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Information technology and transitions in the public service: a comparison of Scandinavia and the United States*

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New information technologies have the potential to transform the ways governments are organized, the activities they perform, the manner in which such activities are performed and even the nature of the work itself. Governments in the US and Scandinavia have followed fundamentally different approaches to the introduction of computing and to dealing with its effects. In the US, automation has been individualistic – each individual unit of government has introduced the technology according to its own needs. For the most part, the implemented systems were small scale, have followed functional lines, have merely automated existing operations, were implemented incrementally and have evolved slowly over time. In contrast, automation in Scandinavia has been communal – systems have been designed, developed and implemented by communal data processing agencies serving an entire level of government, national or local. The systems introduced were relatively large scale, have crossed functional lines, have involved the reorganization of work, have integrated both data and work processes, and were implemented more or less simultaneously for all units or agencies of government. These differences in approach to automation have influenced each country's view of the role of government in anticipating and dealing with the effects of changes in computer technology on the public workforce.

Introduction

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli, *The Prince*

New technologies are frequently described as 'transforming', or 'having the potential to transform' state and local governments and society more generally (Nora & Minc, 1981; Osborne, 1988). In fact, technology has rarely been shown to have such effects. Rather than transforming state and local governments, technology has been adapted by government leaders to fit their perceptions of the opportunities and threats of its application. For the most part, such adaptive application of technology has been incremental and evolutionary precisely because, as Machiavelli's words suggest, dramatic revolutionary change is difficult, perilous and uncertain. Taken together however, incremental, evolutionary change can, and often does, affect the way in which state and local governments operate.

Nowhere is this more the case than with information technology. New information technologies such as computers, airport metal detectors, traffic signal video monitors, radar detection jammers, automated teller machines and genetic fingerprints are changing the day-to-day operations of many state and local governments. Figure 1 shows a few examples of these new technologies which illustrate that although these bring new opportunities, they also introduce constraints and dilemmas (Bozeman & Rahm, 1989). Constraints arise because both financial and human resources are seldom sufficient to take advantage of all the opportunities that exist. Dilemmas arise because existing government employees are seldom prepared for the new technologies and the changes they bring to the work pattern.

Thus, we are interested in two broad questions:

(1) What is the nature of information technology use in the public sector?

(2) What will be the effects of IT use on the public service during the 1990s?

This paper addresses these questions with respect to information technology (IT) and computers and information systems in particular. [IT includes computers, office automation, telecommunications and management science techniques. We focus on information technology for several reasons. Firstly, it is pervasive in

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Citizen information. Expert systems for determining health and social welfare subsidies and software for providing improved, computer-supported information directly to the clients in the municipalities have affected government–citizen interaction and the structure of functions within government in Scandinavian countries. The systems have challenged the municipalities, which traditionally have been split into specialised departments. The new technology has enabled a number of routines to be transferred from various functions to a 'front services' office that interfaces with citizens (Hoff & Stormgaard, 1990).

Automated services delivery. Automatic teller machines (ATMs) and smart cards which permit cash withdrawal and credit charges have in the US reduced the time that welfare recipients must wait in line for payments, and thus the stigma attached to the cashing of welfare cheques, the use of food stamps in making purchases for daily living, etc. But this innovative and client-sensitive method of service delivery currently costs about ten times that of the paper system and is not widely accepted by merchants or banks (Fiordalisi, 1988).

Management information systems. Computerised case management systems have allowed detectives, inspectors, social workers, probation officers and other case workers to be more personally productive, handle a larger caseload and do better casework (for example, better follow-up, to complete more cases, etc.), thereby increasing the diversity of their work, the bottom line performance and the sense of accomplishment in their work. At the same time, the speed-up of work, the errors in case records entered by co-workers and the insatiable appetite of supervisors for more information about the cases from computerised files have sometimes increased worker stress (Danziger & Kraemer, 1986).

Detention monitors. Electronic monitors for detention of both adults and juvenile offenders in homes or in workplaces have reduced the overcrowding of jails, facilitated policing by probation and social workers, and allowed offenders to perform useful work and community service. However, stress has resulted for probation and social workers who are insufficiently trained to use this new technology and for offenders whose lives or work are needlessly disrupted by mistakes and insensitive use of the monitors (Maxfield & Baumer, 1990; Baumer *et al.*, 1991).

Figure 1 Examples of new information technologies in public administration.

governments and will become more so during the next decade and beyond. Secondly, it is illustrative of other pervasive technologies such as biotechnology and materials technology which are expected to have major effects in the distant future. Thirdly, information technology is embodied in many other discrete technologies, such as those specific to a particular area like transportation, criminal justice, health care, or infrastructure. Fourthly, more is known about the diffusion, use and effects of information technology than about discrete technologies which tend to have more limited scope of application.] For each of these questions we are interested in examining the differences between Scandinavia and the United States.

