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Computers and Control in the Work Environment

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■ This paper provides a systematic and empirical analysis of the impact of computers on the work environment of selected types of "white collar" professional service workers in municipal governments in the United States. While there have been hyperbolic claims about the impact of computers on the professional workplace, the effects that are empirically validated are marginal. Moreover, the patterns and levels of computer impacts on work vary across roles. A particularly significant finding is that greater employee control in the workplace is attributed to the computer as the employee's role ascends the organizational hierarchy. This is the first empirical confirmation that computer technology enables an information elite to reap the greatest increases in control within organizations. It suggests that empirical research on the distribution of control within organizations and on the rise of technocratic elites might focus on the nature of information elites, in particular, to determine whose interests and agenda will be best served by the actions of the information elite.

The computer has become the essential symbol and perhaps the crucial driving force of "post-industrial" society. Despite the centrality of the computer, there is continuing disagreement regarding the overall impact of computers on social and personal life. On the one hand, the computer is presented as a technology whose protean applications will create an increasingly dehumanized and technocratic world. On the other hand, computer technology is credited with the capacity to produce goods and services with great efficiency and rationality, facilitating a life of abundance and leisure.

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The work environment is a domain where major impacts from computer technology have been predicted. Yet, our social-scientific knowledge of these impacts remains quite fragmentary. This paper provides a systematic and empirical analysis of the impacts of computers on the work environment of selected types of "white collar" professional service workers[1] in one class of public organizations, municipal governments in the United States. Employing data gathered from a purposive sample of 1,448 employees in 42 governments, the analysis focuses upon two questions: (1) have computers substantially altered the employees' work environments? and (2) do the impacts of computing on work vary significantly among different types of employees?

While there have been many hyperbolic claims about the impact of computers on the professional workplace, the effects that are empirically validated are more modest. The early empirical research (surveyed by Sartore and Kraemer[2]) suggested that computing tended to reduce the quality of working life, particularly by producing greater time pressure and reducing individual satisfaction with the job.[3] The more recent empirical research (summarized by Kling[4]) holds that, overall, computer technology has had limited rather than major impacts on the character of white collar working life: increasing job pressure, having little effect on the level of supervision experienced by the employee, and possibly resulting in moderate increases in job satisfaction.[5] It also seems that the patterns and levels of computer impacts on work vary across roles, with more positive (or less negative) impacts attributed to the computer as the employee's role ascends the organizational hierarchy from clerical workers to professionals and supervisors to managers.[6]

Conceptualization

The central focus of this research is to assess whether computer technology has altered aspects of the employee's control of his or her work environment. In our conceptualization, the linkage between the individual and the job can include control in relation to other individuals or in relation to the job itself. Thus, we employ four variables that measure the effect of computing on the employee-work nexus: (1) control of the employee's work by others, as indicated by closeness of supervision; (2) the employee's control over others,

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as indicated by the capacity to influence others in the work environment; (3) the constraints imposed by the job itself on the employee's behavior, as indicated by time pressure in one's work; and (4) the employee's overall feeling of control over his or her work life, as indicated by a sense of accomplishment on the job. The development of specific measures for these variables has been informed by core dimensions of the "Job Diagnostic Survey"[7] as well as existing research on computing in organizations. Our indicators for the measures are the employees' own assessments of whether these four aspects of control within their work environments have been affected by the computing systems with which they deal.

Given the possibility that the effects of computing on control of work-life might vary across types of employees, we distinguish four role-types from among the professional service workers in our study of government personnel. The role taxonomy is based on the employees' autonomy within the organizational hierarchy and on the dominant characteristics of their data-handling tasks. The four role types are: (1) managers, the top department-level administrators who mainly use summarized information from automated files on an occasional basis (primarily department heads and division heads in our sample); (2) staff professionals, the relatively professionalized groups who serve policy-makers and managers mainly in a staff capacity, analyzing data and providing information and advice (primarily planners, policy analysts, budget and management analysts, and accountants in our sample); (3) street level bureaucrats, the line personnel who directly provide public goods and services to citizen-clients and who typically use specific information on a case-by-case basis (primarily police detectives and patrol officers in our sample); and (4) desk top bureaucrats, the administrative and clerical employees who are extensively involved in recording, processing, searching and using information files for general administrative assistance to department and division heads, for internal operations and/or for dealing directly with citizen-clients (primarily administrative assistants, bookkeepers, traffic ticket clerks, and records clerks in our sample). In general, these four role types are listed in terms of decreasing autonomy within the organizational hierarchy and of increasing pervasiveness of data-handling responsibilities.

Hypothesized Relationships

Most empirical research that has addressed the impact of computing on worklife has examined a particular role type in a single organization or across a variety of organizations. Our research employs a systematic, comparative framework, undertaking both within-role and between-role analyses for a large sample of individuals within a single class of organizations. Certain patterns of linkages between computing, employees and control of work suggested by existing research serve as our specific working hypotheses. These are briefly stated below and also characterized in Table 1.

