IT Innovation in Government: Toward an Applied Research Agenda

Part Two: Government Information Technology Issues The Researcher Perspective

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Government Information Technology Issues -- The researcher perspective

This paper is a preliminary attempt to summarize and categorize current or recent government IT research. The results presented below were derived from a literature review that first focused on identifying recent publications of individuals invited to participate in the workshop. Additional literature dealing with government IT research was also included in the summary. The primary limitation of the method used to identify research interests and papers was an almost exclusive dependence on materials found in books and peer-reviewed journal articles, although some preliminary Web searching was also conducted. Another limitation of this method is that the search included only journals published in English. Therefore, there are very limited cites for individuals who publish in journals in other languages. This limitation makes it especially important that authors identify missing citations. Lastly, the search was limited, for the most part, to materials published within the last ten years.

As a result, we have surely missed some very interesting and relevant research material published directly by research centers or found in unpublished white papers or project reports. We have also likely missed seminal works by researchers not participating in the workshop. We hope that these additional materials will be identified by the workshop participants.

The companion paper (Government Information Technology Issues- the practitioner perspective) provides a preliminary summary and categorization of the issues or topics that have been identified as important to practitioners.

Overview

The research on the application of technology in government is wide and varied. As a consequence, it is difficult to summarize in simple terms. Any given thread of research may have multiple facets -- technologies, program areas, policy threads, management issues -- and placing a piece of research into a given category ignores the complexity of the research.

That said, this paper is an attempt to provide some structure to this research. In the paper, we discuss government IT research in the context of the following major categories:

- Government IT research from a programmatic perspective
- Public management
- Information infrastructure and society
- Technology transfer

Each of the major groups is comprised of or subcategories of issues. In most cases, the discussion presents the identified research issues, research methods, and conclusions.

Government IT Research from a programmatic perspective

Much of the identified research is focused on specific government program areas. The following programmatic areas have been identified based on the preliminary review:

- Economic Development and Commerce
- Public Safety
- Health and Human Services
- Environment and Natural Resources

Economic Development

The information technology industry represents an increasingly larger proportion of the world economy. Government policies that affect the use and development of

information technology products and services can have substantial impacts on national and sub-national economies. Information is a critical resource in assessing economic conditions and in policy and decision making. Additionally government organizations collect, process, and disseminate critical information and forecasts that drive the decisions of economic agents.

Accurate, timely, and comprehensive information is required to support economic development decision and policy making at all levels of government. Additionally, appropriate information must be identified and used to evaluate the effectiveness of policies and decisions. Many argue that development decisions have traditionally been made without sufficient consideration of environmental and social effects. The concept and principles of sustainable development have been promoted to more effectively account for environmental and social factors in economic development decision making Brundtland (1987). Kelly (forthcoming) indicates that identifying policies and programs to support sustainable development requires the integration of information about economic, environmental, and social factors. She suggests a systems approach to identifying decisive information for sustainable development policy and decision making and argues that such an approach supports the identification of causal linkages and feedback among the types of factors, an increased understanding of the effects of policy scenarios, and an increased capability in the necessary communication across disciplines.

Public safety

Sparrow (1990) discusses the 911 phone system as well as other innovative uses of technology to support policing activities in departments in Los Angeles, Virginia, and London.

Health and Human Services

Smith and Lipsky (1992) discuss the notion of privatization in health and human services. They note that an increasingly common form of privatization involves contracting with nonprofit organizations and that such practices do not follow market principles. In particular, these arrangements are fraught with politics and inadequate information and are built upon long-term relationships between government and contract agencies. They indicate that contracting hides, to some degree, the growth of government in part due to the fact that the press and government critics are not accustomed to making contract employees an issue. Some additional problems associated with the privatization of health and human services include: substantial consumer and contract administrator transaction costs, high costs associated with monitoring and evaluating service providers, and inequitable distribution of services. Sparrow (1996) reviews methods of Medicare and Medicaid fraud in the US and argues that electronic claims processing will result in an increase in fraudulent claims.

Environment and Natural Resources

Bartels et al. (1993) describe the Market Clearing Auction (MCA), a computer-assisted smart auction designed to replicate the outcome of an efficient market in sulfur dioxide (SO_2) emissions allowances created by the Clean Air Act Amendment of 1990. The system is a centralized marketplace for trading SO_2 emission allowances and accepts

bids and offers for any combination of allowances and for streams of allowances covering more than one year.