Nature of IT use in the public sector

Computing in the public sectors in Scandinavia [there are important historical, cultural, economic and social differences between the Scandinavian countries (Denmark, Norway and Sweden), but in this paper we will mainly use examples from Denmark and Sweden, though we believe that similar examples can be found in Norway] and the US historically differs in several important regards (see Table 1). Similarities and differences can be seen with regard to: (1) extent of use; (2) organization for use; (3) nature of use; (4) government role in computing affairs; (5) worker involvement in automation; and (6) work organization

and computing. However, these differences might diminish over time as the technology itself changes and as public officials gain greater control over its deployment and use.

Extent of use

In the US, almost all of the state and local governments have adopted computing, and computing now accounts for about 3% of state and local government operating budgets (Kraemer *et al.*, 1986, 1989; Caudle & Marchand, 1989). Most governments have one central computer installation but the larger state and local governments have multiple installations, or so-called 'departmental computing'. The adoption of PCs has been fairly rapid since the early–mid 1980s, and the PC inventory often equals the dollar value of computing equipment in central and departmental installations. Thus, computing within governments has gradually been extended so that 75% of all functions within government have some kind of IT basis. Moreover, the technology has increasingly been extended to individual users through terminals, PCs and workstations. The ratio of such end-user devices to state and local government employees is currently about 1:200 and expected to reach 1:1 by early in the twenty-first century.

Computing in central and local governments in Scandinavia is at a higher level than most other OECD-countries. While the US has traditionally had

Table 1 Nature of IT use in Scandinavia and the US.

Comparison	Scandinavia	US
1. Extent of use	All state and local governments	All state and local governments Greater sophistication
2. Organization for use	Centralised, shared pattern	Decentralised, diverse
3. Nature of use	Conventional business functions Experiments	Conventional business functions
4. Governmental role in computing affairs	User Promoter Regulator for social implications	User Promoter
5. Worker involvement in automation	Participation in various issues Influences on policy and research Unions supportive	Participation in design for new applications Unions supportive
6. Work organization and IT	Concern and use of work organization and IT relations	Little concern

more extensive applications (lead users) compared with Scandinavia, a larger proportion of the cities in Sweden and Denmark was using IT in the mid-1970s: 90% of Danish municipalities and 72% of Swedish municipalities, compared with 51% in the US (King & Kraemer, 1985, p. 38). Today all cities use computing, and the technology has also been extended to individual users. The use of computing in the public sector in Scandinavia might have more influence on working conditions because the public sector employs a larger part of the total workforce and spends a larger part of the gross domestic product than do governments in the US.

What accounts for the current relatively low use of computing in Scandinavian governments? Given that the public sector is such a great proportion of the total economy in Scandinavia, one might have expected that automation would be used more widely as a means of achieving efficiency. However, the 'communal' approach to organizing for use and the considerable influences of workers and unions have slowed the pace and extent of automation in Scandinavian governments. In addition, these governments have been concerned about possible social impacts and therefore have been slower to invest, adopt, promote and use technology than might otherwise be the case. These points will become apparent in the following sections.

Organization for use

Governments at all levels in the US followed a decentralised pattern of organization for computer use in the 1970s. Whether and how computers would be used has been left to each level of government, each unit of government and each agency within a government to decide. While the computing function was initially centralised within government organization and provided as a service to all departments, the advent of minicomputers in the mid 1970s brought about departmental computing, just as the advent of micro-

computers in the mid 1980s brought about end-user computing. While most computing services are still provided by one or more computer installations in MIS departments, a plethora of organizational arrangements exists; this includes individual offices for computing, office automation, end-user computing and telecommunications, as well as integrated offices combining these functions in various ways. In addition, as the size of government databases continues to grow yearly, attention has been focused on managing the information in computerised systems, and a new function – information resource management – has been born. This is commonly known as executive information systems (EIS). In short, diversity is the key characteristic of organization for computer use in US state and local governments.

The Scandinavian countries have historically followed a communal or shared pattern of organization for use, through large data centres established to serve each major level of government (national, county and local), although the largest units (such as cities like Copenhagen and Stockholm) have established their own computing centres. The central governments and the associations of local governments in Denmark, Norway and Sweden established the Kommunedata centres that provide most of the computing services to local governments. These centres have had profound effects on the overall diffusion rate of IT-use in those countries. The establishment of the Kommunedata in the Scandinavian countries (in 1965, by the Swedish Union of Local Authorities) was intended to provide central IT-use and a technical organization of sufficient strength to handle advanced applications, to coordinate the technical personnel resources and to develop new application systems for the municipalities. [The public sector employs a large part of the total labour force, and spends more than half of the GNP. Local governments play an important role in managing the welfare

state. In Sweden the public sector spends 67% of the GNP, while the public sector in the US spends 38% (1982). Swedish local governments spend 35% of the GNP (1981), the US local governments 8% (1982). The main expenditure in Swedish local governments is health, education and welfare (Bogason, 1987).] The growth problems (unbalanced economic growth, shifting production structure, etc.) in the cities and regions of Sweden directed the development of computing toward specific, restricted fields of application rather than general, abstract ideas such as urban databanks or MIS. It also led to the design of applications intended to serve the country as a whole, rather than the independent development of a large number of scattered, uncoordinated experiments with varying types of applications (OECD, 1974, pp. 109–119). An indicator of the relative strength of the Kommunedata centres is the number of staff trained as computer operators, system planners, etc. In 1986, approximately 1,500 professional staff (systems analysts and programmers) were employed at the Danish Kommunedata centre, and only 108 in the 275 municipalities (Hoff & Stormgaard, 1990, p. 123).