1. Computing will result in moderate increases in the *supervision of work* by others, particularly among those in what we term "bureaucratic" roles, where job performance involves less discretion, more routinization, and tasks whose quantity and accuracy are amenable to quantitative measurement.
2. Computing will result in differential changes in *influence over others,* with those roles lower in the organizational hierarchy experiencing relative decreases in influence as they lose their capacity to mediate the information flows to those in decision-making and supervisory roles, who will enjoy increased influence.
3. Computing will increase *time pressure* on those in more routinized and bureaucratic information-handling roles, especially desk top bureaucrats and street level bureaucrats, and it will reduce time pressure on top managers and staff professionals who utilize aggregated and summarized data.
4. Computing will generally increase the overall *sense of accomplishment* with the job for those employees who have enjoyed increases in control over others and have avoided increases in control by others and time pressure—primarily managers and staff professionals, given our prior hypotheses.

As suggested by these specific hypotheses, we expect that the overall impact of computing on control of work life will be differentially distributed among role types. In general, computing will enhance control of work life in relation to other individuals and in relation to the job for those employees who are higher in the organizational hierarchy and who perform more discretionary information processing tasks (managers and staff professionals) while diminishing control of work life for employees lower in the hierarchy and with less discretion (those in "bureaucratic" roles).

Data and Methods

The data are primarily derived from lengthy self-administered questionnaires completed by a random sample of municipal government personnel in selected positions. Of the total sample in the data base, this paper examines the 1,448 employees who correspond to one of the four role-types specified above, who indicated that they use the computer or receive computer-based information, and who have had some interaction with those providing computing services. We analyze these employees because they are capable of providing the most informed responses regarding the impact of computing on their work environment. The employees are from 42 American municipal governments drawn in a sample stratified on key technological dimensions such as the level of automation, the sophistication of hardware and software, and the level of centralization in the provision of computing.[8]

Initially, we present tabular analyses of the responses of the employees to specific questions regarding the impacts of computing on their work environment with respect to supervision, job pressure, influence over others, and sense of accomplishment. Then we assess whether there are significant between-role differences in

TABLE 1
Hypothesized Relationships Between Computing and Control of the Work Environment

Autonomy in the organization's hierarchy	Pervasiveness of data-handling in work[a]: High	Pervasiveness of data-handling in work[a]: Low	*Predicted Impacts*[b]
High	Staff Professionals	Managers	– *Supervision of work by others* + *Influence over others* – *Time pressure* + *Sense of accomplishment*
Low	Desk top bureaucrats	Street level bureaucrats	+ *Supervision of work by others* – *Influence over others* + *Time pressure* – *Sense of accomplishment*

[a]High means that data-handling tends to be direct, multi-modal, and continual; low means that data-handling tends to be indirect, use-oriented (relative to generation and manipulation), and intermittent.

[b]Impacts are those effects on control of work attributed to computers. The table indicates the predicted hierarchical differentiation of impacts among roles. It is read as follows starting from the top:

– Supervision of work = Decreased supervision of work by others for staff professionals and managers
+ Influence over others = Increased influence over others for staff professionals and managers

. . . and so on.

the effects of computing on work, by means of the Chi-square and Kendall's tau statistics.

Findings

Overall Impacts of Computing on Work Life

Table 2 indicates the percentage of employees in each role who attribute impacts on control in their work environment to computing. Two interesting broad generalizations can be derived from these data. First, *the changes in work life caused by computing are widespread, but are not pervasive.* Rather, like descriptions of the half-full/half-empty glass of water, there are nine instances where the majority of employees within a role report no change due to computing and there are seven instances where the majority have experienced a change. In fact, it is most accurate to reformulate this generalization to emphasize that the incidence of change caused by computing varies considerably with the nature of the work impact. On two of the four impact measures, the majority in each of the four roles have experienced no significant impact of computing on their work environment. The large majority in every role (73-78 percent) find that computing has not altered the extent to which their work is supervised and most (54-68 percent) indicate that computing has not affected their capacity to influence others. In contrast, a majority within each of the four roles does report a notable impact of computing on the sense of accomplishment with their work and only the staff professionals (at 49 percent) fall below a majority among all roles in attributing changes in time pressure to computing.

It is intriguing that substantial majorities of employees, across all roles, report that computing has had no noticeable effect on supervision of their work or on their capacity to influence others. The images of the computer as an effective/pernicious device for careful and precise monitoring of work are prevalent from the early predictions about the impact of computers in organizations by Leavitt and Whisler to more recent ones by Pfeffer.[9] Why then has computing not altered the level of supervision of municipal personnel?