Public Management

Bozeman (1993) indicates that the discipline of public management is comprised of such issues as strategy, interorganizational relations, and the intersection of public policy and management and includes the implications of technological innovation. Information technology issues in public management are well represented in the literature. As previously discussed, government is a collector, user, and disseminator of information. Information technology tools, in conjunction with reengineering or process improvement, can increase productivity and reduce the cost of government while improving the quality of services. Many factors influence the degree to which these types of benefits are realized. The following public management issues have been identified from the preliminary review:

- Information as a government resource
- Process improvement and reengineering
- Strategic information resource management in government
- Information resource management and information technology issues in local government
- Hiring and maintaining an IT-skilled workforce
- Government information systems
- Government publishing
- Budgeting for IT resources
- Evaluating government information systems
- Factors that affect the use and effectiveness of information and information technology
- Procurement
- Use of specific technologies

Information as a government resource

Bozeman and Bozeman (1989) discuss local government use of federal statistics. They indicate that incompatibility of data obtained from multiple sources; dissimilarity of data collection efforts between state, local, and federal agencies; and a reduction in funds and an increase in responsibility as problems in local government use of federal statistics. They further indicate that the federal government can take steps to increase the utility of federal statistics to local governments. For example, the provision of resources and technical assistance to local government in answering their questions about data structures, a move toward maximum uniformity of definitions and procedures, devotion of more resources to small areas and categories, consideration of a quinquennial census, and the provision of assistance for the implementation of geocoded systems are suggested as mechanisms that the federal government can use to increase local government use of federally-developed information.

While much research focuses on information technology in public organizations, another stream of research focuses on how policy makers select and use information in policy deliberations. Bretschneider and Gorr (1992) describe the forecasting process in government by extending an existing model used to explain forecast accuracy to include a series of complex factors related to the potential political and policy use of state sales tax revenue forecasts. The factors include economic uncertainty, political influence, and organizational designs for forecasting. Bretschneider and Schroeder (1988) propose an approach to evaluating commercial economic forecasts for use in local government budgeting.

Kowlowitz and Kelly (1997) emphasize the need for the integration of electronic records management mechanisms into the design and development of government information systems. They indicate that many organizations lack adequate tools to manage the growing number of electronic records and that some organizations are in danger of losing access to records stored in personal computers, e-mail boxes, or personal local area network directories while others face the challenge of linking documents created in different forms and formats to business transactions. From an archival perspective, which focuses on long-term organizational and societal needs, these problems may result in the loss of records of enduring value. They present preliminary versions of practical tools to support the identification and implementation of records management requirements in system design and development.

Process improvement and reengineering

Information technology is often discussed in terms of its role in business process improvement or business process redesign. Much of the literature emphasizes the role of process improvement and reengineering as a critical component to realizing benefits of IT. Davenport and Short (1990) discuss the role of information technology and business process redesign in the transformation of organizations. Davenport (1993) describes performance improvements and changes in organizational efficiencies resulting from information and communication system implementations. Information technology provides the capability of hardware and software applications and telecommunications, while business process redesign involves the analysis and design of work flows and business processes within and among organizations. They identify

the following as important factors or tactics toward achieving business outcomes: using IT as a design tool, understanding generic design criteria, and creating organizational prototypes. They indicate that obtaining and maintaining management commitment is perhaps the greatest difficulty in IT-driven process redesign and that modifying structural dimensions such as function, product, and geography along process lines can aid in achieving desired outcomes.

Mechling (1994) also discusses the perception that reengineering in the public sector may not be much of a reality. He indicates that true reengineering is characterized by a fundamental redesign of work processes associated with the production of a good or service, rapid and large scale improvements in performance, and the aggressive use of supporting information technologies. Reengineering is discussed in terms of both a goal and an approach for reaching a goal and given that information technology can be used to organize work processes in substantially more efficient manners, the time is right for reengineering. He argues that organizations and societies that reengineer will be much more successful than those that do not and that reengineering, as an approach or process can take many forms.

Bashain et al. (1994) discuss the organizational conditions that influence the degree of success in business process reengineering. Sampler and Short (1994) discuss an explanatory framework based on expertise half-life and information half-life. They propose that under certain conditions, project failures are associated with a disjointedness between reengineering project objectives and the organization's general business and information systems planning agenda. Under other conditions this

decoupling can be associated with successful projects. They arrive at two observations regarding strategic assets, IT, and process reengineering. First, information technology's capability to destroy tangible as well as intangible assets suggests a more substantial and complex role for IT in the development of an organization's core competencies. Second, reengineering efforts that do not take into account the difference between restructuring physical assets and rethinking the flow, or characteristics of, intangible assets are incomplete. King (1995a) stresses that the role of government and shifting public-private interactions are within the realms of social and technical change that can be considered in the context of business process reengineering.

Kambil and Short (1994) discuss the need to alter both the fundamental structures of organizations and their environments, therefore shifting the focus of study of electronic integration-- the use of IT to reengineer business processes, from that of the organization to the entire business network. They indicate that the role-linkage perspective is a useful abstraction to characterize the business network and to guide research on the effects of IT on organizational structures. Earl et al. (1995) describe a framework for analysis of the relationship between business process reengineering and strategic planning. Four case studies are used to demonstrate variability in the following four domains: process, strategy, information systems, and change management and control. A taxonomy of BPR strategies is identified through the case studies suggesting a richer variety of BPR practice than had been previously documented as well as opportunities for further research.

