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Automating the Public Sector and Organizing Accountabilities

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Abstract:

In this paper we examine the ways in which implementing new information and communication technologies (ICTs) to automate public sector processes affects accountability. New technologies alter conventional modes of behavior in the public sector, shedding light on certain areas of bureaucratic practice and obscuring others, and in doing so they enhance accountability and exacerbate dysfunctions. To investigate how ICTs influence the accountability equation, we explore a range of empirically documented e-government implementations, from simple transactions involving low-levels of automation to highly automated systems such as fingerprint analysis technologies. Drawing on these empirical examples, we develop a tentative framework of ICT-exacerbated accountability dysfunctions. Following this, we then discuss potential accountability arrangements for different types of e-government processes, in hope of realizing the benefits of new technologies while minimizing the potential for unaccountability and dysfunction that could arise from their application. Throughout, we stress the necessity of striking a balance between the potential benefits of ICTs to the bureaucratic process and systems that may reduce efficiency but uphold accountability.

Keywords: Accountability, automation, decision-making, dysfunction, e-government, information and communication technologies (ICTs), open source, public sector

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I. INTRODUCTION

Public sector bureaucracies are fundamentally socio-technical information processing systems, with information storage, communication, and manipulation at the heart of their activities [Dunleavy et al. 2006, pp. 10–12]. The central role of information processing to the operation of the bureaucracy is an important reason why ICTs are thought to bring increased efficiency, effectiveness, transparency, and accountability to the public sector—reducing corruption, improving service provisions, and democratizing the bureaucracy [Bellamy and Taylor 1998; Fountain 2001; Layne and Lee 2001; Moon 2002; Silcock 2001; Weare 2002; West 2005].

While often efficient and technically beneficial, the introduction of ICTs can significantly affect existing practices within the public sector and in doing so raise important accountability issues. The British government's continued pursuit of a biometric-based identity scheme for foreign visitors and citizens is a potential case in point. The presumed technological benefits of the scheme have yet to be adequately reconciled with the myriad of privacy and accountability problems they engender, including the real possibility of frequent fingerprint enrollment failures and false matches. The difficult questions of how to manage the new accountability problems that emerge when such systems are implemented have been lost in public debates surrounding the scheme, which often focus on costs and missed deadlines.

In this piece we examine several cases of ICT implementations in the public sector (also known as e-government) to reflect on the interaction of ICTs with public sector accountability processes. In particular, our analysis highlights some problematic aspects, not to dismiss the potential positive benefits, but rather to uncover how new technologies can affect the conventional modes of behavior that then impact on accountability arrangements. The analysis will show that these technologies do not necessarily enhance accountability; rather they shift and redistribute responsibilities, enhancing accountability and exacerbating dysfunctions simultaneously. If we can better understand this dynamic and identify challenges and threats to accountability, we will be better placed to improve future ICT interventions in the public sector.

With this paper we aim to contribute to the development of a general conceptual framework with which to consider the potential of ICT in the public sector. The paper proceeds as follows. In the following section, we introduce the core concepts of accountability and how ICTs are theoretically implicated in public sector accountability. In Section 3, we present a tentative framework that draws from the empirical examples to structure our view of where and how the introduction of automating technologies appears to exacerbate accountability dysfunctions in the public sector. In Section 4, we consider empirical examples of various public sector ICTs—from simple e-services to more complex ones that automate decision-making—with a focus on how accountability processes are altered, shifted, improved, and compromised by ICTs. Then, in Section 5, we discuss some potentially appropriate accountability arrangements depending on the characteristics of the e-government implementation and other aspects of the broader socio-technical context.

II. PUBLIC SECTOR ACCOUNTABILITY

Accountability is central to the human experience and participation in social life [Willmott 1996, p. 23]. It is a social mechanism, “in which an actor feels an obligation to explain and to justify his or her conduct to some significant other” [Bovens 2005, p. 184]. As such, this mechanism has become an increasingly central feature of governance in modern democracies [p. 182]. Holding people and institutions accountable for their actions and decisions is a fundamental element of the checks and balances around which public sector institutions are organized. Accountability helps ensure that the democratic contract between government and the people is fulfilled [Barata and Cain 2001, p. 248]. Organizing the public sector such that account-giving is enforced thus requires that institutions make and maintain certain accountability arrangements.

Accountability Arrangements in Democratic Institutions

There are many forms of accountability in the public sector: senior management is accountable for their organizations, the judiciary is accountable for the fair implementation of the law, and professionals are accountable to peers. Funding bodies demand financial accountability and citizens demand public and political accountability from elected and bureaucratic branches of government [Heeks 1998]. Note that it is not just individuals, but also groups and institutional actors such as government agencies or corporations that can also be held to account [Johnson 2001, p. 173]. These different types of actors give account to specific fora, such as funding bodies, peers,

and a more diffuse forum like the public. The process of account-giving can be structured by informal norms, laws, rules, protocols, technologies, and other elements. We call the particular configuration of these elements *accountability arrangements* [Schillemans 2007]. Accountability arrangements are explicitly or implicitly configured to enable accountability processes.

The different kinds of accountability arrangements have one thing in common: they serve the instrumental purpose of structuring social organizations according to a set of values. Public accountability arrangements, for instance, are institutionalized to enable a form of democratic control to enhance integrity and legitimacy, improve performance, and provide a cathartic vehicle in the event of tragic incidents or failures [Bovens 2005]. Moreover, in democratic societies, public accountability is motivated by core values that dictate how society should be organized [Grimsley and Meehan 2007; United Nations 2003]. Public sector institutions have a moral responsibility with regard to public welfare. This responsibility, as well as the responsibilities that follow from it, can be interpreted in many different ways, depending on the specific values of each society. These values can include the promotion of equality, justice, liberty, quality of life, security, and freedom; as well as performing in an efficient and effective manner. These values shape the expectations of the forum to which an actor gives account.

