architecture only to design specific systems.

Information managers must begin by thinking about how people use information, not how people use machines.

As at Rank Xerox and other large companies, information architects have assumed that common information is created through the development of a computer model instead of through the long and often arduous process of reaching a shared understanding. They haven't identified, trained, or monitored the desired behaviors for information users and providers, both of whom must cooperate if common information is to be developed. Most im-

The Information Facts of Life

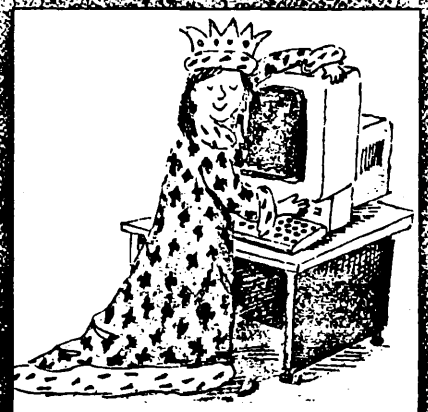
1. Most of the information in organizations – and most of the information people really care about – isn't on computers.

2. Managers prefer to get information from people rather than computers; people add value to raw information by interpreting it and adding context.

3. The more complex and detailed an information management approach, the less likely it is to change anyone's behavior.

4. All information doesn't have to be common; an element of flexibility and disorder is desirable.

5. The more a company knows and cares about its core business, the less likely employees will be to agree on a common definition of it.



If information is power and money, people won't share it easily.

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7. The willingness of individuals to use a specified information format is directly proportional to how much they have participated in defining it or trust others who did.

8. To make the most of electronic communications, employees must first learn to communicate face to face.

9. Since people are important sources and integrators of information, any map or models of information should include people.

10. There's no such thing as information overload; there's only our capacity for it.

portant, they make the unrealistic assumption that most of a company's information can be organized according to a few common terms.

A Natural Mess: Multiple Information Meanings

While information architecture can't capture the reality of human behavior, the alternative is hard for traditional managers to grasp. That's because a human-centered approach assumes information is complex, ever-expanding, and impossible to control completely. The natural world is a more apt metaphor for the information age than architecture. From this holistic perspective, all information doesn't have to be common; some disorder and even redundancy may be desirable. (See the chart, "Human-Centered IT Managers Focus on How People Use Information Rather than Machines.")

No matter how simple or basic a unit of information may seem, there can be valid disagreements about its meaning. At Digital Equipment Corporation, for example, a "sale" to the indirect marketing organization happened when a distributor or reseller ordered a computer; but to direct marketing, the sale occurred only when the end customer took delivery. Even within direct marketing, there were differences of opinion: salespeople recorded a sale when the order was placed, manufacturing and logistics when the product was delivered, and finance when it was paid for.

At American Airlines, there are several perspectives on what an "airport" is. Some managers argue that an airport is any location to which American has scheduled service; others count any airport granted that status by the international standards body. At Union Pacific Railroad, there's little consensus on what a "train" is. Is it a locomotive, all cars actually pulled from an origin to a destination, or an abstract scheduling entity? Even U.S. Department of Agriculture officials can't agree on the meaning of "farm."

These multiple meanings make the job of information management treacherous at best. At one oil exploration company, for example, information architects worked for years on ineffective models because people assigned different meanings to "oil location." Some users defined it as the original geographic coordinates in the ground; others thought it was the well from which oil sprang; still others used the term to refer to the oil's current location in a tank farm or pipeline. Each definition found its way into computer databases. As a result, it was difficult to share even the most basic infor-