Our intensive case study fieldwork offers several explanations. While computing systems offer great potential for the collection of data on work performance that facilitate closer supervision, that potential has been only partially realized. For example, in situations where work was not monitored before automation, it tends not to be monitored after automation. When a new automated system is installed, managers have enough difficulty getting people to adopt and use the automated system, without adding objectionable monitoring features. Moreover, to this point there is an absence of computerized work monitoring systems with sufficient sensitivity to merit extensive use. Finally, many superordinates are disinclined to place reliance upon automated data as opposed to other kinds of information personally gathered in their supervisory functions.

It is also unexpected that so many of the employees who use computing feel it has not altered their capacity to influence others. Virtually all the literature on automated data systems predicts that these systems will importantly change the manner in which those in particular information-handling roles will access, manipulate, and utilize data and, as a consequence, that

TABLE 2
Effects on Work Environment Attributed to Computing by Municipal Employees, by Role[a]

Computing Effect Upon:	Managers (N=498)	Staff Professionals (N=321)	Street level Bureaucrats (N=343)	Desk Top Bureaucrats (N=286)
Supervision of work				
More closely supervised	17%	6%	18%	9%
No difference	78	78	73	78
Less closely supervised	5	16	8	13
Influence over others				
Less	2	3	3	4
No change	56	54	68	67
More	42	43	30	28
Time pressure				
Increased	22	34	19	37
Not affected	48	51	36	40
Decreased	29	15	45	24
Sense of accomplishment				
Lower	4	3	5	6
Not affected	44	46	40	42
Raised	52	52	55	51

[a]Respondents are 1,448 professional service workers in 42 American municipal governments who indicated that they use computers or receive computer-based reports and have had some contact with data processing personnel. Responses were from a self-administered questionnaire which included these questions:

As a result of computing, is your work more or less closely supervised?
(less closely supervised, no difference, more closely supervised)

Has computing given you more or less influence over the actions of others?
(less influence, no change, more influence)

Has computing increased or decreased time pressures in your job?
(decreased, not affected, increased)

Has computing increased or lowered your sense of accomplishment in your work?
(lowered, not affected, raised)

All questions also had a "Don't Know" response.

automated systems will lead to what Anthony Downs[10] termed "power shifts." Yet the majorities in each of the five roles report that computing has not altered their influence. The data actually do suggest a pattern of differential effects of computing on influence and we shall explore this more fully when we examine between-role differences below.

The second broad generalization that emerges from Table 2 is that *the effects of computing on work life are largely job-enhancing.* This is most evident on the overall measure of the impact of computing on the employee's sense of accomplishment. About half of those in every role find that computing has raised their sense of accomplishment on their job, while most of the rest indicate that computing has no effect. Similarly, while the majority in every role report that computer technology has not altered their capacity to influence others, nearly all those who have experienced an impact report that they have greater influence due to computing, ranging from 28 percent to 43 percent across the roles. Less than one in five employees in any role reports that computing has increased the level of supervision of their work. Even the impact of the computer on time pressure has been generally benign, with 64 percent to 81 percent reporting that computing either has not affected or has actually decreased the pressure they experience on the job. Overall, there is little support in these general measures for the view that computer technology, at least in its current modes of implementation and use, has been a dehumanizing or demoralizing force in the work life of professional service workers.

Between-Role Differences in Impacts of Computing on Work Life

A fuller understanding of these data on computers and the work environment can be achieved by an analysis of the between-role variations. Table 2 is useful for addressing this issue, and Table 3 adds precision to the assessment, identifying the between-group variations that are statistically significant, as determined by Chi square and Kendall's tau measures. Table 3 indicates all those instances where the distribution of effects attributed to computing by any two roles are significantly different on both statistical measures and it also identifies the role that has experienced the greater increase.[11]

Two broad findings are quite evident from the analysis of between-role differences in the impacts of computing on the work environment. First, there are no

TABLE 3
Significant Between-Role Differences in Effects on Work Environment Attributed to Computing[a]

	Staff Professionals	Desk top Bureaucrats	Street level Bureaucrats
Managers	← Supervision*** ↑ Time Pressure***	← Supervision*** ← Influence*** ↑ Time Pressure***	← Influence*** ← Time Pressure***
Staff Professionals		← Influence**	↑ Supervision*** ← Influence*** ← Time Pressure***
Desk Top Bureaucrats			↑ Supervision** ← Time Pressure***

[a]Table 3 indicates only those role pairings where the between-group difference is statistically significant for *both* the Chi square and the Kendall's tau b statistics, with the significance level for tau: ** = $p < .01$, *** = $p < .001$.

[b]Arrow indicates the role with the higher direction on the indicator—that is, the role at which the arrow points experiences relatively greater supervision; influence or time pressure attributable to computing.

significant differences between any two roles in the extent to which computing has altered the overall feeling of accomplishment with work. Since Table 2 indicates clearly that computing does raise the sense of accomplishment of most workers, this finding merely reveals the absence of systematic differences in such effects across role-types. The second broad finding is that computer technology produces substantial differential effects across roles on the other three aspects of control of the work environment examined in the analysis. Of the eight possible role pairings, there are significant between-role differences in five instances regarding time pressure, and in four instances regarding both supervision and influence. The subsequent paragraphs characterize these differences.