In this paper we focus on two essential features of accountability processes: information provision and human discretion. A forum evaluates and judges the actions of the actor according to its expectations and based on information provided and obtained. Scholars identify three stages of an accountability process: the information provision stage, the debating stage, and the judgment stage [Bovens 2005; Elzinga 1989; Schillemans 2007]. In the debating stage the forum weighs the information and can sometimes ask for more information. Information provision is thus a core element of any accountability process. Besides the exchange and representation of information, accountability processes also require some form of human discretion. The obligation to account for one's performance implies a responsibility relationship; an actor that has no formal, causal, or moral responsibility in acting or deciding cannot be held accountable. An actor can be held accountable only for an action that involves an intentional choice as well as the knowledge, capacity, resources, and ability to act appropriately [Eshleman 2008].

Accountability Dysfunctions

Bovens [2005] identifies five functions of public accountability: democratic control, integrity, improvement, legitimacy, and catharsis. While judiciously applied accountability can bring positive benefits to public governance, too much emphasis on accountability can lead to dysfunctions. For example, excessive democratic control squeezes discretion out of the hands of public managers and can result in rule-obsessed bureaucracies. Or, more transparency might reveal more blemishes of public sector governance, effectively lowering legitimacy despite potentially improved behavior [O'Neill 2002]. These dysfunctions emerge from the "inherent and permanent tension between accountability and effective performance" [Bovens 2005, p. 194].

III. ICTS AND PUBLIC SECTOR ACCOUNTABILITY ARRANGEMENTS

Given the centrality of information flows and discretion to accountability, it is no surprise that introducing ICTs into the public sector necessitates the development of new accountability arrangements. We view ICTs as not just a range of information processing and communicating technologies, but as part of a larger socio-technical system composed of humans, technologies, practices, knowledge, values, and responsibilities. Consequently, the introduction of ICTs will not only take over tasks previously done by humans but can also redistribute tasks, responsibilities, and accountabilities [Collins and Kusch 1998].

ICTs affect accountability arrangements in the public sector through a variety of means. A much heralded property of ICTs is the potential they offer for enhancing transparency in bureaucratic processes. It provides new potential channels of information flow and lines of reporting that were not possible before. For example, new channels of downward communication can be opened [Weare 2002] to empower citizens to monitor government [Wong and Welch 2004]. Examples of relevant information provision include public sector performance, information on rules and activities [Bhatnagar 2004], policies, and policy intentions [Gelders 2005]. Yet, the increased provision of information does not guarantee an improvement in accountability. The effectiveness of transparency is dependent upon the quality, veracity, completeness, and timeliness of the information [Gelders 2005]. Information provision mechanisms are only as good as the information going in; "garbage in, garbage out," as the saying goes. The quality of input information is influenced by several factors, including human data entry, the motivation for collecting data, and the type of activities being represented that may or may not be easily or accurately codifiable or interpretable.

ICTs also shape the limits of human discretion, and thus affect the extent to which accountability can be exercised. In the public sector, the automation of decision-making processes can be used to remove biased human discretion, in favor of "impartial" or "objective" algorithmic processes. At the same time, however, it creates new opportunities for people to have discretion in decisions at other stages of the development, implementation, and use of the

technology. The negative side effect of this is that increasingly complex automation can obscure the lines of responsibility, compromising accountability processes.

Of course, not all e-government implementations are oriented toward accountability. For example, simple e-service transactions, such as online driving license renewal, are implemented to reduce bureaucratic cost and make the user experience more convenient. Nevertheless, these implementations too can affect accountability processes in the same way.

Public Sector Accountability Dysfunctions Through ICTs

The central thesis of this paper is that the implementation of ICTs in the public sector does not just contribute to the functions of accountability, but that they might exacerbate some of the accountability dysfunctions and make them more visible. Technologies work like built-in procedural accountability mechanisms in that they shape, constrain, or remove human discretion from certain key decision phases, and they structure information provision processes. Drawing from relevant literature we suggest that applied excessively, this could lead to extreme forms of rule-obsession, proceduralism, rigidity, and an unproductive shirking of responsibility in the public sector (see Table 1). Note that this is not meant as a definitive classification, but rather as illustrative of potential accountability dysfunctions exacerbated by technology. In this sense the framework is an attempt at “conceptual ordering,” which comes before full-blown theorizing.¹

Table 1: Conceptually Ordering Potential Automation-Exacerbated Accountability Dysfunctions, adapted from [Bovens 2005, p. 194]

Functions of accountability	Dysfunctions	Automating ICT and public sector dysfunctions
Democratic control	Rule-obsession	Output-obsession
Integrity	Proceduralism	Encoded-proceduralism
Improvement	Rigidity	Encoded-rigidity
Legitimacy	Politics of scandal	Blame the technology (Politics of blamelessness)
Catharsis	Scapegoating	Blame the technology (Sacrifice the system)

Output-Obsession

Borgmann [1984] argues that technology makes a commodity out of reality. Technology prioritizes the production of outcomes and hides the underlying processes from view. “In a device,” he argues, “the relatedness of the world is replaced by a machinery, but the machinery is concealed, and the commodities, which are made available by a device, are enjoyed without the encumbrance of or the engagement with the context” [Borgmann 1984, p. 47]. Indeed, Borgmann presciently noted as early as 1984 that as computers become more widely used and increasingly “friendly,” they simultaneously become increasingly unknowable to pedestrians and professionals alike.

This focus on outcomes over process takes the rule-obsession dysfunction and transmutes it into an equally dysfunctional output-obsession, where the output of the computer process cannot be questioned and is endowed with the ultimate authority. Underlying such output-obsession is a tacit complaisance: users trust computers to produce the “correct” information and to do so in an “objective” manner. This is witnessed with the increasing reliance on quantitative decision criteria [Anderson 2004].