Beginning in the early 1980s, the pattern of centralised computer organization in the government administration underwent change as part of a general transition in the national government. This transition was towards decentralisation to local bodies (countries and municipalities). Indeed, computer technology was a major factor facilitating the decentralisation of government administration because it permitted data in support of local administration to be collected and restored locally while also sharing and accessing data in the central government (Ingelstam & Palmlund, 1991).

Character of use

Most applications of computing in US state and local governments are currently conventional and oriented toward business functions and administrative support rather than direct service delivery to citizens (Kling & Kraemer, 1985). A primary reason for this is government emphasis on productivity and administrative control. While control benefits have been achieved, the productivity improvements from these applications have been marginal for the most part, or confounded with other improvements and, therefore, difficult to identify and measure. However, productivity gains are expected to be greater in the future as more emphasis is placed on applications that restructure service delivery, both as a means of reducing costs and meeting special needs. For example, restructuring service delivery towards 'one-stop shopping' and 'little city halls', along with the introduction of computing, are expected to reduce the need for more staff, for multiple service centres and for longer service hours as governments try to respond better to the diverse needs of individuals,

households and business. These developments will only increase the pervasiveness of information technology in government.

In Scandinavia, computing has already begun to be oriented towards direct service delivery to citizens, although the main part of the computing is oriented, as in the US, towards business functions and administrative support. Experiments with 'front service' were introduced in the municipality of Ringsted (Denmark), to help the street-level bureaucrats to attend to the problems of citizens better. Citizens need only apply to one place, irrespective of the reason for their application, and a considerable number of matters can be handled there (Hoff & Stormgaard, 1991). The front service has largely been developed to attend to the citizens' rather than bureaucratic interests.

Governmental role in computing affairs

Governments in the US have perceived their role primarily as a user of computers, and to some extent a promoter of greater use through the demonstration of advanced or leading edge applications and the design, development and transfer of mainstream applications. In some instances, federal or state agencies have developed model applications which they sought to have implemented by lower levels through a combination of carrot-and-stick incentives. Buoyed by belief in the benefits of technology, government agencies have not been highly concerned with the social and health aspects of the technology's use. Moreover, because computing has been used primarily to automate existing operations, the social effects have not been great. Most studies of computer use in government indicate that the computer's effect has been neutral, but where there has been an effect it has been beneficial to the quality of worklife of government employees (Danziger & Kraemer, 1986).

In Sweden, the government paid close attention to the social implications of the penetration and development of the use of computing. Studies of social issues related to computer use were carried out with governmental support on learning mechanisms for computer-based systems, the work environment (high ergonomic and health standards) and managerial organizations for work involving computer-based systems (OECD, 1991). Sweden also has a well-organized system of planning and project implementation in IT policy. In addition, government and private sector have had frequent mutual interactions in the planning of programmes for IT development. An incident that triggered the establishment of large-scale IT programmes in Sweden occurred at the beginning of the 1980s. The NATO-member countries refused to provide integrated circuit (IC) chips to Sweden, claiming that Sweden exported some systems listed by the Coordination Committee for Mutual Export controls

(COCOM), for construction projects associated with the information systems used in the Moscow Olympics. This incident increased public awareness of the necessity of ensuring a secure supply of key components of manufactured products on which Sweden's international competitiveness relied. Automation and process control equipment were examples of these. This has resulted in the establishment of a range of governmental institutions to deal with the technology. Coordination of the acquisition and utilisation of computers in government administration is provided by the Swedish Agency for Administrative Development (SAFAD). Improving the interface between humans and computer-based systems is the responsibility of the Swedish Environment Fund (AMFO), a government agency that belongs to the Ministry of Labour (OECD, 1991). The latter agency, in particular, illustrates the awareness of the social implications of computerisation in Sweden.

Worker involvement in automation

In the US, worker involvement in computing affairs has focused on participation in the design of new applications. The purpose of their involvement has been to communicate to computer specialists the nature of their operations, the information and processing requirements, and the data definitions in order to facilitate the design of new computerised systems. Worker involvement has extended to the number and nature of screen designs and reports produced by the systems, training of government staff for use, and even evaluation of the system once it became operational. It has not usually been extended to decisions about whether to introduce new systems, as these were generally made by high-level managers or professional staff. However, the decentralisation of computing to departments through minicomputers and the introduction of PCs has brought about greater user involvement in the spectrum of decision making about computing matters.