Supervision

Our hypotheses were guided by the assumption that the capabilities of automated systems are best suited to provide work-monitoring data and supervisory control over those whose work is most routinized and has standardized outputs amenable to quantitative measures of accuracy and workload. Thus, among our roles, we would expect the increases in supervision due to computing to be greatest for desk top bureaucrats, next greatest for street level bureaucrats, and least for staff professionals and managers. But Table 3 indicates that it is managers and street level bureaucrats who experience increases in supervision that are significantly higher than those for the other two roles.

We can suggest possible explanations for these rather surprising findings. It might be that employees in the most routinized information-processing work, the desk top bureaucrats, find that computerized systems now perform some of the more mechanical aspects of their work, reducing their responsibility for some kinds of data-handling errors, thereby reducing the need for close supervision of their work and perhaps even increasing the proportion of their time allocated to more discretionary activities. For example, Kraemer, Dutton, and Northrop[12] found that automation enabled clerical staff in traffic agencies to improve their accuracy in handling tickets and also increased their ability to provide discretionary services, such as sending reminder/delinquent notices to citizens.

In contrast to these desk top bureaucrats, computing might increase the level of supervision felt by street level bureaucrats because automated systems capture data that reduces the insulation of their activities in the field from those who monitor their performance. For example, patrol officers in the field are routinely assigned calls for service by computer-aided dispatchers who continuously monitor the status of the call until it is completed. When patrol officers stop a citizen or respond to a field situation on their own, they notify the dispatcher and further complete a field incident report, offense report or other report, which is placed on the automated data system. When patrol officers take a break they call in to the dispatcher at both ends of the break. Thus, the automated data systems of the police department contain a comprehensive and detailed portrayal of the patrol officers' activities. While the data in these systems is not routinely used to monitor individual performance, it can be used to reconstruct a detailed portrait of an individual officer's activities when something goes wrong. It is this ever-present surveillance and potential for performance assessment that might account for the patrol officers' feeling of increased supervision.

The increased supervision experienced by managers relative to other roles might be due to the greater access

to operational data about their departments' operations that computing provides to others responsible for centralized monitoring (top managers) and control of resource use (budget officers, finance managers). Support for increased supervision that computing can place on managers is provided by Markus's[13] study of a financial information system in a multi-divisional corporation, where a new automated system gave corporate managers greater control over divisional expenditures.

Influence

Table 3 indicates that on four of the eight role pairings there are significant between-role differences in the effects of computing on individuals' influence. As we expected, managers and staff professionals have enjoyed relatively greater increases in influence attributable to computing in comparison to those in the two "bureaucratic" roles. This seems to offer empirical support to the power shift hypothesis in the sense that those higher in the organizational hierarchy and in more policy-oriented roles seem to credit computing with affording them the greatest increases in influence.[14] However, this support is qualified by the fact that while power is normally viewed as a zero-sum phenomenon, no more than one in 20 employees in any role felt that their influence over others had been reduced by computing (see Table 2). It might be that the power "losers" are in roles other than those in our analysis or that the losers do not recognize their loss. Alternatively, influence can be viewed as a form of power that need not be zero-sum.[15] From this perspective, when computing has had any notable effect, it has been influence-enhancing, especially for those in more discretionary, policy-oriented roles.

Time Pressure

Time pressure is the dimension of work life in our study where the effects of computing produce the greatest variation within and across roles. Although the changes in time pressure are most prevalent among the two bureaucratic roles, the directions of change are not fully consistent with our hypothesis. Along with desk top bureaucrats, staff professionals also report increased time pressure rather than decreased pressure by ratios of about 2:1. As expected, managers are more likely to experience decreased time pressure due to computing; but the street level bureaucrats experience the highest incidence of decreased pressure, by a ratio of more than 2:1. This last point is underscored in Table 3, where the street level bureaucrats report decreased time pressure significantly more often than any other role. And managers enjoy reduced time pressure relative to the two remaining roles. One can, of course, reverse this characterization, observing that desk top bureaucrats and staff professionals experience work effects from computing that tend to increase time pressure much more frequently than street level bureaucrats and managers.