Encoded-Proceduralism

Too much emphasis on integrity and corruption control can cause civil servants and public managers to fall back on formal procedures to avoid responsibility and accountability. This can undermine the effectiveness and efficiency of public organizations. Moreover, civil servants can effectively lose the ability to balance procedures with public values and the nuances of each contingent situation, when they adhere too strictly to the procedures.

¹ “Conceptual ordering is the organization of data into discrete categories according to properties and dimensions.... Researchers attempt to make sense out of their data by organizing them according to a classificatory scheme. The chief reason to discuss conceptual ordering is because this type of analysis is a precursor to theorizing” [Corbin and Strauss 2008, pp. 54–55].

The implementation of ICT can contribute to the risk of proceduralism. Fundamentally, the drive to automate and rationalize the public sector through ICTs is part and parcel of the techno-rational Weberian bureaucratic ideal—they are the “zenith of legal rational authority” [Bovens and Zouridis 2002, p. 181]. Bureaucracy defines roles and positions with assigned responsibilities and practices, including discretion. As the operating procedures are embedded in the system, they can become more rigid and more highly rationalized than manuals or supervisors could be [Fountain 2002, p. 130]. Too heavy a reliance on these encoded computer procedures can compromise the effectiveness of public sector organizations as it, for example, constrains civil servants in acting on broader societal norms in contingent circumstances.

Encoded-Rigidity

The encoding of procedures thus also results in encoding rigidity. In new systems, many simple encoded processes may be able to deal with a majority of cases without serious incident. However, as the process becomes increasingly rigid, the ability to take contextual variations into account becomes limited, especially those that were not originally conceived to be important [Bovens and Zouridis 2002, p. 182]. Furthermore, such a situation becomes harder to change as it requires altering the software, although the difficulty depends on the complexities of the particular system. In the extreme case of legacy systems, the ability to alter the pre-existing software is severely limited. Thus, after the development of a system, the embedded rigidity can make it difficult to engage in organizational learning and development to improve performance with respect to those embedded processes.

Blame the Technology

The problems of the increasing automation of decision-making processes underline that the introduction of ICTs in the public sector implicates designers, as well as policy makers, in the displacement of accountabilities. In her paper on accountability in computerized societies, Nissenbaum warns that “the conditions under which computer systems are commonly developed and deployed, coupled with popular conceptions about the nature, capacities, and limitations of computing,” can create barriers to accountability [Nissenbaum 1997, p. 43]. The tendency to use the computer as a scapegoat is one of them. Nissenbaum goes on to note how the shift in accountability from the front-line bureaucrat to the software engineer, whose role does not include the responsibility to answer to the citizen, leaves an accountability void.

The tendency to blame the technology has other psychological roots besides the desire to pass the buck. As computers increasingly automate, users are encouraged to attribute a kind of decision-making capacity to the computer that sits uncomfortably with the practical implementation of responsibility and accountability in daily life [Johnson 2006; Nissenbaum 1994].²

Of course, these dysfunctions can interact and reinforce themselves. Output-obsession and encoded-proceduralism are often precursors to blaming the technology and ducking responsibility. Indeed, as encoded procedures become increasingly autonomous and opaque, who or what can one blame but the technology?

IV. AUTOMATING ICTS AND ACCOUNTABILITY IN THE PUBLIC SECTOR: EMPIRICAL CASES

In this section, we explore the relationships between ICTs, accountability arrangements, and dysfunctions through a comparative analysis of different types of e-government implementation. To enable this exploration, we have chosen to focus on a small subset of e-service cases that illustrate a range of changes to accountability arrangements and, at times, the emergence of dysfunctions. The sample is meant to be illustrative rather than comprehensive as we seek to highlight and understand the dynamics of potential areas where accountability may be threatened and where dysfunctions might emerge.

To improve the cross-case comparison, we categorize the cases into two subgroups: low and high automation. Not all ICT implementations automate to the same degree. Sheridan [1992] developed an automation framework (see Table 2) that provides an informative overview of the different nuances in the degrees of automation. Sheridan’s framework provides a starting point to consider how varying levels of automation affect discretion, transparency, and responsibility. This 10-point scale illustrates the incremental levels of control that can be shared between the human operator and computers. At the lower levels of automation (1–4), the human operator makes all the decisions and

² When grave errors have occurred—especially massive failures in technology—rejecting technology is a popular cathartic method. Three Mile Island and Chernobyl initiated a generation of antinuclear activists, the effects of which are still felt today in contemporary energy policy debates. The dysfunctions of the e-voting machines in the US have led legislatures in many counties to turn back to paper based techniques, although the election experiences in Florida in 2000 brought even that into question. Ultimately, the political scapegoating of technology can be just as dysfunctional as that of scapegoating people. It also means that there might be a tendency to overlook potentially beneficial solutions to problems because of their association with particular technologies.

takes all the discretionary actions; the computer makes no decisions itself. As automation increases, human decision-making opportunities are constrained by the actions of the computer, ranging from offering a set of complete decision/action alternatives to providing a narrow selection of choices. The more a system is capable of collecting, analyzing, interpreting, and acting on information—be it sensory information or explicit symbolic representations of knowledge—the more autonomous the system is considered to be. Higher levels of automation (5–10) are then attributed to those automated systems (machines or computers) that are left to perform tasks on their own, and have the authority over these processes; i.e., humans have a reduced need and ability to intervene. By separating the cases into these two groups, we can establish a common denominator for cross-case comparisons, and engage in a more nuanced discussion about the different types of accountability repair strategies depending on the type of implementation.