Strategic information resource management in government

Andersen et al. (1994) discuss the role of strategic information management in government restructuring to meet demands for integrated customer-oriented services in an environment of increasing fiscal constraints. Soh et al. (1993) describe Singapore's statewide strategic planning process for information technology. They describe Singapore's plan for a national information infrastructure designed to capitalize on the country's information as a key factor for production and improvements in quality of life. The planning process, the participants' roles, and the main recommendations are outlined. The plan is evaluated in terms of its objectives, unanticipated results, and impacts on industry participants. Implications and lessons are drawn to support strategic IT planning at national or sectoral levels.

Caudle (1996) indicates that in light of public demand for improved government services at reduced costs, government organizations must show increased accountability for positive results. She highlights six fundamental strategic information resource management best practices that can improve government performance in terms of service delivery and accountability: directing IRM changes; integrating IRM decision making in a strategic management process; linking mission goals and IRM outcomes through performance management, guiding IRM project strategy and follow-up through an investment philosophy; using business process innovation to drive IRM strategies; and building IRM/line partnerships through leadership and technical skills.

Fletcher and Foy (1994) provide a review of the literature from 1980 to 1993 discussing the uses of information technology by state and local governments. The

paper provides a history of information technology management, including a discussion of current information technologies including information architectures and information resource management, and geographic information systems. Citizen access to information and the role of government information professionals is also discussed. Caudle (1990b) presents the results of a national survey conducted by the School of Information Studies at Syracuse University that focused on state information resource management. The study found that communication is a primary area for innovation and change in state government. In particular, voice, data, video, and image transmission were found to be key areas of interest. Organizational and telecommunications issues such as telecommunications expenditures were also indicated as important.

Information resource management and information technology issues in local governments

The management of information and information technology at the local government level has also been addressed by a number of researchers. Northrup et al. (1982) discuss the results of a study focused on the management of computer applications in local government. They conclude that the single most important factor influencing the success of computing is a commitment to advanced technology. They also indicate that the more advanced the technology application, the greater the pay-offs associated with the application. Policies such as user involvement and decentralization, while important, appeared to be of secondary importance in comparison to the state of the technology's development.

Fletcher and Bertot (1994) discuss the role of county government in the management of information technology. They discuss a national study of centralized management of information technology conducted to identify practices, critical success factors, and future challenges. The study also focused on assessing the benefits, costs, and constraints of centralized county-level management of information technology.

Norris and Kraemer (1996) present survey results comparing computing characteristics in cities that use only personal computers as opposed to those that use central computer systems. The findings did not support the claims that PC systems would increase the rate of speed of automation of government functions. Rather, it was found that those cities with central systems were more extensively automated, had more widespread use among staff, and were more likely to implement leading-edge computing technologies than those cities that had only PC's. The results indicated that respondents in cities with centralized systems were positive about computing impacts and were satisfied with computing. Those cities that had only PC's had an advantage over those with central systems in that they reported fewer computer-related problems, however there was only weak statistical significance in the test. The authors argue that the reliance on ad hoc solutions, outsourcing, and computer gurus, resulted in a failure to support sufficient on-going support activities in PC-only cities while in those cities with central systems, these capabilities were developed over time and therefore provided greater support for the computing function in addition to a more stable technology platform.

Sparrow (1994) discusses the role of information management in the evolving strategies of three U.S. enforcement professions: policing, environmental protection, and tax administration.

Hiring and maintaining an IT-skilled workforce

Another key area for research focuses on maintaining an IT-skilled public sector workforce. Kraemer et al. (1986) discuss the need to upgrade public management education to reflect changes in society, government, and knowledge, in particular those areas related to information technology. Three levels of computer literacy courses are recommended and investments in hardware, facilities, and faculty are suggested. Caudle (1987) also stresses the need for public management training that addresses: 1) knowledge about current and emerging technologies; 2) understanding of equipment and software; 3) understanding of organizational behavior. Caudle (1990a) also points out that public management education should take into account the substantial organizational changes associated with the applications of information technologies. In particular, information technology can present both new opportunities and obstacles for public managers. She identifies three critical skill sets for inclusion in public management education: information technology management, information management, and human resource management. She further indicates that new ethical issues in information management such as privacy, accuracy, property, and accessibility will pose challenges in terms of creating an environment in which human resources can be creative and entrepreneurial.

King et al. (1992) explore the concept of the knowledge executive. Using data collected from 500 U.S. municipal government department heads, they present results on the degree to which the respondents use microcomputers, mainframes, and computers for record search and explore the degree to which the concept of knowledge executive applied to public managers. They note a lack of knowledge executives among local level public managers and that greatest efficiency increases are found in those executives that use computers.