As with the effects of computing on supervision, we find the unexpected grouping of managers and street level bureaucrats versus the other two roles. In this case, our fieldwork suggests that the best explanation of this particular pattern of impacts on work lies in the dominant styles of data handling that characterize the different roles. Managers and street level bureaucrats are essentially *users* of automated data, and this use tends to be indirect (that is, mediated by others) and occasional (that is, on a periodic or case-by-case basis). For example, the patrol officers who comprise part of the street level bureaucrats in our sample require rapid, straightforward fact retrieval in response to a field incident such as a speeding driver. In such situations, they obtain specific information by radio from headquarters dispatch staff who search computerized files for them. Since patrol officers can only detain citizens for a limited time, the rapid response provided through a computerized information system can actually decrease the time pressures that officers feel.[16]

In contrast, the incidence of increased job pressure from computing occurs among staff professionals and desk top bureaucrats—role-types who are not only users, but also generators and manipulators of considerable amounts of data amenable to automation. These roles are more likely to be involved with computing directly and on a frequent basis. For example, the work of such desk top bureaucrats as departmental bookkeepers and traffic clerks is dominated by data-handling activities, and they are likely to have substantial "hands-on" involvement with computers and computer-generated data. For those working in such roles, the automated system can increase time pressure in a variety of ways—by increasing the demands for more extensive and timely data entry, by expanding the amount of data that must be considered on a given task, and, where interactive systems are used, by forcing the user to conform to the rhythms of the automated system. Such intensification of information processing tasks can substantially increase the time pressure experienced by an employee.

Discussion and Conclusions

In assessing the array of data and findings above, several general conclusions are quite apparent. The first overall conclusion is that, for the public employees in our analysis, computing has not yet caused the kinds of dramatic impacts on the work environment that have been suggested in the previous studies. In Table 2, the modal response was no change/no effect attributed to computing in 11 of the 16 pairings of a role with a feature of the work environment. In fact, the majority in *every* role reports no change due to computing on the key issues of control of work by others and control over others in the work environment. The modal response on the effect of computing on time pressure is no change for every role except street level bureaucrats.

A second general conclusion, qualifying the first one, is that computing has had notable effects on some aspects of the work environment. The majority of those in all four roles have experienced a change they attribute

to computing in their sense of accomplishment with work, and a majority in three of the four roles report such changes on time pressure. Substantial minorities in several roles also report that computing has altered their capacity to influence others. Finally, a third general conclusion is that where computing has altered the employee's control in the work environment, the change tends to be job-enhancing. In 12 of the 16 cases, the proportion within a role experiencing a favorable change due to computing is greater than the proportion reporting a negative effect.

. . . computing will enhance control of work life in relation to other individuals and in relation to the job for those employees who are higher in the organizational hierarchy and who perform more discretionary information processing tasks. . . .

When we consider the working hypotheses summarized in Table 1, we find that the data in this analysis constitute a strong case against those hypotheses. That is, if the positive and negative signs in the table imply that a majority of those within the given role would attribute to computing the particular change in the work environment, the predictions in the table are supported (by the data in Table 2) in only two of 16 cases—namely, computing results in a greater sense of accomplishment with work for the majority of managers and staff professionals. Moreover, even if we examine only those employees who report that computing has altered a particular aspect of their work life, our initial expectations about the direction of the effect of computing are supported by the data in only eight of 16 cases.

Since Table 1 was informed by the existing research, what might account for the variance between our expectations and reality? One might argue that the flaws are inherent in our sample or methodology, although we believe this explanation is unsupported. We are more sympathetic to the notion that the existing research does not provide a strong basis for generating hypotheses, since it is rarely characterized by systematic and empirical comparative analysis. Indeed, that research and the conventional wisdom resulted in several assumptions that were not supported by our analysis.

First, we assumed that the impacts on work would vary considerably across roles, with some roles experiencing quite positive effects from computing and others experiencing negative effects. As we have noted, this was true for the measures of supervision and time pressure, where changes were positive for some roles and negative for others; but it was not true for the measures of influence and sense of accomplishment, where all four roles indicated that changes were essentially positive. Secondly, we assumed that the pattern of directionality in the changes would be hierarchical, in the sense that the distribution of effects from computing would scale from those roles higher in the organization and with greater job discretion to those roles lower in the organization and with less job discretion. In fact, the data in Table 3 provide a strong case that there are clusters of roles within which rather similar patterns of effects from computing are reported. Moreover, these clusters are composed of different roles on different aspects of control in the work environment. These varying clusters were characterized for each aspect of control in the work environment in our explication of Table 3. Is there an underlying structure in these intriguing and somewhat surprising patterns of effects of computing on the work environment?

While the absolute levels of computing effects on control in the work environment serve as the base for discussing this question, we stress the *relative* effects between roles in order to focus attention on the differential impacts of computing on work. Two different clusters of roles emerged in the between-role analyses in Table 3. When the issue is the employee's control over others, as measured by the level of influence, managers and staff professionals enjoyed greater increases in control attributed to computing than did those in any of the two "bureaucratic" roles. However, when the issue is the control of the employee by others, as measured by the level of supervision, or when the issue is control by the work context itself, as measured by time pressure, the impacts of computing on managers and street level bureaucrats are similar and vary significantly from the impacts of computing on staff professionals and desk top bureaucrats. Broadly, the latter two roles experienced relatively less supervision due to computing and relatively greater time pressure due to computing than did those in the former roles.