Table 2: Scale of Degrees of Automation [Sheridan 1992, p. 358]	
1.	The computer offers no assistance, the human must do it all.
2.	The computer offers a complete set of action alternatives, and
3.	narrows the selection down to a few, or
4.	suggests one, and
5.	executes that suggestion if the human approves, or
6.	allows the human a restricted time to veto before automatic execution, or
7.	executes automatically, then necessarily informs the human, or
8.	informs her after execution only if she asks, or
9.	informs her after execution, if it, the computer, decides to do so.
10.	The computer decides everything and acts autonomously, ignoring the human.

Our analysis has two stages, within-case and cross-case, to draw higher-level conclusions about the relationship between new public sector ICTs and accountability arrangements. They are drawn from secondary sources and one author’s empirical work on two e-services in Chile [Smith 2007].

Lower Levels of Automation

In this section we present two types of e-services: information provision mechanisms and simple transactions [Bhatnagar 2004; Teo and Pian 2003]. For each type we provide examples that illustrate the different ways they potentially influence (i.e., intervene in or transform) accountability processes.

Information Provision Mechanisms

Placing information on a government website is a straightforward case of information provision. The Internet provides an opportunity for greater transparency through information provision to a broader public audience, and thereby potentially new forms of accountability toward the public. In a multi-case study, Eschenfelder [2004] explored the website content production for four US state agencies. Eschenfelder found that a wide range of political and other factors influenced the nature of information presented on each agency’s website. These factors included public education mission, public inquiry burden, top-down directives, review and approval process, resources, personal career aspirations, and management interest and goals. A central conclusion was that whatever information is published is always the result of political negotiations. Consequently, “transparency” information on a website reveals only the outcome of these negotiations; the details and background of the political process remain concealed. Potential accountability arrangements are greatly shaped by these internal machinations.

A slightly more complex example is ChileCompra (“Chile Buys”), a Chilean public sector e-procurement system. ChileCompra was developed to make public sector purchasing in Chile more efficient, effective, and transparent. The central transparency feature is an information publishing system that opens a broad range of information about the purchasing process to public scrutiny. This system automatically publishes public sector organizations’ yearly procurement plans, bid invitations, and a searchable database of past public sector purchase information. This currently happens for almost all public sector organizations, including, most recently, many purchases made by the military. The overall amount of information produced is impressive.

Much like the US state agency websites studied by Eschenfelder, and in spite of the copious amount of information published on the ChileCompra portal, ChileCompra cannot expose the subtle, subjective human decisions that underlie decisions—the hard data are just a byproduct of these processes. The portal information cannot account for

the extensive human expertise that underlies the construction of procurement invoices and the selection of winning bids. Purchasing officers develop both objective and subjective criteria for evaluating competing tenders, yet these are prioritized at the discretion of the human agent. Though the implementation of this system was accompanied by a series of training reforms aimed at professionalizing the procurement officer role, effective planning and consultation processes are necessarily subjective and are difficult to document empirically. For example, there is always necessarily discretion at the point of describing the purchasing tender and placing weights to particular criteria. If the procurement officers wish to sell to a particular supplier, they can still shape the tender in such a way that only that supplier can respond with a winning bid. The key point here is that while the system does actively constrain the procurement officer, forcing the production of purchasing plans and justifications for purchasing, it still cannot illuminate the fundamentally cognitive points of decision upon which purchases depend.

These two examples illustrate how information provision at times conveys only a superficial representation of the political and cognitive processes that generate the transparency information. In one case, the political process behind choosing what information was to be presented is hidden from view. ChileCompra provides a lot of financial information, but does not and cannot reveal the underlying institutional needs or cognitive decision-making process that went into the purchasing decisions. Without the necessary context, which may be impossible to provide, key underlying components remain opaque. In the case of ChileCompra, of course, the amount of information provided goes way beyond what was previously provided by an almost entirely nontransparent purchasing process. Thus, provided that the information is of good quality, it will provide more insight than what existed before, potentially strengthening accountability. It is important, however, to understand the limits of the information provision; there is only so much depth and effectiveness of accountability mechanisms that represent the outward manifestations of internal processes. Consequently, there is always some room for maneuverability and the avoidance of accountability measures by a skillful and motivated civil servant.

In both of these examples, there are only modest alterations of accountability arrangements, and there does not appear to be much risk of accountability dysfunctions. In both cases the information that is provided online was not available beforehand and in this way opens up potential lines of new accountability arrangements, both vertically (toward the public) and horizontally and internally. As the technology is merely a platform for presenting information, it does not appear to fundamentally alter practices and thus does not open up spaces for exacerbating dysfunctions.

Simple Transactions

Simple transactions are e-services in which the computerized processes are nondiscretionary. These are generally digitized forms of existing mechanical (e.g., paper-based) procedures, where technology makes service transactions easier and more convenient [Tan and Benbasat 2009]. Two examples illustrate these transactions: filing for a grant electronically and electronic voting (e-voting). Both transactions are almost entirely technical with minor decision components. Even so, these systems can be highly problematic and produce a score of difficult accountability issues.

An example illustrates how computer outputs can be manipulated for political purposes and can be effectively devoid of accountability. In Boston, Massachusetts, a computer glitch on a federal government website resulted in an application for funding for an award-winning, inner-city education program being filed forty-six minutes late [Abel 2007]. The US Department of Education refused to consider the grant proposal, following the guideline that all grant proposals must arrive before the deadline. Accusations quickly arose that the administration was using this error as a pretext to achieve the political aim of dismantling the program. Congressional representatives wrote the director of the Department's higher education programs, stating: "Constituents—and the students they serve—should not be penalized because of computer glitches that are beyond their control.... The difficulties encountered were completely out of their hands." The response from the Department was an appeal to procedures: "The Department *does not have the discretion* to waive the deadline *nor the flexibility* to alter Grants.gov requirements" [Abel 2007, emphasis added].