Dawes (1994) discusses the influence of changing information technology on the nature and operation of government programs, the structure and function of government organizations, and the related shift in content of government jobs. Problems related to such areas as title structures, recruitment, testing and selection, and civil service processes are also discussed.

Galvin (1995) describes a tension between unification (convergence) and specialization (divergence) in education for information professionals. He identifies issues such as striking a balance between theory and practice in curricula and the appropriate place in curricula for skills training. He also discusses the controversy over whether a professional school should have as its priority the development of knowledge and skills for entry level jobs versus a focus on lifelong career preparation.

Government information systems

Government organizations differ from private sector organizations in a number of ways. These differences must be considered in the design and implementation of information systems. Caudle et al. (1991) indicate that government has multiple,

conflicting, and often intangible goals and that government is substantially affected by red tape and politics. These features or characteristics must be taken into account in the management of information systems. Based on a national survey of public information managers, a lag in information systems development was identified as compared to the private sector. The analysis also showed that middle-level public sector managers are critical for information system development, small government agencies are more interested in IS transfer than large agencies, governments with a lot of red tape tend to have flexible information systems, and local government information system issues tend to be driven by transaction processing while state and federal governments use information technology to support their oversight missions.

Government publishing

Hernon and Relyea (1995) provide an overview of publishing across levels of government, in particular, in the context of US federal government. They discuss the shift from paper to electronic publication for some governments as well as the implications of the shift.

Budgeting for IT resources

King (1989) describes the complexity of budgeting for information systems in a constantly changing environment. He indicates that the budget development process requires an analysis of current activities, a projection of activities that will occur in the future, as well as an estimate of the resources required to support future planned activities. He states that the degree of stability within an environment is affected by changes in the mission of the department, costs of inputs to production, the degree to

which increased needs for one input increase that for another (input complementarity), and the degree to which one input can be used to replace others (input substitutability).

Evaluating government information systems

The distinguishing characteristics of government must also be taken into account when evaluating proposals and fully implemented information systems. Consequently, research has focused on evaluating the effectiveness of government information systems. Evaluations are critical both before and after systems are implemented. Newcomer and Caudle (1991) stress that the key issues to be considered in the design of a government information system center on the purpose of the information system. In particular, the focus should be on the users of the system, their responsibilities, and the type of administrative or programmatic decisions that the system will support. They further indicate that once an information system has been implemented, the following characteristics can be used to assess the level of system success: usefulness, understandable output, currency or timeliness, relevant output, access, adaptability, accuracy, and ease of use.

Caudle (1994) presents the results of a US General Accounting Office (GAO) study that examined the strategic information resource management fundamentals of 19 private, state, and federal government organizations. The following practices were shown to have a direct, positive effect on the quality, quantity, cost, and timeliness of organizational products and services: top leaders recognize that change is needed and have strategies for transitioning, implementing, and reassessing new IRM processes; leading organizations develop a formal strategic management process that covers all

major management decision and action points; senior managers select, control, and evaluate IRM projects as investments; organizations develop and integrate rigorous performance measures within the organization's existing management and decision making processes; and leading organizations focus on dramatic business process innovation and change.

Northrup et al. (1990) discuss the technical or operational payoffs f rom computerization such as the increased availability of information, better information for management control, better information for city planning decision, greater efficiency of operational performance, and better interaction with the public. Based on survey data, they indicate that the respondents were experiencing the most payoffs in the areas of fiscal control, cost avoidance, and better interaction with the public while only minimal levels of payoffs were observed in nonfiscal management control and planning decisions.

Factors that affect the use and effectiveness of information and information technology

Kraemer et al. (1993) present data gathered from 260 public managers to assess general perspectives of the potential of information technology and the value of computer-based information (CBI). The two perspectives are the knowledge executive and consumers of computer-based information. The results of the analysis indicated that public managers believe that CBI is important and heavily relied upon. The findings also showed that information is more valuable in supporting control of financial resources than in the management of operations. Four sets of factors were identified that might account for variability in the usefulness to public managers of

computer-based information. Quality and accessibility of information were found to be particularly important as were the manager's style of use. The authors also indicate that the managers who found CBI the most useful were those that used support staff to mediate their CBI environment. They conclude therefore, that IT design efforts should include mediating support staff as well as executives. Danziger et al. (1993) present the results of a survey of 1,869 end users in 46 U.S. cities. The survey results identify three major factors that can be controlled to influence the quality of computing services: the structure of service provision, the level of technological problems, and the service orientation of computing service specialists. The authors indicate that the survey results do not support the argument that the degree of centralization of computing services is the most important factor in quality of computing systems. They conclude that service improvement strategies that focus on the socio-technical interface between users and computing service providers should be stressed.