Table 4 displays this pattern of relative effects of computing on work for the four roles. Broadly, it shows that one dynamic seems to account for the effects of computing on influence and another for its effects on supervision and time pressure. The configuration of similar roles on influence over others is generally consistent with our initial notion that the effects of computing on control would be contingent on the role's level in the organizational hierarchy. Moreover, this is the one case where the pattern hypothesized in Table 1 is at least loosely confirmed. We infer that those in roles higher in the hierarchy do experience relative increases in influence as computerized systems increase their capabilities for accessing, analyzing, and utilizing data relevant to organizational problem-solving, decision-making, and action. With regard to changes in influence, it should be recalled that few in any role reported that computing had actually reduced their control over others. Thus, we have argued that computing seems to expand the influence "pie" or, at least, it seems to approximate a Pareto optimal situation where some perceive they are better off and few/none perceive they are worse off. But it is also clear that computing has particularly enhanced the control over others of those already in positions higher in the organizational hierarchy, lending some support to the view that computing is a power-reinforcing technology.[17]

To account for the role clusters on supervision and time pressure, Table 4 suggests that a second dimension of each role might be crucial. This dimension focuses upon key characteristics of the dominant data-handling

TABLE 4
Summary of Findings About Relative Impacts of Computing on Control of Work

Autonomy in the organization's hierarchy	Pervasiveness of data-handling in work[a]: High	Pervasiveness of data-handling in work[a]: Low	*ACTUAL IMPACTS*[b]
High	Staff Professionals	Managers	*+ Influence over others*
Low	Desk top bureaucrats	Street level bureaucrats	*– Influence over others*
ACTUAL IMPACTS	*– Supervision of work by others* *+ Time pressure*	*+ Supervision of work by others* *– Time pressure*	

[a]High means that data-handling tends to be direct, multi-modal, and continual; low means that data handling tends to be indirect, use-oriented (relative to generation and manipulation), and intermittent.

[b]Impacts are those effects on control of work attributed to computers. The table indicates those roles which have experienced an impact in a significantly different pattern than the roles with which it is contrasted.

responsibilities associated with the role. Our earlier explanations of why these role clusters emerged on supervision and time pressure tended to emphasize the different patterns of data-handling in each cluster. Managers and street level bureaucrats tend primarily to be users of the kinds of data amenable to automation, tend to use such data on an intermittent or case-by-case basis, and tend to gain access to such automated data through intermediaries. In contrast, such data handling for staff professionals and desk top bureaucrats is likely to be far more pervasive in their work. These roles tend to be not only users but also generators and manipulators of the kinds of data in automated systems; they tend to work directly with computers and computer-based data, and such data-handling is a continual feature of their work.

Computing systems are an increasingly crucial force in the work environment of those for whom data handling is a pervasive job characteristic. The technology can affect and even control the scale and rate of information-processing demands and pressures on the employee. Continual and multi-modal data-handling responsibilities as well as direct involvement with computing are all important factors that tend to increase the time pressure associated with work. In contrast, managers and street level bureaucrats in the field tend to be buffered from the pressures resulting from continuous and direct involvement with computers; rather they tend to enjoy mainly the job benefits from requesting and receiving from others the timely and relevant information they desire from automated systems.

The data-handling characteristics of the different roles also provide a partial explanation for the role clusters on the effects of computing on work supervision (although it is important to note that the majority in every role indicate that computing has not altered the level of supervision of their work). Since the work of those in roles where data handling is more pervasive, particularly the desk top bureaucrats, seems most suited to automated work monitoring systems, it is surprising that these groups were more likely to experience *reduced* supervision due to computing than managers or street level bureaucrats. We suggested that for those whose work is high in data handling there are computerized systems that can fulfill many of the routine calculating, printing and record-keeping tasks which previously required particularly close supervision regarding accuracy and speed. Indeed, by automating such tasks, computing might reduce not only the closeness of supervision required, but also the proportion of the employee's work time devoted to the non-discretionary activities where supervision is appropriate. Ironically, it is possible that computing might result in the greatest increases in supervision of those whose work was traditionally insulated from effective data-based monitoring. The relevant examples for our analysis are the role of computing in the supervision of managers by centralized controllers using the data in automated resource utilization systems and the capture and analysis in computerized systems of performance data about street level bureaucrats whose work was previously buffered from direct supervision because it occurred in the field.

In assessing the "net" effects of computing on control for each role, Table 4 illuminates the fact that no single role has uniformly gained greater control over the work environment as a result of computing. Clearly, the employees in each role have experienced a mix of positive, neutral and negative control impacts. The table does suggest that computing has particularly benefitted the staff professionals on the most crucial components of control in the work place. Staff professionals are the only group who have enjoyed both relative increases in

their control over others (influence) and also relative decreases in control by others (the level of supervision) of their work. The data on the impacts of computing in Table 2 are consistent with this interpretation that staff professionals have enjoyed the greatest control benefits. Staff professionals credited computing with more favorable effects on sense of accomplishment than any other role, they reported the lowest level of increased supervision of any role, and they were the role where the highest percentage attributed increases in influence to computing. Only in terms of increased time pressure did staff professionals report a net negative effect from computing.