The dysfunction of encoded-proceduralism emerges in this example. While in a bureaucracy discretion is generally structured by rules and standard operating procedures [Dunleavy et al. 2006; Fountai 2002, p. 137], it does allow civil servants to take into consideration contextual variations and presumably act according to other norms of integrity. In this case, the encoded computer procedures not only limited the discretionary tasks of the public officials, but also sacrificed their uniquely human ability to act on broader societal norms in contingent circumstances. At the same time, responsibilities were displaced. The rationalized procedures effectively represented a shift of discretion from the street-level bureaucrats to system analysts and software designers [Bovens and Zouridis 2002; Reddick 2005]. Such a situation is taken further by new paradigms, such as "new public management," which seek to translate private sector strategies like internal competition to the public sector to increase productivity.

The second example of simple e-transactions, e-voting machines, demonstrates how it is possible to automate relatively simple government-citizen interactions and at the same time redistribute roles and responsibilities. In theory, the switch from paper to electronic vote counting involves a fairly low level of technological sophistication in terms of the fundamental process, i.e., tallying inputs from voters. The e-voting machines make no decisions themselves as they are simply meant to count votes. If implemented correctly, with a high degree of political and technological transparency (including audit trails), the automation of the voting process can effectively remove elements of potential human error or malfeasance (which are both forms of discretion). Such a system would provide all of the necessary information, directly linking outcomes to processes, for an accountability verification process.

But even systems for seemingly straightforward transactions can produce complicated accountability problems. First, there are myriad security issues that make such a system technologically complex. For example, if data are transmitted over networks, they are open to outside attack. The hardware is also subject to attack. What was once a moderately difficult social process involving the hand counting of votes and observers has been transmuted into a complex algorithmic and technical computer security affair. Technological complexity requires technological expertise, turning a relatively simple and effective task like organizing a system of vote tallying and oversight into a job for an increasingly select group of computer experts who can influence the quality of information. Ongoing e-voting controversies in the US revolve around past decisions by election officials to contract work to companies such as Premier Election Solutions (formerly known as Diebold), which continually refuse to make available the code of their proprietary software. Furthermore, the systems often do not produce a paper receipt for voters, making it impossible to visually verify the inner activity of the system. The end result is an almost entirely opaque system that, not surprisingly, has led to significant political controversy [see, for example, Feldman et al. 2007]. In this case, the emphasis on enhancing the efficiency of the voting process and the integrity of vote counting procedures led to output-obsession and actually compromised democratic control.

These two examples illustrate how relatively simple service transactions can alter accountability processes. These services do not just automate vote tallying or online filing; they automate part of the operation of a socio-cultural organization. In a highly technical and procedural activity such as online grant applications, reliance on technological performance replaces the reliance on the bureaucratic paper-pushers who once owned the process. In the case of e-voting, the testing of the software and complex computer security systems is the new substitute for human counting and election observers, making the process more exclusive and opaque, effectively reducing checks and balances.

Both of the applications shift at least some responsibility for the acceptable completion of a set task from people to technology. The potential for technological error is substituted for bureaucratic error or malfeasance. In such cases, if the underlying process is opaque, it potentially undermines accountability arrangements. In the case of the inner city education-funding example, this shift in responsibility allowed for the offloading of blame onto the technology, arguably as a convenient excuse to achieve a political end. In the case of e-voting in the US, an "open" process of vote counting has been replaced by an almost entirely obscured process involving proprietary software and insecure systems. The problem of responsibility and accountability has actually been created by the use of ICT, whereas the social process that existed before helped to radically reduce the potential for error and malfeasance through distributed local responsibilities and built-in accountabilities (observers and redundant counting).

Higher Levels of Automation

In this section we move from low levels of automation to those e-government implementations that begin to make decisions themselves. The first example of this draws on original empirical research and concerns a tax information system in Chile [Avgerou et al. 2005; Smith 2007]. The second illustration builds on recent case study research on the automation of forensic fingerprint analysis [Davis and Hufnagel 2007], which we reinterpret in this paper in terms of accountabilities and dysfunctions.

E-tax System

Over the last fifteen years, the Chilean Tax Authority has implemented a sophisticated electronic tax (e-tax) system. This system has been highly successful: an impressive 97+ percent of the tax-paying population now files online. This system collects and processes data from a variety of institutions, including banks and businesses, to produce a completed tax form for many citizens. This system has resulted in a huge increase in internal efficiency, effectiveness, and tax revenue collection, along with time savings and convenience for many taxpayers.

Two interesting accountability issues emerge from this situation. First, the interconnectedness between public and private sector entities that is required to produce the tax forms raises potential privacy and data protection issues. While this is not a replacement of a decision-making process, the technology opens up a whole new range of potential abuses that earlier were not possible. Without the appropriate accountability arrangements in place, this increases the potential for sacrificing democratic control and the integrity of the system.

Second, this gathering of financial information has enabled the tax authority to perform much more sophisticated audits than ever before. Where auditors in the analog age were largely preoccupied with time-consuming information collection, digital era auditors can now devote their time to auditing a far larger sample of the population. They have also developed algorithms to flag returns that are likely to produce the highest yield when scrutinized. For the Chilean Tax Authority, suspicion is now algorithmic.

Automating tax auditing raises some risks of dysfunction. The algorithmic encoding of tax audits moves the decision-making role from the auditor to the algorithm. This shift, while reducing discretion, also reduces the flexibility to deal with different contextual circumstances, as it is entirely algorithmic.