Kraemer et al. (1994b) compare the government computing implementations in the US with those in Scandinavia. They indicate that in the US, individual units of government have implemented information technology to support their own needs while those in Scandinavia have been designed and developed via communal data processing agencies serving an entire level of government. Additionally, systems implemented in the US have tended to be small scale, following narrow functional lines, implemented incrementally, evolved slowly over time, and have essentially automated existing operations. As compared to Scandinavian efforts, US efforts have focused little attention on automation effects, have responded to situations in an ad hoc

fashion, and have been reactive rather than proactive. Scandinavian efforts, in particular those in Sweden, have done more to address the reorganization of work processes along with automation and the potential effects on government workers are more substantial.

Henze and Lenk (1988) describe a high level of intergovernmental coordination and cooperation as a salient feature of information technology as used in the German public administration. They indicate that large automated data processing centers at the federal, Laendar (states), and municipal levels play a coordinating role in bringing together major government users of information technology. They indicate that the prevailing information technology application and coordination structures have resulted from a stage of information technology development that was reached by the end of the 1960's and that the future application of IT in the federal administration will focus on performance improvement, communications, and quality of service. Dawes (1996) also argues that the sharing of program information among government agencies can aid in the achievement of important benefits such as increased productivity, improved integration of services, and more informed policy making. Technical, organizational, and political barriers however, often limit government agencies' ability and willingness to share information. Results from a study of state government managers are presented and a theoretical model for understanding the interactions among policy, practice, and attitudes is proposed. Stewardship and usefulness are suggested as two policy principles to enhance the benefits and mitigate the risks associated with information sharing.

Procurement

Another issue that has drawn attention from the research community is that associated with government procurement. Kelman (1990) presents case studies of federal government technology acquisitions. In particular issues associated with procurement regulation, official discretion, and relationships with contractors are discussed.

Use of Specific Technologies

Internet

Ryan and McClure (1995) report on the perceptions and views of 67 government officials and contractors who had or were about to embark on the development of Internet services. The group participated in a Strategic Information Resources Management Seminar entitled "Building and Managing Government Internet Services." Survey instruments were implemented to identify key issues and concerns about the building and managing of government Internet services. The following issues were identified by the respondents: technical challenges; including security, encryption, and document integrity; data quality and organization; cost and funding issues; moving the barriers created by bureaucracy; integrating Internet services with agency mission and function; developing external partners with non-governmental organizations and the commercial sector; understanding and communicating with users; evaluation criteria for extensiveness, efficiency, effectiveness, impact and usefulness; personnel and training needs; and federal or agency policy adjustments. The respondents also identified the strategic benefits to their agency that had resulted thus far from the provision of government services over the Internet including

improved communication, coordination, and collaboration; wider dissemination of information; and enhanced agency profile.

Expert systems

Expert systems have been developed and used to support a diversity of government operations. Van de Donk and Snellen (1989) discuss the development and introduction of knowledge-based systems in public administration. Three types of knowledge-based systems: handling systems, advisory systems, and expert systems are examined in terms of the functions of public administration as derived from political, legal, technical-scientific, and economic rationales. Bourcier (1989) describes the main features of MAIRILOG and BRUITLOG, expert systems developed for the mayoral and municipal offices of Paris. She discusses how the systems work as well as evaluation methods and methodological problems. Coursey et al. (1993) describe an expert system, the Intelligent Waste Stream Advisory System (IWSAS), that provides phone survey assistance in the collection of information from small quantity generators of waste in New Jersey. The system facilitated the completion of 252 surveys and contributed to the understanding of factors influencing waste generation.

Group decision support and cooperative work systems

Group process is a critical component of government planning and policy making. The Delphi Method, Nominal Group Technique, and Social Judgment Analysis are identified by Reagan and Rohrbaugh (1990) as decision processes that have been developed to increase the quality of group decision or commitments to decisions once they have been made. They indicate that with the increased availability of Group

Decision Support Systems, organizations are expected to invest substantial resources in new information technology to support the work of teams and expert groups. Further as the number and variety of group processes and supporting technologies increases, identifying the most appropriate methods and technologies will become more difficult. They suggest the Competing Values Approach as a mechanism for evaluating group decision process and provide an example of its use. Many private sector and government organizations are choosing to use computerized decision support systems or automated group decision support systems to facilitate decision making and planning. These technologies facilitate decision making through the use of automated decision support models. Research has focused on the factors that influence the degree to which these systems are effective. For example, Nunamaker et al. (1988) discuss principles of group processes and the hardware and software features of computer-aided deliberation. They discuss findings from their group decision support system research with respect to such factors as anonymity of participation, facility design, need for multiple public screens, use of knowledge and databases, communication network speed, methodological approach, and software design.

Kraemer and King (1988) indicate that technology to support cooperative work and group decision making has grown out of three traditions: computer-based communications, computer-based information service provision, and computer-based decision support. Their paper provides an overview of group decision support systems (GDSSs) that support group work and evaluates experiences with such systems. They indicate that progress has been slower than originally expected due to shortcomings in

the available technologies, insufficient integration with various components of the computing "package," and an incomplete understanding of the nature of group decision making. They conclude however, that the field shows promise in the area of tool creation to aid group decision making and in the development of mechanisms to support the study of group decision making dynamics.