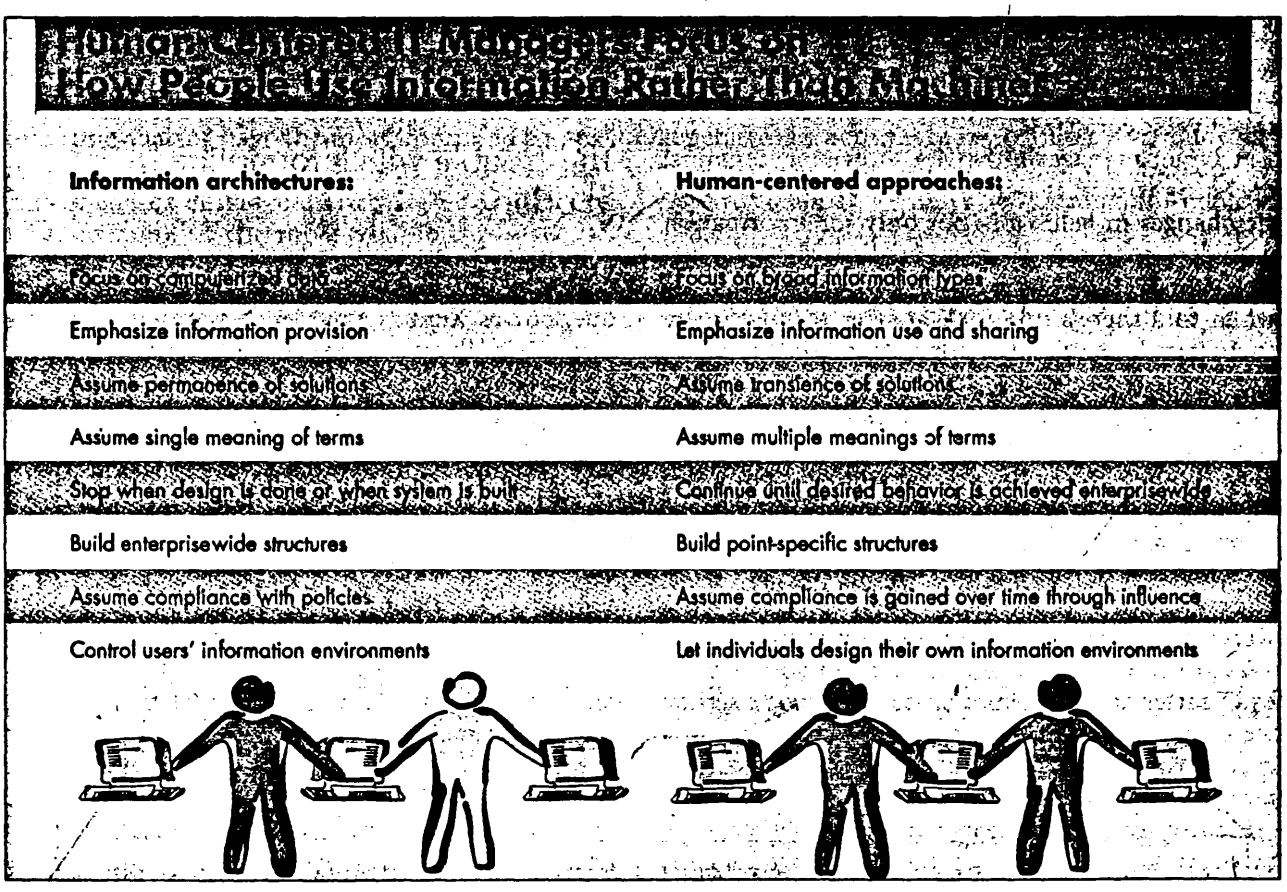
mation on the production of different sites. Among many other problems, the company couldn't accurately monitor the performance of specific wells or figure the taxes it owed states and counties where the oil was pumped.

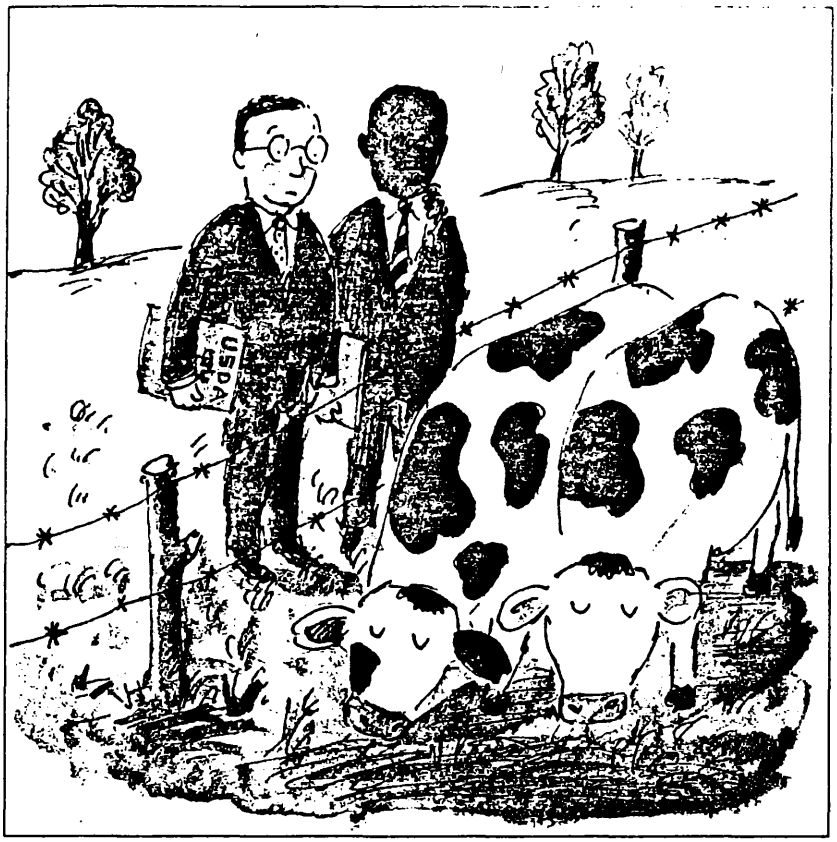
In this case, the CEO finally dictated to the entire management team what "oil location" would henceforth mean: an official corporate algorithm that reflected drilling location, well angle, and drill depth. Those managers or other employees who used alternative meanings would lose their jobs. Although this solution is extreme, it did achieve the desired result: consensus on the meaning of oil location and better information on production that could be shared.

But while multiple meanings can create problems for organizational integration and information sharing, they shouldn't always be eliminated, especially in large companies with diverse businesses. In fact, given the importance of information to the success of individuals and groups within organizations, managers should expect pressures to define information in ways that are useful to these smaller units. There will always be a healthy tension between *information globalism*, which seeks to create meanings that apply to an entire organization, and *information particularism*, in which individuals and small groups define information in ways that make sense to them.