Automated Fingerprint Identification System (AFIS)

Fingerprint analysis involves highly specialized training and expertise. A high degree of both vertical and horizontal accountability traditionally exists in organizations where this type of work takes place, such as forensics laboratories. Novices are accountable to expert technicians and experts often review one another's work to ensure consistently high quality results. Communication and accountability thus play a crucial role in fingerprint analysis.

In their study of fingerprint work, Davis and Hufnagel (2007) look at the organizational impacts of new fingerprint analysis technologies in terms of work practices and norm and value formation. They do not explicitly discuss accountability in their paper, though it is implied throughout their discussion of the socio-cognitive perspectives on automating fingerprint analysis. Davis and Hufnagel note that the expert fingerprint technicians they studied were highly disturbed by what they referred to as the "ghost in the machine," that is, the algorithms for searching and matching that perplexed their work. With the automation of fingerprint analysis, the expert technicians were often "helpless"—unable to explain how the system arrived at its decisions. That these experts could not account for system outputs raises particularly difficult accountability questions where false-positive identification can ruin the lives of innocent people. The authors state, "Lacking an authoritative source to help them interpret the results, [analysts] could only speculate about how the software was designed and what they could do to influence its selections" [Davis and Hufnagel 2007, p. 698].

From this example, it is apparent that experts no longer make final decisions regarding possible fingerprint matches without algorithms first doing most of the work. However, this algorithmic software is fallible. From an accountability perspective, it is disturbing that a technology meant to facilitate the role of experts is beyond their comprehension and scrutiny. Moreover, the values that are embedded in such algorithms are highly difficult to inspect. Such developments, therefore, not only problematize notions of expertise, but also complicate our understandings of accountability in such organizations.

Thus, in this case, at least two automation-exacerbated accountability dysfunctions emerge. First, experts are obsessed with outputs, perhaps more so than before, for the simple fact that the "ghost in the machine" prevents them from understanding the internal workings and decision-making of the algorithms. Second, when erroneous accusations of crime are made, based on these decisions, it may be possible to pin blame on the experts who are entrusted with final decisions, but it is difficult to fault them entirely considering the ICT-entrenched process of which they are a part.

Cognitive dependencies that new computer technologies create can limit the extent to which users can take or be ascribed responsibility [van den Hoven 2002]. These complex technologies increasingly hide the theories, models, and assumptions that they embody. They limit users' ability to assess the validity and relevance of the information presented by computer systems, which are never fully error-free, while they are often under pressure to make choices based on this information. Moreover, a lack of alternative knowledge sources to validate beliefs or an over-reliance on the accuracy of an automated system can interfere with users' ability to make appropriate decisions. Depending on the organization and its mission, software might be programmed such that its acceptance threshold is particularly low, thus increasing the possibility of a false hit. Alternatively, such biometric technology might bias certain populations [Introna and Wood 2004] without users being aware of these biases.

All decision-making is value-laden, but when values are obscured by technological automation, points of accountability grow illusive. Much like the politics of search engines in which certain values are hidden in algorithms [Introna and Nissenbaum 2000], the systems described in this section are necessarily political in that they favor certain models and assumptions over others by design. However, unlike the case of the search engines described by Introna and Nissenbaum, the automated e-tax and fingerprint identification systems support public sector activities in which a special set of values are at play. Granted, the first case brings with it the benefits of massively increased efficiency and effectiveness, but where might we find accountability in situations where certain individuals are accused of political targeting with the tax system, for example? Can supposedly impartial civil servants use technology as the scapegoat of last resort, a perfect way to conceal vested interest? These two cases illustrate an

array of ICT-exacerbated dysfunctions: a reliance on opaque algorithms for efficient decision making leads to a neglect of process and an obsession with outputs. Decisional rigidity is also encoded into the systems, preventing a consideration of the contingencies of the context and the flexibility to make changes. Consequently, it is increasingly common for mistakes or failures to be blamed on “the system.”

Summary

It would seem that, in general, as technology automates more and more decision-making processes, more potential dysfunctions are risked. Internal dynamics and values are obscured—there is increasing potential for unquestioning reliance on the technology to produce acceptable outputs and complete procedures. Rule-based procedures inherent in bureaucracies are further calcified into code that provides little room for flexibility. This allows for the potential of an offloading of responsibilities onto the system and away from the individual actors within the bureaucracy. Given the natural propensity of people to wish to avoid sanctions, it is only logical that where and when mistakes occur, they would blame the technology or the system rather than themselves. And with decision-points taken away from them, the attribution of responsibility becomes more difficult, especially as the inputs of humans decrease. However, as we will see in the following section, proper adjustments to accountability arrangements alongside the introduction of ICTs are possible to help avoid some of these dysfunctions.

V. MOVING FORWARD: POTENTIALS FOR PUBLIC SECTOR ACCOUNTABILITY

As we move toward the increased application of information and communication technologies in the public sector—which we almost inevitably will in order to achieve increased efficiencies—designing accountabilities needs to be a central part of building information systems architectures. As discussed, technological outputs reveal only superficial bureaucratic workings. Decisions must still be made, and technology cannot reveal the complete content and context of these decisions. For these activities, internal accountability mechanisms remain central. Technology will also help structure certain activities, constraining and enabling human decision-making in significant ways. Where these structures can reduce opportunities for non-professionalism and corruption, the public sector will benefit. Although humans delimit the space in which technology performs, technologies in turn set conditions on the range of actions humans can perform, often in ways not anticipated in their design. Technological artifacts persuade, facilitate, and enable particular human cognitive processes, actions, or attitudes, while constraining, discouraging, and inhibiting others [Kallinikos 2004].

As technology is used more and more to automate decision-making processes, new forms of transparency and accountability are needed. If technology is to increase transparency and thus potentially lead to greater accountability, especially toward the public, then we need to make transparent the major decision-making points embedded in the software. These decision-making points are one case in which, as discussed, values are embedded in the technology. The decision-making criterion and the types of information upon which these decisions are based can be made explicit.