In fact, it is most accurate . . . to emphasize that the incidence of change caused by computing varies considerably with the nature of the work impact.

These beneficial effects of computing for staff professionals regarding control over others and control by others are in accord with the predictions by Downs and Lowi[18] that an "information elite" would gain increased control from the expanding use of computers within the organization. The "information elite" combines a high level of technical expertise in their organizational domain with some sophistication in the use of computers and/or computer-based information. Given their organizational position at the center of the policy process, these capabilities enable the information elite to influence, and possibly even to dominate, the nature of policy definition, policy formation, and policy implementation.[19]

The information elite in our sample is primarily composed of such municipal employees as policy analysts, planners, and high-level management and budget analysts. These groups of technically skilled specialists provide increasingly sophisticated information services to the organization. Although they are dispersed among different organizational subunits, they tend to share basic norms regarding professional standards of practice and the role that technical expertise ought to play in guiding decisions and actions. Staff professionals, as an information elite, are particularly likely to gain increased control as the role of computing expands within the work environment because this elite serves as the effective broker between the computer elite who provide data processing services and the policy-makers and managers who need to tap the extensive capabilities of automated information systems. The information elite gains control over others (influence) and resists control by others (supervision) by a combination of persuading others through the force of their data- and information-based arguments and of serving others as an effective information broker whose competencies are essential.

These findings regarding staff professionals seem especially significant because they are one of the first (if partial) confirmations in a systematic, empirical analysis of the prediction that computer technology will enable an information elite to reap the greatest increases in control within organizations. It is possible that, over time, the spread of computer literacy and of "user-friendly" computer systems will reduce the relative advantages of the information elite. But the advantages of this elite in the near-future seem considerable, and they might continue for quite a long period. Consequently, empirical research on the distribution of control within organizations and on the rise of technocratic elites might well focus on the nature of information elites. In particular, it is important to determine whose interests and agenda will be best served by the actions of the information elite.

Notes

1. The employees in our analysis range from department heads to police patrol officers, and thus include a broader range of professional service workers than is normally considered "white collar." In fact, the concept of white collar workers has lost much of its precision due to dramatic changes in the work force, and it is no longer an official designation of the U.S. Bureau of Labor Statistics. Under the new B.L.S. classification, our sample includes three of the six categories: managerial and professional specialty; technical, sales and administrative support; and service occupations.
2. AnnaBelle Sartore and Kenneth L. Kraemer, "Part III: Research on Impacts of Computers on Local Government Personnel and Organization," in Kenneth L. Kraemer and John Leslie King (Eds.), *Computers and Local Government: Volume 2, A Review of the Research* (New York: Praeger Publishers, 1977), pp. 129-190.
3. Ida Hoos, "When the Computer Takes over the Office," *Harvard Business Review,* Vol. 38 (July/August 1960), pp. 102-113; H. C. Lee, "Electronic Data Processing and Skill Requirements," *Personnel Administration,* Vol. 29 (May/June 1966), pp. 365-370; Floyd C. Mann and Lawrence K. Williams, "Organizational Impact of White Collar Automation," *Annual Proceedings of Industrial Relations Research Associates* (1958), pp. 59-68; Enid Mumford and O. Banks, *The Computer and the Clerk* (London: Routledge & Kegan Paul, 1967).
4. Rob Kling, "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research," *Computing Surveys,* Vol. 12 (March 1980), pp. 61-110.
5. Rob Kling, "The Impacts of Computing on the Work of Managers, Data Analysts, and Clerks" (Irvine, Calif.: Public Policy Research Organization, 1978); Rosemary Stewart, *How Computers Affect Management* (Cambridge, Mass.: MIT Press, 1971).
6. William H. Dutton and Kenneth L. Kraemer, "Management Utilization of Computers in American Local Governments," *Communications of the ACM,* Vol. 21 (March 1978), pp. 206-218; Art Guthrie, "Attitudes of the User-Managers towards Management Information Systems," *Management Informatics,* Vol. 3 (1974), pp. 221-232; Kling, *op. cit.;* Kenneth L. Kraemer, "Computers, Information, and Power in Local Governments," in A. Moshowitz (ed.), *Human Choice and Computers,* Vol. 2 (1980), pp. 212-235; Kenneth C. Laudon, *Computers and Bureaucratic Reform* (New York: Wiley, 1974); Enid Mumford, *Job Satisfaction* (London: Longmans, 1972); Thomas Whisler, *The Impact of Computers on Organizations* (New York: Praeger, 1970).