Another large computer company exemplifies the natural tension between particularism and globalism. This company is renowned for granting autonomy to product and geographical units. That autonomy extends to information; when it comes to financial information, for example, there are 103 general ledgers. Divisional, geographical, and product executives can therefore count costs, revenues, and profits in ways that are most meaningful for their particular products or businesses. To deal with aggregation, this company maintains a corporate-level ledger to consolidate results across common financial categories.

Undoubtedly, such particularism turns aggregation and information sharing into a challenge. Even though there is a corporate-level information stream, managers are often evaluated by comparing their financial results against that corporate stream. Much effort goes into reconciling and explaining how the local stream relates to the corporate stream. Finance managers keep trying to remove as many entries from ledgers as possible and coaxing local executives into using corporate-level information when they can. Some top managers are actively trying to get rid of the local ledgers alto-





No unit of information is too basic to prevent disagreement about its meaning: USDA officials can't even agree on what a farm is.

gether. But while dual information streams are messy and hard to control, they seem realistic for this diverse company.

A larger managerial barrier, however, remains: operating with multiple meanings also requires basic changes in behavior – not only for information providers, who categorize and collect the information, but also for users. The CEO who is annoyed when told there's no quick answer to how many customers (or employees or products) the company has is just as guilty of oversimplifying information as the database designer who insists on one definition of customer.

And when it *is* necessary to define common meanings, the process requires much more management participation and time than many assume or want to allot. For instance, Xerox did data modeling and administration for 20 years, but in the words of the director of information management, "We got nowhere." These initiatives were driven by IT rather than by senior business managers; they were always abandoned in favor of specific development projects like the new order-processing or billing system, which yielded obvious benefits.

Finally, Xerox's IT department asked senior executives to identify the key pieces of information on which the entire business should be run. The executives debated the issue on several occasions but weren't able to reach a consensus. They did agree, however, that their main priorities were customer, financial, and product information – in that order.

Xerox's IT department then took another tack. From around the world, 15 marketing and sales managers, accompanied by their IT counterparts, met to agree on the set of common customer information the company would use. As usual, people disagreed about what "customer" meant. But these managers eventually agreed to define customers as corporations that had already purchased products or services from Xerox and to refer to them with a common worldwide number; they also reached consensus on 11 other customer-oriented terms, including customer-satisfaction measures. This coordinated approach allowed country managers to then create customer information that the IT department has now combined into a global data warehouse.

The Trouble with Information Sharing

In today's competitive business environment, it makes sense to give information particularism its due; but as Xerox's experience with customer information illustrates, executives must also decide which aspects of a company's information are global. More to the point, executives must determine how such information is to be shared effectively – one of the trickiest management issues for today's companies. While information architecture can specify who controls information, such rigid models don't account for the unpredictable growth of information or human nature.

Some managers are quick to point out the obvious difficulties with information sharing, especially when it's driven by new technologies like electronic mail. If sharing makes it easier for a company's employees to get at critical information, it also opens the way for any interested external parties – competitors, attorneys, even computer hackers. Given the many recent and highly visible

cases of departing employees allegedly taking with them reams (or diskettes) of proprietary information, many executives wonder whether or not such information should be widely disseminated in the first place.

Paranoia about external opportunists has its roots in practical information issues. For information to be shared, it must first be structured and compiled, which makes it easier to steal or subpoena. For example, when Otis Elevator began to compile information on elevator reliability and performance – which would enable sharing among managers, service personnel, and new product designers – the company's internal counsel feared having to produce this information if the company were sued for an elevator-related accident. This hasn't happened so far, but it's all too easy to understand this attorney's concerns. Ironically, his response exposes some of the old-line corporate attitudes about controlling information through secrecy and ambiguity.

Paranoia about dissemination has its roots in practical information issues.

Indeed, the internal problems that arise with information sharing have the most impact on companies and are much less obvious than external thieves and ex-employees with a grudge. Mergers produce some of the most visible clashes, since managers from companies with sometimes very different attitudes toward information use often find themselves thrown together. For example, a number of contentious issues surfaced at Chemical Bank shortly after it merged with Manufacturers Hanover.

The two banks had very different information cultures. Chemical Bank favored sharing information across departments and product groups. Manufacturers Hanover believed that each group owned its information and could choose not to share it. To help integrate banking operations, senior executives decided to create a basic set of information management principles, a process that allowed managers of both banks to discuss which policy should prevail.

One draft principle stated that if a business area had a legitimate need for information, it should get it. But managers from the different banks first disagreed about access to sensitive information – would they be breaching both customer security and trust? And what was a "legitimate need," anyway? For instance, should the private banking group furnish information on wealthy customers to the capital markets division, which could then promote a bond offering to them? If so, which of the groups were responsible for identifying likely prospects, notifying the appropriate managers, and outputting the customer information in the correct format for the capital markets division?

Other Chemical Bank principles addressed the need for a clear owner for each major piece of information and clarified responsibilities and priorities for supplying information to other parts of the bank. These information management principles aren't magic, but they've hastened the integration of the two banks and limited disagreements about important information issues. As with so many human-centered information management techniques, the process of developing principles – of hammering out how information is defined and distributed – was more important than any fixed result.