In Scandinavia, the nature of industrial relations implies considerable influence for employees regarding issues of working conditions. Any consequences that may arise from computerisation in the workplace must therefore be seen against this background of active and often constructive consultation in the process of implementation. The labour movement in the Scandinavian countries has been highly influential in decisions taken by government, the research conducted and the formulation of strategies for influencing technology development – the Scandinavian approach for studying computerisation is thus highly linked to improving conditions for the workers (Bjerkes et al., 1987; Bermann, 1989; Floyd et al., 1989). The labour movement has, by and large, over the years supported, rather than resisted new technology.

The employee is, by legislation and cooperative

arrangement, given the right to receive information about new technology, and its attendant changes in working methods and processes (Mathiassen et al., 1983). However, no general regulations secure employees any influence upon technology change – the employers have the final word. The Swedish unions' attitude towards new technology is more positive than in many other countries. The main reason for this is that unemployment caused directly by technical change has been limited (Ullmark, 1988).

Work organization and computing

Because most US computer applications were the automation of existing activities in government agencies, there has been very little concern about the relationship between work organization and computing. Employee unions have generally been supportive of government automation. Experiments were conducted during the 1970s with information and referral (I&R) systems for health, social services and ageing, in an attempt to bring about greater coordination and cooperation among public agencies, but these effects generally failed because insufficient attention was paid to agency incentives for participation in the systems. A brief characterisation of work organization and IT-use in the US is thus the general absence of consideration of this important relationship.

In Scandinavia, experiments with new technology have enabled a number of routines to be transferred from various functions to 'front services' offices that interface with citizens (Hoff & Stormgaard, 1990). Expert systems for determining health and social welfare subsidies and software for providing improved, computer-supported information directly to the clients in the municipalities have affected government–citizen interaction and the structure of functions within the government (Karlström, 1986; Khakee, 1985). Such systems have been a challenge to the municipalities which traditionally have been split into specialised departments. A brief characterisation of work organization and computing in Scandinavia is thus the awareness of this relationship.

Effects of IT use on the public service

Our review of research and practice indicates that the effects of computing can be broadly classified into four general areas: (1) creation of new institutions; (2) organization and distribution of activities performed by government; (3) alteration of work processes; and (4) nature of the work. These effects are generally well documented by individual studies, empirical surveys (both cross-sectional and longitudinal) and/or literature reviews. However, not all effects are equally well understood, as will become apparent below.

Creation of new institutions

The largest effects of computing and other information technologies have been concentrated in the computing and information systems function in government rather than on the other functions and activities of government (see Table 2). In the US, information technology has resulted in the creation of new government functions and institutions – the information systems function and the MIS department, the telecommunications function and the Office of Telecommunications, the information resources management (IRM) function and the IRM Office (Andersen & Dawes, 1991). Most often these institutions have existed separately, but some governments have integrated them into a single institution. The computing function has undergone the greatest change.

Initially, computing was set up as a centralised function in most governments, usually under the finance department. In time, however, as computer use expanded, the function was often converted into an independent government department outside the finance function. The continued spread of computer use, along with the advent of microcomputers, led to the distribution of the computing function among large departments with the former central unit serving finance and administration and the myriad small government functions and agencies. The advent of microcomputers reinforced and hastened this trend towards distribution of computing equipment and expertise to even the smallest functions and activities. In an attempt to manage and facilitate these effects, central IS units created new 'information centres', 'computer stores' and 'end-user computing offices'. At the same time, department users have created their own informal users' groups for sharing information and expertise. These have been independent of the former IS units and sometimes in opposition to their attempts to manage, facilitate, or control computing on an organization-wide basis. These developments have occurred because top managers have not known how to deal with these computer-based developments and/or did not choose to become involved. The disruption and trauma for IS units have been considerable in some instances, and relations between the IS units and the user departments have seriously deteriorated with an overall loss of effectiveness to governments.

In Sweden also, computing resulted in the establishment of a range of governmental institutions. The Swedish Agency for Administrative Development (SAFAD) was established to coordinate the acquisition and utilisation of computers in the central government administration. The Swedish Environment Fund (AMFO), a government agency in the Ministry of Labour, was set up to improve the interface between people and computer-based systems (OECD, 1991). The software houses, referred to as Kommunedata, were established to provide computing and development services to local governments. Kommunedata was established in Sweden in 1965 and in Denmark in 1972. The Kommunedata organizations established a highly centralised activity which provided computing to local governments via terminals to a central mainframe and with development services via a central staff which developed applications intended for use by all local governments. The Kommunedata organizations grew in computing power and number of staff throughout the 1970s and 1980s as computer use expanded throughout local governments. However, computing also grew in the larger municipalities and counties, which were allowed to obtain their own computing equipment and staff because of their size and purported unique requirements.