Organizing for Accountability

A central point from the empirical cases covered is that the implications for accountability are a function of the type of e-government implementation. Moreover, the effects of the implementation of ICT on accountability arrangements extend beyond a single system or organization. In the following, we discuss alternative accountability mechanisms depending on the level of automation. Central to this discussion is the notion that finding appropriate accountability arrangements requires a broader socio-technical perspective. With this in mind, the discussion below tries to stay at a level low enough to enable engagement with the influential elements of the context while staying sufficiently abstract to find lessons applicable to other e-government applications and in different contexts. This implies that any suggested “solutions” are necessarily partial; it is always necessary to consider how they might have interactions, favorable or not, in any given context.

One alternative way to organize for accountability is to pursue a strategy of opening up software code to allow for public scrutiny [David 2004]. Publishing source code online introduces an added dimension to existing checks and balances. Software in e-voting machines would seem to benefit from open source code. If e-voting technology is proprietary or otherwise beyond public scrutiny, then the integrity of the system has been sacrificed for the value of efficiency (or other less positive values) and, perhaps, a false sense of security. Opening up the source code to analysis would decrease security concerns and probably do wonders for public trust in the system. Here, code transparency appears to outweigh the benefits of keeping the code secret. However, it should be noted that publicly available software addresses only one component of the operation of the e-voting machines, as it leaves the hardware unaddressed. Given these security threats, it is not surprising that governments have recently begun to reject e-voting. Nothing illustrates the conflict of values better than the recent case of Germany, whose Federal Constitutional Court ruled e-voting unconstitutional in March 2009.

The open source strategy has its drawback as well. For some cases of low-level automation, this strategy would not appear to enhance accountability. For example, with the e-procurement process described above, opening up the source code would not change the subjective dimensions of the procurement officer's work. In such cases, we see no pressing case for open source implementations. Likewise, it seems excessive to make the inner-workings of form processing code available. Such a situation calls for a simpler and more direct accountability arrangement in which someone can be held directly responsible for the errors of functioning.

Furthermore, the open source strategy also means that the public places its trust in a relatively small group of technical experts to do the monitoring. This introduces problems of scale, if more and more software were to be made open to the public, and will test the limits of such collaborative models of production. The strength of the standard voting system is that it is open to a much wider, and more politically diverse, scope of the public. Alternatively, certain independent organizations could be empowered to audit such systems, certifying that the code is doing what it is supposed to be doing. This work could be added to the work of existing auditors or it could become a new business for professional associations such as the Association for Computing Machinery or British Computing Society.³

The Chilean e-tax system represents another dynamic. It would appear that tax-processing could be a strong case for open source based low-level automation. The code is a direct translation of tax policy, and the data format is ideal for codification. However, not all tax codes are as simplified as Chile's and Chile also underwent an extensive simplification of the tax process before they brought computers into the process [Constance 2000]. Highly complex tax legislation might require systems that fall into higher level categories of automation and, hence, might be subject to different considerations.

In systems where open source does not appear applicable, other accountability arrangements need to be devised. The situation in Chile points to one such arrangement. Citizens are ultimately responsible for their data; government's provision of data is simply a convenient service. In this case, citizens would appear to be best situated to deal with the problem. In such a system, as in the Chilean case, the citizen has the ultimate say in the validity of the data, and a clear mechanism exists for the citizen to rectify the error.

In other situations, where citizens are not responsible for the input, there must be a means to acknowledge, make amends, and apologize for errors or mistakes that occur. This is where humans must step in and do the repair-work, both in terms of technological errors and human relations. We can imagine that, in many instances, automated decisions might be in error only at the margins—affecting only a small percentage of decisions made. This makes collective action more difficult. If the government wants to balance the efficiencies of automation with the public values of trust and accountability, then a potential logical step is the establishment of a contract with the public as to the ability to appeal decisions. This process should guarantee a response to citizens' complaints within a particular time frame. Something like this would have helped greatly in the inner-city school program funding case where a simple technical error caused such havoc because there was no policy in place to deal with such situations.

In devising and establishing contracts between the government and the public, as we move to higher levels of automation, issues of accountability arise prior to implementation and use. The values that underlie the decision-making component of these technologies are built-in design features. For example, our discussion of the biometric software in the automated fingerprint system demonstrated that important decision-making processes are hidden behind complex algorithms. The discussion underlines the point illustrated by literature in the area of science and technology studies—that the design of technological devices reflects the values and worldviews of their designers [Akrich 1992; Friedman and Nissenbaum 1996; Woolgar 1987]. These built-in values can conflict with prevailing values of the context into which they are introduced. This point underscores the responsibility of the companies and research institutions that develop these technologies. As van den Hoven stresses in his discussion on value sensitive design, "A value analysis needs to be made in advance and protocols need to implement them. No IT application ... can work satisfactorily if its value implementation is inadequate" [van den Hoven 2007, p. 3]. Addressing ICTs and accountability issues therefore requires a broader focus that extends over time and across organizations.

Nissenbaum conceives of accountability as something very akin to answerability, which can be used as "a powerful tool for motivating better practices, and consequently more reliable and trustworthy systems" [Nissenbaum 1997, p. 43]. Accepting explanations such as "it's the computer's fault," she argues, stands in the way of a "culture of accountability" that is aimed at maintaining clear lines of accountability. A culture of accountability is worth pursuing because a developed sense of responsibility is a virtue to be encouraged, and it is valued because of its

³ Thanks to an anonymous reviewer of an earlier version for this insight.

consequences for social welfare. Holding people accountable for the harms or risks caused by computer systems provides a strong incentive to minimize them. Moreover, accountability can provide a starting point for assigning just punishment. This instrumental take on accountability shifts the focus to the socio-technical system in which technologies are developed and used. It underscores that increasingly autonomous technologies are the result of choices in developing technologies, rather than an inevitable outcome.