In this case, bank executives were well aware of what made information sharing such a touchy subject. But consider a less successful example: the IT managers of a large telecommunications company generated an admirable set of their own information management principles. They addressed the need to establish "enterprise information" and the ways such corporate information should be managed and shared. But while corporate senior managers reviewed these principles, divisional heads weren't consulted. As a result, several divisions decided they were separate "enterprises" and could therefore define their own information.

Many people suffer from far too much noninformation rather than the "information overload" they complain about.

Such natural power plays, malicious or not, are legion. The will to power – whether that applies to CEOs, separate divisions, line supervisors, or individual professionals – is the main reason why new

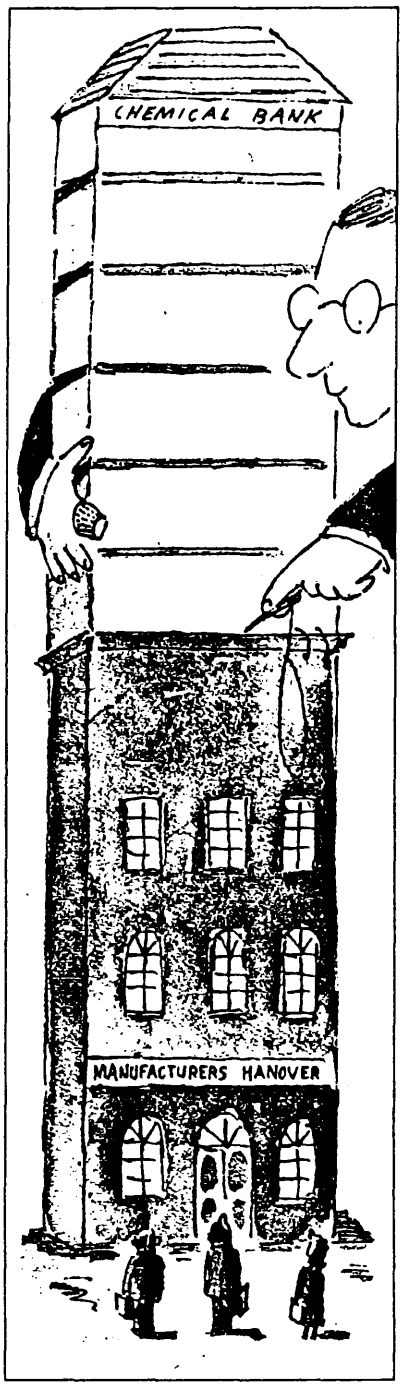
information technologies don't inevitably lead to flattened hierarchies and empowered employees. Working out information issues in a company with a monolithic culture – instead of wrestling with two competing information cultures that result from a merger – often involves digging out entrenched attitudes toward organizational control.

In such companies, technologies that promote information sharing can end up controlling employees rather than empowering them. When lower level workers are ordered to "share" information with those higher up the corporate ladder, a cutthroat information culture of meddling micromanagement can result. At the refining and marketing division of a large oil company, for example, the division president delighted in being able to use his computer to peer electronically over the shoulders of oil traders – and occasionally to override or initiate a deal.

On the other hand, Xerox's executive support system has been limited to accessing data two levels below the user – precisely to avoid this type of excessive control. Such human-centered technology implementations are still rare, but they indicate the way managers must think about the issues that information sharing brings to the surface.

Populist exhortations to the contrary, unlimited information sharing doesn't work. In fact, increased information sharing can either improve or actively harm company morale. Sharing information about actual corporate performance is usually good for morale – even when performance is poor, since uninformed employees often assume that it's worse than it really is. Sharing rumors, however, can be demoralizing.

An information systems manager at a New York bank, for example, created a Lotus Notes bulletin board that he called the "Rumor Mill." The system allowed employees in his department to share rumors easily; the manager could then quash false ones on-line. This experiment worked just fine – until rumors were posted about the manager's own departure from the bank. When he refused to comment, employees correctly surmised it was true. They became cynical about this attempt to share information through technology, since the manager hadn't communicated with them on this particular piece of information. Needless to say, Rumor Mill was not continued by his successor.



When Chemical Bank and Manufacturers Hanover merged, two information cultures clashed.

Sharing rumors in this fashion underscores the distinction between information and *noninformation.* Many people suffer from far too much noninformation – which companies seem to generate with ease and at the expense of useful information – rather than the "information overload" they complain about. Any heavy E-mail user can testify to the junk mail problem. Right now I have more than 160 messages in my electronic mailbox, some of which inform me that one colleague lost his appointment book or that another wanted to be included in last Thursday's pizza run. I should never have received them, and now I don't have the time to delete them.

Technologists are working on personalized filters or "agents" that can separate real information from junk. But it's likely that good marketers of electronic information will find ways to circumvent filters – just as direct mail now looks like a tax refund or personal check. In fact, some communication technologies just exacerbate this problem.