Information Infrastructure and Society

This category reflects government IT issues that span multiple programs within government, those that cross between government agencies and levels of government, as well as those that involve communication and coordination between government, citizens, industry, and non-profit organizations. Kraemer and King (1987) discuss the growing use of information technologies such as telecommunications and management science at all levels of the US Federal systems in terms of its significance to the US Constitution. They indicate that the following aspects of the federal systems are particularly susceptible to disruption due to changes in technology: federal interbranch relations, intergovernmental relations, relations between government and the people, and political process functions. They propose that these balances are under daily attack by computerization but they tend to be affected primarily at the margins, such as cases where computerization provides a temporary inequity in advantage to one level or agency. They conclude that currently, computerization is not a threat to constitutional arrangements but that it could eventually put at risk personal privacy and

political elections and, perhaps to a lesser extent, the separation of powers and federalism.

National Information Infrastructure Initiatives

While design and operation of the NII is primarily in the hands of the private sector, government policy plays a significant role in its development by reforming telecommunications policy, promoting NII applications, resolving information policy issues such as privacy, security, and intellectual property, and investing in long-term R&D (Kalil, 1995). Maule (1994) indicates that the foundation for current information infrastructure projects in both the public and private sector are initiatives and legislation by the Clinton/Gore Administration and Congress, in particular, the National Research and Education Network (NREN) and the National Information Infrastructure Act (NII). Kahin (1992a) describes the mission of the National Research and Education Network and its multiple policy objectives The breakdown in classic forms in the computer environment due to the computer revolution is discussed as is the concept of flat rate pricing as an important feature of the Internet.

Branscomb and Kahin (1995b) discuss the criticality of standards development in the development of the NII. Three models associated with software applications, the Internet, and facilities-based communication are presented and further point out that interoperability and open systems affect the development of government policies. King (1995) discusses the dilemma of national policy development for information technology in the context of the U.S. national information infrastructure and reviews the technological forces affecting the convergence of computing and communications.

He also describes current and future services well as service providers and markets associated with the NII as well as the implications for national competitiveness.

Information Society- Citizen access to information and information technology

Hernon and McClure (1993) discuss the final revision of OMB circular No. A-130, The Management of Federal Information Resources which is described as having government-wide implications as the cornerstone of US government information policy. The circular stresses the public good associated with access to government information and also articulates the relationship of the federal government to state and local governments, the public, and the private sector. Relyea (1994) discusses aspects of the administrative experience with the Freedom of Information Act (FOIA) over the last 30 years. He indicates that the Act has never been held in high regard or enthusiastically implemented by the Executive branch, and that much of its effectiveness can be attributed to Congress. He stresses that the FOIA has not received comprehensive congressional evaluation or examination for over a decade and that its existing procedures could benefit substantially from a reassessment and upgrade in terms of its capacity to contend with electronic formats. Relyea (1996) also discusses the acquisition and dissemination of government information and publications and the relationship between national security and information dissemination (1987).

Guthrie and Dutton (1992) discuss the politics associated with citizen access technology. A comparative study from California cities - Santa Monica, Pasadena, Glendale, and Irvine, examines the factors shaping decisions about network technology to facilitate public access to community information and dialogue. Kahin (1991)

discusses the role of the Internet in providing a versatile new environment for the dissemination of government information. He indicates a new consensus that federal information should be distributed in its original form and enhanced by the private sector will be a driving force in the expansion of computer networks. Such factors will therefore blur the distinction between the dissemination of information and access to information under the Freedom of Information Act. Further, while there is opportunity for closer communication between government agencies and the public, the role of intermediaries such as the Government Printing Office and the National Technical Information Service is uncertain.

Gurbaxani et al. (1990) describes government's role in shaping the information society in the context of Singapore's national computer policy. He describes the high level of government involvement in shaping informatization and computerization in Singapore including a review of the political, social, and cultural environment, and the surrounding economic development and industrial policies. He describes the overall IT infrastructure and three phases of computerization: government computerization, national computerization, and the informatization of society.

Information technology policy and economic development

The relationship between national information technology policies and the impact on national economies is considered extensively in the literature. Kraemer et al. (1992) examine the effectiveness of government policies in promoting the diffusion of information technology through a review of industrial policies in 9 Asia-Pacific nations. The results showed that while some government trade and fiscal policies do

facilitate increases in expenditures on computing technologies, the level of economic development was identified as a stronger predictor.

Kraemer et al. (1994a) indicate that the laissez-faire information technology strategy in Hong Kong, reflective of the country's economic strategy, shows little government intervention in the promotion of production or use of IT products and services. Dedrick and Kraemer (1993) present a similar discussion of Australia's treatment of information technology. They indicate that Australia has vacillated between laissez-faire, market-directed strategy and strong government interventionist, plan-directed strategies resulting in a collection of individual strategies as opposed to a single coherent strategy.