The dependency of public sector institutions on high technology companies and research centers necessarily implicates these organizations in the distribution of responsibility, as decision-points are located within these organizations as well. Nissenbaum has argued, "If we consistently respond to complex cases by not pursuing blame and responsibility, we are effectively accepting agentless mishaps and a general erosion of accountability" [Nissenbaum 1994, p. 76]. This implies that, to prevent the gradual erosion of accountability in such cases of high-level automation, it might prove necessary to locate new accountabilities within the third parties (i.e., companies, research centers, and others) that provide many of the sophisticated technologies employed in such systems. These parties should be explicitly acknowledged in any potential contract between a government and its public. The European Commission recently proposed such a measure, extending consumer protections for physical goods to cover software licensing agreements.

The notion of value sensitive design raises another critical question: are the benefits of new technologies worth certain social costs? An answer to this question can be found only in concrete practices, where values can be weighed and discussed, although mostly without complete knowledge of the resultant direct and indirect consequences. Here the proposed British national biometric identity scheme appears a clear example of how certain technologies might simply not be worth the societal costs. Perhaps at this point, the push for efficiency in public sector delivery by way of an identity card scheme with serious surveillance implications (i.e., the databases that comprise the scheme, the proposed audit trail of identity verifications, and the extensive use of biometric identifiers, among other features) compromises too greatly other important public values such as liberty and personal autonomy. So, too, with the country's national DNA database [Martin and Smith 2008] or the much-maligned national program for IT at the national health service [McGrath et al. 2008]. As with the accountability argument, we have made throughout this paper, it is crucial that the rich variety of values that make up the public sector be respected.

One-size-fits-all solutions do not exist. Automation changes practices and displaces accountabilities. The development and implementation of technologies, therefore, requires the continuous interrogation and discussion of the values at stake and the way in which new technologies can change practices. Yet, rhetoric about increasing complexity or the benefits of efficiency and effectiveness can distract policy makers, developers, and citizens from the necessary task of organizing appropriate accountability arrangements. So far, we fear that efficiency, as a value, has unjustly prevailed over other crucial public values. We, therefore, underscore the need for public debates about the conditions under which ICTs should or should not be developed, integrated, and used.

VI. CONCLUSION

ICT implementation in the public sector is about maintaining a suitable balance between competing public values and the benefits of new technologies. Improved information flows and automated processes can produce much-coveted efficiency, effectiveness, and transparency that must be balanced against the tendency of technology toward certain dysfunctions. This balance extends beyond the implementation of the technology to the broader socio-technical system. The shift in responsibilities, roles, and processes that comes from the implementation of ICTs in the public sector requires a broad view of socio-technical organization when it comes to accountability. Where technologies intervene or break down existing accountability processes, or introduce new problematic dimensions, new social arrangements have to be developed.

To improve our theoretical understanding of how ICT implementations interact with accountability arrangements in the public sector, we proposed a tentative framework of potential ICT-exacerbated accountability dysfunctions. This framework should be seen as a first step in conceptualizing the potentially negative accountability outcomes associated with ICT implementations in the public sector. Further empirical research needs to be completed to test this framework and enrich its working concepts. The exploration of additional cases across different public sector organizations will help refine this theorizing and contribute to a more exhaustive framework for understanding ICT-exacerbated accountability dysfunctions.

As we have tried to illustrate in this paper, different types of ICT implementations require different types of accountability mechanisms that have to be developed, based on a careful evaluation of the effects of the use of the technology within particular contexts. Central to establishing and organizing these mechanisms are the questions of which actors are best held accountable, for what types of actions, and through what accountability arrangements. Through our empirical examples, we see that different types of e-services can potentially support accountability

processes. At the same time, they can also displace accountabilities or even exacerbate accountability dysfunctions, as they alter the form and content of the available information regarding the underlying process. The cases we discussed also showed that high-level automation formalizes decision-making processes, potentially constraining human discretion. Limiting human discretion can sometimes prove a good thing when, for example, it reduces corruption in the public sector as is intended in many e-government programs. However, the removal of the human element in decision-making can also prove problematic when the outcome is the severe displacement or dissolution of accountability. Such a consideration alters the calculus behind the implementation of ICT in the public sector. In dysfunction-prone situations implementation must be questioned and values must be weighed and discussed. Are the efficiency and effectiveness benefits worth the potential social costs of dysfunction? The tipping point will be different in different cultures, of course, with different historical orientations toward government and varied public value systems influencing the calculus.

If we could peer into the future and observe the newer, faster, and more “intelligent” technologies [Rudowsky 2004] that await us, negotiating this balance will remain a central concern for the governance of information systems in the public sector. The concerns about the increasing pervasiveness and ubiquity of ICTs in the public sector are often countered by the promise of increasingly intelligent technologies, which will prove capable of reasoning about the moral and social consequences of their actions. The ability to operate without the continuous direction of human operators is an appealing feature of computer-regulated systems that perform tasks that are too complex, too dangerous, or that require accurate time-critical control [see, for example, Noorman 2008]. It is still an open question as to the extent that new developments in software can codify and automate “non-legal, non-routine, street-level interactions, such as teaching, nursing, and policing” [Bovens and Zouridis 2002, p. 180]. However, what the foregoing discussion illustrates is that new technologies will not solve the accountability problem in and of themselves. A preoccupation with technology-centered solutions distracts us from addressing which, why, and how particular accountabilities should be enforced or shifted. The analysis in this paper underscores the responsibility of individuals in constructing, pursuing, integrating, and accepting ICT solutions.

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