At Tandem Computers, for example, a combination E-mail/bulletin board allows field-service personnel to send a "has anyone seen this problem?" message to all technical people in the company. The service technician may get an answer, but is it really necessary for everyone to read this message? As in so many other cases, simply implementing an electronic-mail system – without any guidelines

for how to use it – won't resolve the complicated issues of information sharing and management.

If some companies generate noninformation through E-mail, others rely on it too much to communicate real information. Although such technologies can improve organizational communications, they have their limits. Several researchers have argued persuasively that the organizational trust and interpersonal context necessary to achieve a true network organization aren't based solely on electronic networks.[3] Rather, relationships must be initially constructed through face-to-face meetings.

Symantec Corporation, for instance, found that electronic mail is not all it's cracked up to be. At Symantec, a California software company that grew rapidly through acquisition and ended up with relatively autonomous product groups, there was substantial use of electronic mail. Indeed, senior executives believed E-mail was the fastest way to forge connections in this virtual corporation. But senior managers soon realized their diverse organization still didn't communicate very well. They concluded that people in geographically far-flung product groups just didn't see each other enough.

To address the problem, executives organized the first companywide meeting. Managers began communicating about important issues through several different routes: letters to employees' homes, face-to-face conversations, as well as E-mail memos. In some cases, they made the same announcement across all media to make sure all employees heard essential news. The company's executives noticed substantial improvement in the problem thereafter; employees complained less about communication problems, and those in the field talked about Symantec's overall strategic directions with greater understanding.

New communication technologies will certainly support information sharing when physical proximity isn't a possibility. But as Symantec's story shows, the proliferation of these technologies has created a new problem: how to choose among all the alternatives. A sales rep who wants to communicate with a customer can use first-class mail, express mail, voice mail, electronic mail, a fax, an electronic bulletin board, videoconferencing, or the telephone – not to mention a face-to-face meeting.

Few of us have a clear sense of which alternative is most appropriate for a given communication. But while using a suboptimal medium is not yet a corporate crime, managers should at least acknowledge the confusion. And regardless of the technical form of communication, managers must bear in mind that employees who work together still need regular personal contact.

Preparing the Cultural Ground for IT

If companies as diverse as Symantec, Chemical Bank, Xerox – even the oil company with the controlling division president – are all struggling with information-sharing problems, it's because such issues are unavoidable in today's global economy. What many have discovered, however, is that their solutions do not turn out to be particularly "scientific." Indeed, the solution that most reliably leads to successful IT implementation is also the hardest one to carry out: changing an organization's information culture.

Nonetheless, preparing the cultural ground is essential. Two professional services companies, which I'll call Company A and Company B, illustrate the impact information culture has on technology implementation. Both companies implemented the same new technology for the same purpose. But while one had an existing information culture that fit the management's objectives for the technology, the other did not.

Company A[4] hadn't had a successful information orientation in the past, and now managers decided it was time to lead with technology. They acquired both a large number of workstations and an organizationwide license for a new software program that combined electronic mail, conferencing, and document distribution. But the company's professionals received little training on how to use the new system. They also had no incentives to share information – only disincentives, especially the fear of giving away their best ideas to others, who would then use them to get promoted in this company's up-or-out culture.

The average professional at Company A worked with few other employees outside his or her office and had little knowledge of anyone else's informa-

Changing the company's information culture is the best way to implement IT, but it's also the hardest to carry out.

IBM's Catalog of Information

Hands On Network Environment (HONE)

Overview

HONE is an on-line system that provides access to a variety of applications, tools, and information databases designed to increase the productivity of the field. These applications are organized into the following catagories:

IBM product information
IBM Services information
marketing information and tools
technical information
configurators and tools
financial topics
performance information and tools
administrative information and tools
publications
education topics
customer registration/support tools
about HONE information

Seven components of HONE represent major sources of market information and are described in detail later in this section:

1. Competitive On-Line Marketing Perspective (COMP)
2. EXPERTMENU
3. Market Studies Document Database (MDOC)
4. National Solution Center (NSC)
5. Published Document Database (PDOC)
6. Selected International Account Support (SIASUPP)
7. SERVICES

For futher information on any HONE application while using HONE, enter on the command line:

WHATIS application name

Key Contact

HONE Customer Support
External 800-555-6789
Hours 6 a.m.- 6 p.m. Mountain Time
Contact the electronic delivery specialist or HONE coordinator at a local site.

Availability

5 a.m.-1 a.m. Monday-Friday Eastern Time
5 a.m.-3 a.m. Saturday
8 a.m.-1 a.m. Sunday

Responsible Organization

IBM US Services – Electronic Delivery

User Interface/Query

Menu-Driven and/or STAIRS Query Tools

Educational Offerings

For HONE productivity tips and news, subscribe to HONEINFO Bulletin Board on NATBOARD.
The following educational tools are available on HONE:

*HONE Reference Card – Key HONEREF.
*HONE User Guide – Key GUIDE from the HONE main menu.
*HONEDEMO – On-line demonstrations of selected applications or functions.
*HONE News – On the HONE main menu.
*Applications Guides – A number of applications contain User Guides, which may be viewed by keying GUIDE on the application menu.

tion requirements. The company recruited new employees based on their willingness to work hard and their training in specific disciplines rather than any demonstrated ability to generate new ideas and package them for use by others. As a result, Company A's fancy new software program was ignored and misunderstood. Even the company's IT sponsor for the program now admits that professionals use the new system mostly for E-mail, a limited application that hasn't solved the main information issues.