APPENDIX 1
Distribution of Respondents by Role Type

Job Title	Manager	Staff Professional	Street level Bureaucrat	Desk top Bureaucrat
Department Head	288			
Division Head	137			
Division Supervisor	47			
Police Manpower Allocation Analyst		39		
Central Budget Analyst		59		
Accountant		70		
Mayor/Council Staff		29		
CAO Staff		49		
Planning Staff		75		
Police Detective			179	
Police Patrol Officer			164	
Departmental Administrative Assistant				84
Departmental Bookkeeper				52
Police Records Clerk				36
Traffic Ticket Clerk				114
TOTAL	498	321	343	286

7. Richard Hackman and Greg Oldham, "Development of the Job Diagnostic Survey," *Journal of Applied Psychology,* Vol. 60 (April 1975), pp. 159-170.
8. Our analysis of the 42 cities was part of an extensive, multi-phase research project. On the basis of a first phase survey of all American municipalities with population greater than 50,000, the 42 were selected for intensive field research. The selection was guided by the objective of analyzing alternative configurations on key aspects of the provision of computer technology. A variation of a disproportionate stratified sampling technique was employed, locating each of the 403 municipalities in the appropriate cell of a 64-cell, partitioned sample based on six dichotomized variables measuring computing provision. The individual municipalities for field research were selected randomly from within a balanced set (on the six variables) of 40 strata. For the purposes of this analysis, the cities are somewhat more "developed" with regard to computing than a purely random sample of cities. Given computng expansion and evolution in the subsequent period, the local governments we studied are not untypical of most such governments today.

   During the one to six person-weeks of field research in each of the 42 sites, we undertook multiple data-gathering strategies including numerous interviews, collection of objective measures of the government and the computing environments, and the distribution of 50-100 lengthy self-administered questionnaires to potential users of computer services. Respondents were selected initially on the basis of certain roles in the government that would cover all seven "information processing tasks" which might be automated. Specific respondents were selected randomly from lists of all employees within the given role. Of 3,222 questionnaires distributed, the overall response rate was 82 percent. In this paper, we have analyzed that set of the respondents who met the crucial criteria for our research interests: (1) being classified in one of the four role-types upon which we focus; (2) reporting that they have used computers or computer-based information and that they have had some contact with data processing personnel. Appendix 1 indicates the respondents in each role-type in our analysis. For a complete discussion of the methodology of the URBIS Project, see Kenneth L. Kraemer, William H. Dutton, and Alana Northrop, *The Management of Information Systems* (New York: Columbia University Press, 1981); or James N. Danziger, William H. Dutton, Rob Kling and Kenneth L. Kraemer, *Computers and Politics: High Technology in American Local Governments* (New York: Columbia University Press, 1982).
9. Harold J. Leavitt and Thomas L. Whisler, "Management in the 1980s," *Harvard Business Review,* Vol. 36 (November/December 1958), pp. 41-48; Jeffrey Pfeffer, *Power in Organizations* (Marshfield, Mass.: Pitman Publishing Co., 1981).
10. Anthony Downs, "A Realistic Look at the Payoffs from Urban Data Systems," *Public Administration Review,* Vol. 27 (May/June 1967), pp. 204-210.
11. Since one variable is ordinal, and the other dichotomous, Kendall's tau seems a reasonable choice for the most appropriate statistical measure of covariation. The Chi square statistic was also utilized since one might argue for a more conservative approach, treating the role-type dichotomy as a nominal variable. Alternatively, one might treat both variables as interval measures (not unreasonable, since dichotomous variables can be analyzed as interval measures and since the computing effect variable has a positive/zero/negative form) and employ Student's T statistic. Interestingly, the set of significant relationships is virtually iden-

tical in all three approaches. For assessing the actual strength of the covariation, the tau betas are presented:

	Staff Professionals	*Desk Top Bureaucrats*	*Street Level Bureaucrats*
Managers	Supervision −.22 Time Pressure .19	Supervision −.11 Influence −.14 Time Pressure .13	Influence −.13 Time Pressure −.14
Staff Professionals		Influence −.14	Supervision .19 Influence −.13 Time Pressure −.33
Desk Top Bureaucrats			Supervision .12 Time Pressure −.27

12. Kraemer, Dutton and Northrop, *op. cit.*
13. Lynne M. Markus, "Understanding Information System Use in Organizations: A Theoretical Approach" (unpublished Ph.D. dissertation, Case Western Reserve, Cleveland, Ohio, 1979).
14. Danziger, Dutton, Kling, and Kraemer, *op. cit.;* William H. Dutton and Kenneth L. Kraemer, "Technology and Urban *tion and Society,* Vol. 9 (November 1977), pp. 304-340; Kraemer, *op. cit.*
15. *Franz Neumann, "Approaches to the Study of Political Power," Political Science Quarterly,* Vol. 65 (June 1950), pp. 162-188.
16. Kraemer, Dutton, and Northrop, *op. cit.*
17. Danziger, Dutton, Kling, and Kraemer, *op. cit.*
18. Downs, *op. cit.;* Theodore Lowi, "Government and Politics: Blurring of Sector Lines," in *Information Technology: Some Critical Implications* (New York: The Conference Board, 1972).
19. Danziger, Dutton, Kling, and Kraemer, *op. cit.*

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