Organization and distribution of activities

Information technology facilitates much wider forms of organization and distribution of governmental activities. Information technology permits either centralised or decentralised organization, and central or local distribution of the activities of government while also permitting greater central monitoring and control. For example, some federal agencies use large centralised information systems to facilitate and monitor state and local government implementation of federal programmes. Some states also extend their operations to regional offices and local administrations through mandated state-wide information systems for health, social services and employment. Some local governments are similar, with city-wide systems for distributed activities like libraries, parks and recreation, and little city halls.

Beginning in the 1950s, with the first introduction of the computer, governments followed a centralised approach in automating government activities, such as

Table 2 Effects on public service: activities performed by government.

New institutions	Primarily in the IT arena
Organization and distribution of activities	Automation follows transitions in administration rather than leads Centralisation versus decentralisation facilitates either New organizational forms primarily in IT arena
Alteration of work processes	Coordination and optimisation facilitated Automation of service delivery in special cases Electronic communication with citizens

budgeting and accounting. This trend continued in the 1960s with time-sharing and inter-governmental systems such as the National Crime Information Center/ Computerized Criminal History (NCIC/CCH), and in the 1970s with large-scale computer networks and services integration (Quinn, 1976). Throughout the 1980s, there was a trend towards decentralisation of federal government activities to the states and, in turn, form the states to local governments. This decentralisation trend has continued and perhaps will even accelerate during the 1990s. It will be facilitated by the increasing availability of computer networks, databases, electronic mail systems and microcomputers at each level of government and throughout the federal system.

In all of these technology deployments, governments choose the approach they will take. Some governments prefer centralised approaches, whereas others opt for decentralised ones (Kraemer et al., 1989). For example, the state of Virginia has a centralised social services information system, whereas California has a decentralised one. Some governments provide one-way information services to citizens, whereas others provide for two-way information and communication (Gurwitt, 1988a). This is illustrated by the different approaches of Kansas City and Santa Monica (California). In Kansas City, a 24-hour city hall based on voice mail, provides information to citizens about government operations and activities, and takes requests or complaints from citizens which are handled and answered within 24 hours. The Santa Monica system, which is based on computer conferencing and electronic mail, allows interactive communication among citizens and between citizens and government officials.

The experience of Sweden also shows that governments select the approach they wish to take to automation, and that automation follows transitions in the administration of government activities rather than leads them. For example, the administration of social welfare in Sweden was traditionally centralised and supported by a nation-wide computerised system serving all social welfare agencies at the national, county and municipality levels. Computerisation allowed centralised control of the various social welfare payments for child care, sickness, parental care, unemployment, housing for the aged and handicap care. The first initiatives to computerise the administration of these welfare services were taken in the 1950s, and concentrated from the beginning on developing a centralised, national computer-based information processing system. The system has enabled the government to implement a series of social reforms and provide citizens with a reliable service of payments and different social benefits (Ingelstam & Palmlund, 1991). Beginning in the early 1980s, however, the organization of social welfare was changed dramatically from its

centralised form to a more decentralised one, with the distribution of social welfare functions to local administrations along with the required computing equipment, staff and databases (Ingelstam & Palmlund, 1991).

A related change is the distribution of workers themselves. The bulk of government workers will continue to be located in central places like the statehouse (central governmental buildings), the county hall of administration and the city hall. Some will be decentralised to distributed workplaces such as regional offices, metropolitan subcentres, and little city halls. Others will work at home with a link to the office via the computer and telecommunications, that is, they will 'telecommute' (Kraemer, 1982). In the US, the number of such workers is estimated to be around 10 million nationally by the year 2000. Whether it reaches such heights or not, government workers are likely to be among such telecommuters because of the 'services' nature of their jobs. The type of workers who will telecommute are first and foremost those who already work at home, such as computer professionals, writers and editors, handicapped workers and 'piece workers'. For the most part, work at home will not replace work at the office, but will supplement it; that is workers will work certain days (or parts of days) at the office and the remainder at home (Venkatesh & Vitalari, 1992).

In Scandinavia, the introduction of 'front services' into city and county governments has changed both the distribution of activities and workers. In the past, when citizens needed governmental services they had to interact with each functional bureaucracy independently. There was no mechanism to take care of all their needs at one place. The introduction of front services has created a single office which deals with all the needs of the citizens. This office then interfaces with each of the functional bureaucracies and communicates with citizens about questions or issues that arise during the processing of requests. Another illustration is provided by the use of portable computers by the Danish VAT auditors. The VAT auditors bring computer-stored information to the clients (companies) and, in turn, store the information obtained from the clients in their portable computers for transmittal back to the central office (Vittrup, 1989). This has increased the control of the VAT auditors, and also their direct contact with the clients. The auditors, and not the clients, travel more as a result of the computerised system.

Thus, experience in the US and Scandinavia indicates that the technology facilitates either centralised or decentralised organization and distribution of government activities and workers. Historically, mainframe computers have been viewed as facilitating greater centralisation. The advent of microcomputers is viewed as facilitating greater decentralisation. In fact, computing has always facilitated either approach, or a mix, and

still does today (Robey, 1981; Attewell & Rule, 1984). However, people's perceptions of what computers can do have been influenced by these technology developments, and public officials, knowingly or unknowingly, have chosen to implement the technology one way or the other. Often too, those who have chosen a particular approach have rationalised their decisions made on personal or bureaucratic grounds on the technical requirements, technical advantages, or costs of the approach (Danziger *et al.*, 1982).