Company B, on the other hand, had a long history of hiring people who were good at generating ideas and expressing them in written and verbal form. Managers showed an interest in sharing information long before technology was invented to support this task; the company published regular journals and summaries of press mentions and encouraged its professionals to publish books and articles externally. Company B also had an up-or-out culture, but a key criterion for promotion was whether or not an individual had created and disseminated new ideas in the form of practice bulletins, articles, or books. Most important, information managers at Company B are just that: in addition to software and hardware, they focus on incentives, organizational structures, human support, and presentation formats as facilitators of good information behavior in the company.

As for information technology, Company B only recently invested in a new system comparable to Company A's. Before that, however, Company B had set up a simple database for key practice and client documents; it had also created a system for measuring the documents that were most commonly accessed, which then counted toward the promotions of individual authors. I never heard anyone at Company B utter the words "information culture"; but by the time an IT platform had been implemented, this company could build on and support a program of information sharing that was already in place. Now its professionals use the expanded software capabilities to facilitate electronic discussions and have created new databases at a rapid clip.

As Company A and Company B reveal, valuable tools are still tools; new technologies, no matter how advanced, won't change anyone's behavior without human intervention. In fact, we have yet to address fully the role of people in information management work, though some research has focused on how information itself affects humans at work.[5] It's not even a matter of "implementing" the right information culture at the right time. The specific solutions to information problems described below demonstrate how information cultures can evolve to match new organizational needs, becoming more human-centered, flexible, and cost-effective in the process.

Information Maps. Most large companies now have plenty of databases. But precisely because of the vast amounts of information circulating around organizations, few employees know where to find what they really need. As obvious as it may seem, few companies have an information map that describes the location and availability of the most widely used information. Even at IBM, founder of business systems planning and steeped in the rhetoric of information architecture, executives only recently realized the need for information maps.

Valuable tools are still just tools; new technologies alone won't change anyone's behavior.

Pointers to information in a computer or on a library shelf alone are useful; but pointers to the people who own or oversee particular information are especially valuable. These people can interpret the information, describe its intended uses and limitations, and direct information seekers to other sources. At IBM, a task force studied the use of market-oriented information throughout the entire company. This task force found that market information in regular computerized reports was sometimes ignored by managers – something that other non-IBM research has also suggested. What these managers really wanted was fast answers to their ad hoc questions.

As a result, IBM's task force created the "Guide to Market Information," an internal catalog. The insert "IBM's Catalog of Information" displays a sample page. This guide not only lists available marketing information at IBM but also the people or organizations responsible for that information and how to contact them. It includes proprietary market research, internal and external databases to which IBM has access, electronic bulletin boards, libraries, and internally and externally produced reports. In 1992, IBM printed 5,000 copies, charged internal buyers at cost, and sold out.

Even so, the task force and managers still had to whittle away at old attitudes about information sharing. Some information "owners" were initially reluctant to have their names listed, since they

were afraid that answering questions about information would be too time-consuming. In practice, however, the extra time involved hasn't really interfered with anyone's job. Many of these information owners now say they learn from the questions and comments of others. More important, IBM has saved millions by avoiding duplication in the purchase of external market information.

Information Guides. Along with maps, information users need people to guide them to the right kind of information in the first place. Librarians have often performed this role in the past. But while information owners at IBM can answer specific questions, few companies have general guides to the vast information resources available throughout an organization. Once again, including new kinds of human support for technology can help change a company's information culture.

In 1991, Hallmark Cards's MIS managers realized that the company's information users were confused about how to access necessary data. The problem was both technical and behavioral. Financial, customer, supplier, product, and other data were buried in many different databases. In addition, existing applications were hard to use and provided no information about how the data were created.

Hallmark's MIS managers therefore established in each business unit a new full-time position: the "information guide." These individuals are the primary point of contact for anyone at Hallmark seeking computer-based information. They translate between user information requests and the IT staff who can query databases and get the computerized information that users need. Hallmark's information guides have helped improve data access so much that there are now 10 guides around the company. They have substantially reduced the time it takes for employees to find the right information and to compare information across business units.

Business Documents. The form in which information is presented is also critical to its understanding and use. After all, raw data is not information; and accumulating data is not the same as interpreting it and putting it in a usable form. Company B's emphasis on documentation and presentation, demonstrates how such an attitude shapes the overall information culture. In that case, promotions and other financial incentives were tied to the kinds of documents professionals produced.

In general, business documents provide organization and context, and they exclude enough information so that what remains is digestible. Focusing on which documents an organization needs often leads to a more fruitful discussion than looking at broad information requirements or trying to pin down a term like "customer."

Several companies have begun to identify critical information needs in the form of documents. At Dean Witter, for instance, information managers, particularly those in the central library, were frustrated by their inability to address brokers' information needs efficiently. They advocated hiring more librarians, but financial executives were reluctant to take on additional workers.