Kraemer and Dedrick (1993) describe information technology policy in New Zealand as moving from projectionist and centralized to almost total laisssez-faire policies. They indicate that under these policies, New Zealand has become a heavy user of IT, ranking behind only Japan in the Asia-Pacific region, in terms of IT spending as a proportion of GDP, however the laissez-faire approach may have economic and other implications in an international environment in which many other countries directly subsidize the industry and have explicit strategies for IT infrastructure improvements.

Kraemer et al. (1996) discuss Taiwan's coordinated government strategy in supporting private entrepreneurship by a large number of small, flexible, and innovative companies. They indicate that in just 15 years, Taiwan has emerged as a leading producer of hardware for almost every major computer vendor in the world and

that Taiwan's success has been due to a coordinated government strategy allowing the country's computer companies to respond rapidly and effectively to changes in the international market.

Dedrick et al. (1995) indicate that there is a somewhat surprising number of small countries (those with populations of less than 10 million), including Hong Kong, Singapore, Israel, Denmark, Finland, and Sweden, with proportionally high rates of development and use of information technology in terms of country size and national resource endowments.

Libraries and Archives

With the advent of new technologies for creating, maintaining, and disseminating information comes a changing role for libraries and archives. Research has been conducted that explores the economics of mechanisms for information dissemination. For example, Kingma (1994) presents an economic model to analyze the cost-efficiency of three alternatives to access to journal articles. The three alternatives discussed are journal subscriptions, consortium membership, and commercial document delivery. The results of the analysis indicate that cost efficiency is based upon such factors as the value of future journal use, the value of time to patrons, and the costs of delivery and subscriptions. Kingma and Eppard (1992) discuss the escalation of journal prices in terms of equilibrium between the library market and the market for individual subscriptions. They argue that the availability of high quality photocopying has increased individuals' reliance on library subscriptions and propose

that a socially responsible solution to the problem of journal price escalation is to increase the cost of photocopying and restrict journal use to within the library. Kingma (1996) analyzes the economic efficiency of library consortia in the provision of journal articles by way of journal subscriptions versus interlibrary loan through the development of a cost matrix that includes variables for: the fixed costs of journal subscriptions, the marginal costs of lending, access, and borrowing; as well as three different opportunity costs of patrons in terms of time, money and other factors.

Also of importance is the development of mechanisms to support the archival preservation of digital records. Hedstrom and Kowlowitz (1988) report on a project conducted by the New York State Archives and Records Administration that identified measures required to improve the management and preservation of machine readable records. They describe the scope and nature of computer use in New York State, and provide criteria for, and the process associated with, the selection of records for permanent preservation. They further describe methods for developing working relationships between archivists and staff of government agencies that produce records. Hedstrom (1993) reports on a needs assessment focused on training archivists about electronic records and automated techniques.

Boettcher and Kingma (1994) discuss four purchasing options for telephone directories, one of the most highly used sources of information in a library's reference collection. They indicate that telephone directories are a stable reference tool with a strong history of use, they are familiar to most users, and that resources such as the community and yellow pages are widely used. The future of an all-print telephone

directory collection in libraries is questioned in terms of the availability of CD-ROM technology and the cost of printed directories. They provide a framework for cost analysis for the following four telephone directory purchasing options: printed directories, directory assistance, phonefiche, and CD-ROMs.

As the role of libraries changes, the role of librarians must also change substantially. Librarians and archivists are required to deal with records in an increasing number of forms and formats. Critical to this shift is the identification and delivery of educational programs that prepare librarians and archivists for their new role. Lenk (1987) describes the future role of libraries in terms of the public objective of the provision of technical information. McClure (1995) discusses the gap between the communications technologies available to the public and the public's level of ability to use them. He discusses the federal government's policy on universal access, factors that negatively affect public library involvement in Internet access, and elements associated with the clarification of the role of public libraries. McClure et al. (1996) contend that, with a decreasing federal emphasis on the role that libraries will play in the NII, public libraries must proactively develop their own presence or role. They examine current federal policies and new roles for libraries in ensuring connectivity and offer recommendations for the implementation of both federal policy and connectivity. Additionally, they discuss strategies and policy initiatives for federal, state, and local governments, as well as for librarians and vendors.

Research and development and technology transfer

One of the most critical aspects of the overall value of research relates to the transfer of results to practitioners. Kingsley et al. (1996) discuss the processes of technology transfer and technology absorption based on a set of 31 case studies of research development and demonstration (RD&D) projects. They define technology transfer as the use of technology or technical information outputs by a party external to a project. Technology absorption is described as the use of output by contractors, sub-contractors, or co-sponsors participating in an RD&D project.