Alteration of work processes within institutions

The foregoing changes in organization and distribution of activities will be reflected in changes in the processes by which work is carried out within and between institutions. Although the possible changes are many, three are especially important: sophisticated coordination and optimisation, automation of direct services to citizens and electronic communication with citizens.

Coordination and optimisation. Coordination and optimisation refer to the ability of government agencies in far-flung locations to coordinate their activities and to optimise them in terms of some overall interest. While such systems do not currently exist in US state and local governments, the prototypes exist in the federal government and can be extended to state and local governments. The US Army's computerised REQUEST system for assisting recruiters in meeting military occupational special needs while providing incentives for recruits to join the new 'all volunteer' army is an example (Kelman, 1990a). Basically, REQUEST starts with a listing of requirements for different military occupational specialities, pay bonuses for signing-up for the specialities, training slots for new recruits and available first assignments for the recruits once trained. This information is available at all army recruiting offices in the US and abroad. The recruiter at each local office inputs information about the recruit's preferences for a speciality, training and first assignment, and shows the availabilities on the computer screen, along with any bonuses, to the recruit. When the recruit makes his choices, they are recorded in the central computer and printed out immediately for the recruit and the local office. REQUEST not only helps the army to meet its personnel needs, but optimises the needs of the army and the desires of the recruits and helps to ensure that recruiters seldom lose a 'sale'.

A modest example at the state level is Colorado's job-bank, a system that exists in other states as well (Ullman & Huber, 1973). Most of Colorado's major cities and counties are linked through a central computer to a system that keeps track of participants in job training programmes and job openings, and allows social service personnel to match job openings to clients' backgrounds and qualifications. A logical extension of this system is to provide terminals for both employers and employees so that they can enter job openings and résumés and do searches for a match on their own (Gurwitt, 1988b, p. 41). Similar systems exist in Scandinavia. Job-banks in Sweden have widened the possibilities of locating a suitable position for applicants (SAFAD, 1980, p. 12). Also the job-banks make it possible to match newly registered positions against applications in a faster way than in the manual system. However, it has not been possible to show that there is any reduction in the period people are unemployed or the number of people who are unemployed.

Automation of service delivery. Automation of service delivery refers to the completely computerised handling of requests for information or service. Here there are many examples already in operation around the US. Several cities have automated citizen access to public services such as building inspections and bibliographic retrieval (from public libraries) and to public records such as land records, tax records, vital records, business licences and other 'public' information (Kahl, 1990). For example, Dallas (Texas) has a system for the scheduling of building permit inspections. Instead of calling a city office that is only open from 8 a.m. to 5 p.m. to schedule an inspection, builders can now call the building inspection office at any time of the day or night. The phone is answered by a microcomputer with a voice response system, which asks for the information about the building to be keyed in on a push-button phone. It then gives the caller a time for the inspection. At the inspection office, that information is then fed automatically to a mainframe computer, which goes on to arrange inspectors' daily schedules and routes (Gurwitt, 1988b, p. 40). Another example is provided by experiments in Ramsey County (St. Paul), Minnesota, the state of Washington, and Berks County, Pennsylvania, that involve rethinking the way in which public assistance payments are made to individuals. Instead of issuing cheques, which the welfare recipients then have to take to the bank to cash, the county is issuing bank cards for welfare recipients, who can then use them at ATMs around the county to draw out cash against their public-assistance accounts. Like any other bank cards, these cards have an expiration date and so the individual's eligibility and assistance are re-examined before a new card is issued. In addition, the cards and/or the ATMs can be programmed with information that limits the amount of any one cash withdrawal, the number of cash withdrawals within any time period, or other user options to encourage cash management (Gurwitt, 1988b; Fiordalisi, 1988).

In Sweden, automation of service delivery is illustrated by a computerised system for administrating various social insurances at the local level. Instead of the citizens having to take the initiative to change their

social insurance status, the system issues preprinted forms which are then mailed to citizens when action from their side is needed in order to change the social insurance status. The computer system then takes the information received from the citizens and combines it with the relevant eligibility and benefits rules to produce the new social insurance benefits. While this system provides citizens with better service, the personal contact between citizens and the administration has been reduced (Ingelstam & Palmlund, 1991).

Electronic communication with citizens. Electronic communication with citizens can occur in a variety of ways, but most frequently through the automated handling of citizen requests for information and complaints and through two-way, interactive electronic mail and dialogues. An example is provided by Santa Monica's (California) Public Electronic Network (PEN). Anyone with access to a personal computer, once registered with the city, can use PEN to obtain information about city council hearings, city commission activities, or communicate with city staff, city council members and other city officials, or engage in a 'public dialogue' on community issues such as rent control, the environment, the economy, women's or senior citizens' issues. Computer terminals are located in city hall, public libraries, senior citizen centres, other public buildings and shopping malls, to facilitate access by people without computers (Gurwitt, 1988a; City of Santa Monica, 1989).