With the help of a consultant, finance managers talked to brokers about what information they needed. Instead of phrasing their questions in terms of information and systems, they asked which key documents brokers required. As it turned out, almost all used the same documents over and over. Their needs were categorized into a set of "core documents," most of which were regulatory and reporting documents from U.S. companies.

By separating the documents into three or four industry groups, 90% of the information needed by a typical broker fit on one CD-ROM disk. Dean Witter then created a "perfect information platter," which was updated monthly and kept on a local area network server. By defining common informational needs *and* implementing technology to support what brokers were already doing, Dean Witter was able to reduce its library staff – rather than increasing it as originally suggested – while greatly facilitating information use.

Hallmark has established "information guides" – translators between information users and the IT staff.

Groupware. Groupware like Lotus Notes, NCR's Cooperation, and Digital Equipment's TeamLinks are excellent examples of less structured information-sharing technologies. This new technology allows teams in different locations to share documents electronically, to discuss issues on-line, and to capture and distribute key information easily.

Even so, companies will fail to take advantage of groupware if they don't also provide adequate training and human support. Indeed, groupware implementation stands or falls on a company's informa-

tion culture. For one thing, groupware increases the appetite for information rather than controlling it; therefore, companies must provide both the time and training for employees to get used to handling more information. For another, groupware requires people to manage the technology on a regular basis, not just a one-time implementation of the system.

Grand IT schemes that don't match what rank-and-file users want simply won't work.

Consider this investment bank, where Lotus Notes has been installed to improve communications and access to external information. The Notes system was linked to several different external databases of information on companies and markets. Individual bankers could specify in general terms the types of information they wanted, and intelligent software (aptly named "Hoover") would then search all these databases and send news items and financial reports on particular companies or deals to the individual desktop automatically. Any banker who later sought information about a topic would also find the results of all previous searches.

Information managers expected this facility would increase information demands and external expenses initially, but demands would taper off since the information could be reused and shared within the organization. They were wrong; demands and costs are still increasing. Yet it also appears that this investment in information now supports the bank's overall business goal: more and better deals. In this case, an unexpected result – increasing information use – led to a clear business benefit that a limited focus on the technology couldn't predict.

In addition, since the database searching and basic communications features of Lotus Notes require little human attention after initial setup – and the system itself is easy to use – the bank's information managers planned a low level of human support. But they didn't anticipate two labor-intensive activities critical to the successful use of groupware. One is training, or more accurately, education: that is, the need to show bankers how the new technology can be used to create better deals and working relationships with colleagues and clients.

The other important task is the ongoing pruning and restructuring of the system's document databases. Bank managers have found that this task requires judgment and knowledge; if the system made decisions about, say, which documents to delete based on their age, some of the bank's most widely used documents might disappear.

As this use of Lotus Notes shows, even the best new technologies depend on a strong information culture – one that is open, flexible, and expansive. When executives introduce such potentially valuable new technologies, they must be prepared to support an increasing appetite for information. Large appetites may mean further information expenditures. But that's the reality of today's information economy – a reality that can provide better deals, investments, or product planning, as well as new costs, technical requirements, and all-too-human complications.

Some managers have always been distrustful of the information systems approaches of their companies, largely because they didn't understand them. In many cases, they were right to feel uneasy. As the diverse company experiences suggest, grand IT schemes that don't match what rank-and-file users want simply won't work.

It certainly doesn't hurt for executives to understand communications networks, complicated databases, and the latest groupware. But precisely because of the enormous financial resources involved, we must abandon the idea that technology in and of itself can solve a company's information problems. No matter how sophisticated an IT system, information is inherently hard to control. It's only when executives stop being "technologically correct" – when they start viewing information as ever expanding and unpredictable – that they realize how little the latest computer application has to do with effective information use.

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The Year 2000 Does Not Compute

The new millennium will bring with it a barrage of data corruption problems that must be prepared for now.

By Ian D. Temple
GartnerGroup

In four short years, we will all experience the unique transition of one millennium to another. On a personal level, no real impact will be felt for most of us. Life will go on as usual. Unless, of course, you earn a living as an information technology (IT) professional.

Analyst estimates indicate 20 percent of business applications will fail because of invalid date computations in 1995 (0.6 probability), and that without corrective measures, this number will increase to more than 90 percent by 1999 (0.8 probability).

The issue will also not be solved via procrastination. Unlike other vexing IT issues of the 1960s and 1970s, analysts agree no panacea is forthcoming from the vendor community. Therefore, the year 2000 date change creates a major problem for all government enterprises with computerized information systems that want to avoid the specter of government operations lurching to a halt as systems fail when the clock strikes midnight on Dec. 31, 1999.