Branscomb (1992a) indicates that technology is the single most important factor driving the evolution of global competition and that over the last 40 years government policies have focused on increasing the supply of new technologies primarily through the funding of defense-related research and development. He indicates that what is important in the global economy is not necessarily the creation of new technologies but the ability to absorb and apply new innovations rapidly. To this end, government should stimulate the demand for innovative ideas in industry by encouraging collaborative research, investing in technological infrastructure, and helping organizations improve their capacity to adapt innovations to specific business needs.

Bozeman and Coker (1992) discuss assessments of the effectiveness of technology transfer from US Government R&D laboratories. Three success criteria are discussed, two of which are based on self evaluations. The self-evaluations focus on two different types of effectiveness- getting technology out the door, and having a demonstrable commercial impact. The third criteria discussed is the number of

technology licenses issued from the laboratory. The authors conclude that multi-faceted, multi-mission labs are likely to be most successful in technology transfer.

Kahin (1994) discusses new opportunities for managing and communicating scientific and technical information arising from the advance of computer and network technologies. He indicates that there are however, substantial costs and risks associated with the development of effective knowledge management systems and that it is difficult to organize potential users for cost-recovery. Interinstitutional cooperation and standards development are suggested and a proposal for an organization that would support cooperative efforts in specialized areas is described.

Government funding and collaboration in research and development

Bozeman and Crow (1992) discuss the need for a system that more equitably allocates federal science dollars to university-based research centers. Branscomb (1992b) indicates that government support for research has shifted from a mission-oriented policy to one that focuses on the generation of commercially viable spin-offs. Bozeman and Pandey (1994) compared the cooperative technology policies of the U.S. and Japan to determine the extent, structural patterns, motives, and consequences of cooperative research and development. Schorr and Stolfo (1997) contend that government agencies at all levels are striving to meet citizens' rising expectations for fast, secure, and accurate technology-enabled transactions in environments of shrinking budgets and staff resources. Recent failures in widely publicized large-scale government efforts have tempered the hopes of many governments that these expectations can be made. They argue that government agencies often procure costly

and complex information systems without the benefit of sufficient interaction with each other or with the research and development (R&D) community. In order to move toward the vision of a Digital Government that will allow public access to government information and services, and group participation in discussions at any time and from anywhere on the globe, it will be necessary for government to work with the R&D community and information service providers from all sectors to define a new research agenda.

IT Research Centers

Most of the participants in this workshop participate in larger research initiatives that have very broad agendas addressing the development, application, and assessment of information systems in government and society. Some of these initiatives include:

- the program on Strategic Computing and Telecommunications in the Public Sector at Harvard University's John F. Kennedy School of Government (Jerry Mechling), which "seeks to help public managers and policy makers understand and appropriately use the strategic potential of information technologies," [1]
- the Center for Technology in Government at the University at Albany (the host institution), which merges technology, management, and policy perspectives in conducting specific prototype projects designed to support innovative applications of technology to the practical problems of government,

[1] http://www.ksg.harvard.edu/stratcom/

- the research group at the Copenhagen Business School (Kim Viborg Andersen), which focuses on organizational and social purposes of information systems at varying levels of analysis,
- the Instituto RSO (AnnaLaura Cubello), which engages in multidisciplinary research on such issues as organization design and development, service management, and human resource management,
- the program on Electronic Commerce, Law, and Information Policy Strategies (ECLIPS) at the Ohio Supercomputer Center (Jeffrey Ritter), which "conducts research concerning the legal and regulatory barriers that inhibit the rapid acceleration of electronic commerce,"[2]
- the Informatique Droit Linguistique at the Université de Paris (Danièle Bourcier) which conducts research on law, computers, and information systems, and
- the Centre for Management of Technology at the National University of Singapore (Poh Kam Wong), which conducts multidisciplinary research on innovation management focusing on Singapore and the Asia-Pacific region.

These research initiatives, bringing in a broad array of perspectives from multiple disciplines, help magnify the importance and effectiveness of the research discussed in this paper.

Copyright

Another issue related to technology transfer is that associated with copyright protection laws. In particular, research has been conducted that focuses on copyright issues in an

[2] http://eclips.osc.edu/eclips/intro.html

electronic environment. Kahin (1988) for example, discusses copyright issues in the digital environment with respect to computer software copy licenses. Two models for copy licenses for the faculty examination of software are proposed. Kahin (1992b) also discusses intellectual property rights associated with software patents. Galvin and Mason (1991) discuss copyright law in the context of video and present legal- and library-related issues associated with video copyrighting including clarifications of the law for both users and copyright holders.

Summary

The above discussion is a preliminary attempt at summarizing and categorizing recent government IT research. The identification of categories and the placement of issues into the categories was not obvious and we recognize that there are a number of different ways that this could have been done. We hope that through participant contributions and discussion, we can identify a more comprehensive and current set of research issues and perhaps develop a more robust typology for the issues.

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