Videotex, a combination of computing and television, makes it possible for citizens in Danish municipalities to communicate with databases about government service. The citizens have access to large quantities of information through public videotex terminals and do not need to have a private computer at their disposal (Hoff & Stormgaard, 1991, pp. 228–232). In one experiment, the citizens have videotex terminals located in their homes and can access a number of private services (advertising and home-shopping). In another experiment, terminals have been installed in post offices, libraries and day-centres for old-age pensioners. The citizens have access to information on activities in the municipality, job vacancies, public housing and a 'bulletin board' permitting participation in public debate within the municipality.

The nature of work
As might be expected from the foregoing changes, the new information technologies are changing the nature of work in state and local governments. Empirical research has been conducted in both Scandinavia and the US over the last twenty years. The findings are essentially similar and show that increasing automation of work processes is producing several changes, including: (1) speed-up of work; (2) tighter coupling of work;

(3) greater independence for professional and staff workers, and greater interdependence for operations workers; (4) greater control over people for managers and professionals, and greater control over jobs for clerical and administrative workers; and (5) greater flexibility in work organization (Attewell & Rule, 1984; Kraemer & King, 1986).

Speed-up of work. Computerisation has produced a speed-up of work at all levels within government, ranging from street-level workers to office workers and from professional workers to policy-makers and managers. The speed-up has occurred because the technology allows individuals to work faster, shortens the cycles for processes such as billing, paying and collecting, and records information in real-time, as events and actions occur, and thereby creates an expectation for fast response. An important effect of this speed-up is a general increase in time pressure felt by all types and levels of workers (Danziger & Kraemer, 1986; Irving *et al.*, 1986; Jackson, 1987; Kraemer & Danziger, 1990).

Tighter coupling of work. Information technology is also creating a tighter coupling of work, especially where individuals from several different governmental departments and functions are tied together in a single system such as a financial, personnel, geographic information, or emergency dispatch system. A tighter coupling of work means that what a person does in one part of the organization triggers a decision or action by others, or that what people do in their own parts of the organization creates a picture of something happening that all must respond to in a coordinated fashion. The former is illustrated by the case of a building inspection which discovers serious health, safety and environmental hazards, and triggers the need for response by the fire (hazardous materials), health and police departments. The latter is illustrated when the independent actions of these departments result in determinations that, taken together, suggest that a building must be vacated, sealed-off, or demolished because of the total set of hazards present and the improbability of their amelioration.

Independence/dependence of work groups. As might be expected from the tighter coupling of work, there is a growing interdependence among some work groups as a result of automation, but there is also a growing independence for others. Information technology appears to increase the independence of highly professional and specialised work groups such as engineers, planners, economists, statisticians, management analysts and staff analysts. These groups have always been able to function relatively independently, and computing has only increased their independence at the margins. It has done so by providing them with direct

hands-on access to the technology, data and the power to manipulate data in order to produce information relevant to their jobs. This increased capability has tended to heighten their stature and their independence of action (Danziger & Kraemer, 1986).

In contrast, the extension of computing into government has increased the interdependence of office work groups at the operational level, especially when they rely upon one another for input of data (and its accuracy, timeliness and format), for processing cases/clients in a sequence of steps, or for manipulations of data which form the basis for action by others (for example, forecasts or work schedules). The groups most often affected are the clerical, administrative and managerial in both operational and staff functions such as finance and personnel, planning and building, fire and police, and across these functions (for example, geographic information systems, financial systems and personnel systems).

Control/autonomy of individuals and jobs. IT-use has been shown to have several effects related to control of individuals and jobs (Kraemer & Danziger, 1990). Firstly, computing provides a higher level of organizational control and greater capacity for judging performance via computerised monitoring systems built into the operating systems of government. Furthermore, this capacity for work monitoring via the computer is now a reality for professionals, as it has been in the past for clerical/administrative workers (Bjørn-Andersen *et al.*, 1986; Irving *et al.*, 1986).

Secondly, managers and professionals generally enjoy greater increases in control attributed to computing than do clerical/administrative workers (Danziger & Kraemer, 1986; Majchrzak, 1987; Millman & Hartwick, 1987). However, computerised systems also can make the task of control more difficult, especially for those in superordinate roles who themselves become dependent on the technology. For example, a study of supervisors and customer service representatives in a large public utility (Kraut *et al.*, 1989) found that as a result of installing a new customer inquiry system, the supervisors' work was both made more difficult and more technology-dependent. In the past, supervisors had known the job of their subordinates because they themselves had previously been customer service representatives. However, with the introduction of the new computerised system, this knowledge was suddenly obsolete – and the supervisors did not possess nor were they provided with training to develop the skills they needed to operate in the new computerised environment.