ORIGIN OF THE CRISIS

Put simply, the problem is the absence from almost all software of the two-digit century value within a date-field that distinguishes dates as either 19xx or 20xx. For example:

Birth year: 1954
Age in 1999 is: 99 - 54 = 45
Age in 2000 is: 00 - 54 = -54

Correct calculation should be:
2000 - 1954 = 0046

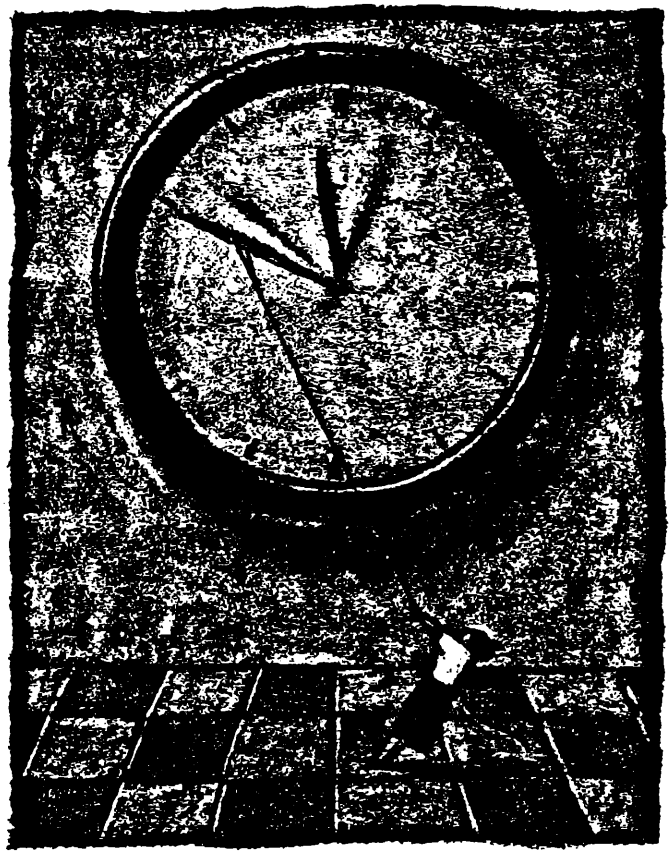
The problem was created by limitations of earlier technology and the historically higher cost of storing information. In the 1960s, the dominant method of entering data into a system was the 72-character key-punched card (with eight characters reserved for control information). This advocated a data-entry strategy that optimized characters because of limited space.

Additionally, early databases (e.g., IMS) were designed based on hierarchical structures and optimized for transaction-based processing so the relative dates of a transaction were stored in the same database record as the other transaction data. This translated into a two-bytes-per-date savings by not storing the century value when a date was stored, and was a tremendous cost saver at the time.

OPINION ANALYSIS

The problem then spread into application code because applications are designed based on data, and the data was stored without the two-digit century value. Even when organizations migrated to relational database management systems, the date data were not always modified to include the century, and due to costs the applications were rarely modified or upgraded. The emphasis was on moving the data to a more responsive storage management system, not on date formats.

It is clear that business pressures and horizons drive awareness and allocation of budgets. This "truth" made it virtually impossible for applications development organizations to focus on the year 2000. While the legislature or other governing boards — along with program areas and/or business units — were stressing requirements that had to be met within the next six to 12 months for survival of the agency/department, the year 2000 was beyond that horizon and therefore not a concern. Increasingly, however, the year 2000 will fall within critical time horizons as applications begin to fail more frequently during the next few years.



SOLUTIONS WILL BE COSTLY AND TIME CONSUMING

The stakes are high, and solutions will be costly — both in time and dollars. Yet the consequences of not responding could be far more damaging. Worse yet, the vast majority of agencies and departments are not geared up to solve the problem.

So what is the solution? Let's look at the experiences of one organization trying to prepare for the year 2000. The organization is a multi-national private service company, with annual revenues of $15 billion. Though it may not seem like this organization correlates to government, it does have many similarities: multiple offices spread across geography, multiple lines of business (a.k.a. different departments), and it delivers a service, not a product. I will reference it as Company X.

Company X recently completed its analysis of resources required to solve the year 2000 issue. It determined that over the next four years it would spend nearly $400 million, with 75 percent of this going to labor! A few footnotes to this staggering figure are important:

- This investment is two and a half times more than Company X spends annually on new IT functionality, yet no new functionality will be generated by this project.
- No interim resources will be available during the project period. Given that this project will be huge in scope, it will require all of IT's best people. Once again, big dollars but no new functionality.
- The project will replace or reengineer all applications.
- Half the investment will go toward application work-arounds and bridges that will be thrown away later.
- Roughly one-third of the money will go toward application packages that will be used as is (no time for customization).
- Client's analysis indicates no vendor's product or service could meet their needs, i.e. "no salvation through technology."
- Company X will cut-over to new code one year before deadline (or 12/31/99) to allow for trouble-shooting. This means they have only 36 months to solve the problem!

Company X realized the life-threatening nature of this issue (life-threatening to the corporation, that is), and convinced executive management to invest hundreds of millions of dollars on a project that will offer no new functionality. Government IT executives need to gain the same degree of management support within their jurisdictions to move forward with a solution. This challenge will prove particularly onerous in an environment of constant cost-cutting. Yet the costs to government may indeed be greater than the private sector given potential litigation costs the private sector often does not have to contend with.

The bottom line is, although good business and technical decisions were made in the past based on the state of business and technology at the time, steps must be taken to ensure that application and data assets are secure. To minimize exposure to the year 2000 crisis, IT organizations must begin immediately to analyze their application portfolios, assess the extent of the problem and begin budgeting, planning for and implementing the potentially extensive corrective measures that will be required.

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