Thirdly, computerisation had increased workers' sense of control over certain aspects of the job, including mastery over relevant information and improved communications. This has especially been the

case for clerical and administrative jobs, and has been accompanied by an increase in time pressures (Kraemer & Danziger, 1990).

Flexibility of work organization. The most significant impact of computing on work organization is that the technology enables managers and policy-makers to choose whatever structural arrangements they desire, including combinations of structural arrangements. IT-use does not determine work organization; computing facilitates it. While information technology may enhance employee skill and autonomy, thereby facilitating decentralisation and distribution of work, it also facilitates hierarchical control and task fragmentation (Bjørn-Andersen *et al.*, 1986; Thompson *et al.*, 1989). For example, hierarchical control and task fragmentation are facilitated by information technology when efficiency is the primary goal, the organizational scope is limited, capital cost is low, equipment reliability high, workforce interest low and computerised monitoring effective (for example, in the mail room or central records department of a state or local government organization). This fact highlights the importance of recognising that the organisation of work is at least as much a matter of political/managerial choice as it is of function/task necessity. It is a matter of choice about the structure of governance in organizations (Kraemer, 1991).

IT-use can influence the work organization through, for example, automating parts of the production or job-routines and, in some cases, establishing separate organizations that are fully, or highly, automated, while the remaining parts of the 'old' organization are manually oriented. This might lead to a high degree of computer networking in the automated part of the organization, but it also might reduce the degree of integration between automated and manual tasks. Also, establishing separate organizations reduces the possibility of formal rotation between types of tasks in the manual and computerised organizations (Child & Loveridge, 1990).

As all of the foregoing suggests, the effects of change in computing are being felt at all levels of state and local government. IT-use has generated opportunities to reconfigure relationships, including those between levels of government, among subunits of the same jurisdiction, and between levels within state and local governments. The effects of computing on the activities of state and local governments and the organization of work have had ramifications for the nature of work itself. State and local government employees are experiencing greater time pressures, tighter coupling of their work activities, and changes in dependence and autonomy.

However, there are many areas where we do not yet

know the effects or have a completely clear idea of the effects. These include the following:

(1) A quantitative indication of the job displacement, new jobs and net employment effects of the adoption of information technology. It is probably impossible to determine these effects across all state and local governments. However, a few carefully constructed empirical case studies over time in highly impacted governments and/or agencies would provide a good indication of the extent of such effects and the key relationships that would help other governments to make their own assessments.

(2) The effects on citizens and public servants of the very new technologies for services automation, computer-assisted service delivery, communication with the public and automatic monitoring. Current knowledge is mainly anecdotal, derived from newspaper and promotional accounts. What is needed is serious study of these technologies in order to draw out more fully their implications for the public service.

(3) A quantitative indication of the numbers and distribution of new technology-related functions and new job classifications in state and local governments. How many technology policy analysts, technology transfer agents, information resource managers, information analysts, GIS specialists, end-user specialists, multi-media specialists and similar new jobs exist in state and local governments? Where are they, and at what rate are they growing?

Conclusion

Computing and other information technologies are part of the general transitions affecting the public service and also bringing about their own transitions. The transitions are evolutionary – not revolutionary. The use of computing is still in the early to middle stages in most governments.

Governments in the US and Scandinavia have followed fundamentally different approaches to the introduction of computing and to dealing with its effects. These differences stem from differences in views about the beneficence of technology, the need for reorganization of work along with the introduction of new technology (the popular word today is 're-engineering') and the role of government in anticipating and mitigating the effects of technology. In the US, the introduction of IT has been individualistic – each individual unit of government has introduced the

technology for its own needs. For the most part, the implemented systems were small scale, have followed functional lines, have merely automated existing operations, were implemented incrementally and have involved slowly over time. While the US has occasionally implemented vertically integrated systems such as NCIC/CCH, these tend to be the exception rather than the rule. Attempts to implement such systems outside the criminal justice area, where a command and control system of authority exists, have generally been unsuccessful.

In contrast, in Scandinavia the introduction of IT has been communal – systems have been designed, developed and implemented by communal data processing agencies serving an entire level of government, national, county, or municipality. The systems introduced have been relatively large scale, have crossed functional lines, have involved the reorganization of work, have integrated both data and work processes, and were implemented more or less simultaneously for all units or agencies of government.

These differences in approach to the introduction of IT have influenced each country's view of the role of government in anticipating and dealing with the effects of changes in computer technology on the public service workforce. In the US, the effects of government IT-use have almost never been disruptive, because the introduction of IT has been incremental and governments have followed a policy of reducing staff through attrition rather than layoffs. Thus, US governments have been relatively unconcerned about effects of IT-use, have responded to each situation in an *ad hoc* fashion and have been reactive rather than proactive in dealing with effects. Scandinavian countries have reorganized work along with the introduction of IT, so that the potential effects on government employees have been more serious. Consequently, they have been concerned about effects of IT-use from the start, have developed plans to deal with these effects, and have been proactive rather than reactive in dealing with the effects of automation.

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