EVOLUTION OR REVOLUTION? E-GOVERNMENT IN THE U.S.

by

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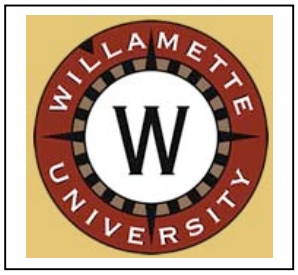

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This is not a book about technology; it is a book about social relationships and economic arrangements. Its focus is things, but our concern is people, with the shared dreams and delusions that inspire and blind us all. As David Noble (1984, p. ix) explains, this is the forge from which technology emerges, is shaped and given meaning. My chapter is about the inherent contradiction between the basic building block of most non-market productive relationships – hierarchy – and the vision inspired by the architecture of modern information technology, especially the World Wide Web, of a more egalitarian commonwealth.[1] Philip Evans and Thomas Wurster (1997), for example, argue that, in the future, all knowledge-based productive relationships will be designed around fluid, team-based collaborative communities, either within organizations (deconstructed value chains), or collaborative alliances like the "amorphous and permeable corporate boundaries characteristic of companies in the Silicon Valley" (deconstructed supply chains). They assert that, in these relationships everyone will communicate richly with everyone else on the basis of shared standards and that, like the Internet itself, these relationships will eliminate the need to channel information, thereby eliminating the tradeoff between information bandwidth and connectivity. "The possibility (or the threat) of random access and information symmetry," they conclude, "will destroy all hierarchies, whether of logic or power."

Evans and Wurster lay it on a bit thick. Nevertheless, we ignore such visionaries at our peril. The World Wide Web, together with the canon that two heads are better than one, has created something immensely interesting and potentially transformative. The genius of the World Wide Web is, as Evans and Wurster explain, that it is (a) distributed (so that anyone can contribute to it), and (b) standardized (so that everyone else can comprehend the contributions). Random access and information symmetry jeopardize the power of gatekeepers of all sorts: political leaders, managers, functional staff specialists, and even experts to determine *what* information counts as evidence and what beliefs are sufficiently *warranted* to count as knowledge. In other words, they threaten nearly everyone with a vested interest in existing institutional arrangements. One does not expect individuals to surrender position or power without a struggle. Furthermore, *homo sapiens'* need for leaders is evidently instinctive, deeply rooted in our simian brains (Heifetz, 1993). The need for hierarchy buttresses the status quo, even where the powerful are neither wise nor unselfish.

To understand the conflict between hierarchical arrangements and the vision inspired by contemporary technology and the possible outcomes of this conflict, I will look closely at three cases based upon recent encounters with e-government in the United States: the 2004 presidential election, the American military's development of a world-wide information grid, and the State of Oregon's recent efforts to consolidate data processing. The

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[1] The other compelling conflict suggested by recent events in the United States and emerging information technologies has to with the clash between individual privacy and security. I do not feel particularly well qualified to tell that story. Moreover, it is inconsistent with the main thrust of this volume. Nevertheless, my omission of this story should not be interpreted as gainsaying its critical importance.

first two cases were selected because they are at the leading edge of e-government owing both to the scale and scope of the activities in question and the resources lavished upon them. The third case was selected primarily because I was there[2] and also because it provides a counterpoint to the case discussed in Chapter 4 of this volume.

Theoretical Considerations: The Economics of Organization

The basic idea behind the new economics of organization is that the comparative advantage of governance mechanisms boils down to a question of information or transaction costs "and to the ability and willingness of those affected by information costs to recognize and bear them" (Arrow: 1969; Coase, 1937). Hence, the circumstances that create market failures: public goods, natural monopolies, externalities, moral hazard and adverse selection, etc., the problems that justify government action in a capitalist economy, are all fundamentally information failures. Markets could deliver public goods, for example – if information technology existed that would permit free riders to be profitably excluded from enjoying them. Monopolies could be compensated to behave like competitors – if information costs were lower. And, bargaining between self-interested individuals could eliminate externalities, without the intervention of government – if transaction costs were zero. Much the same logic applies to the choice between organizations and markets and the kinds of governance mechanisms used within organizations.

A corollary to this basic Coasian insight is that information costs – typically search, bargaining, logistics, and/or enforcement costs – can be reduced by carrying them out through formal mechanisms of governance: organizations rather than markets or government rather than private organizations. Reduction does not imply elimination, however. This fact implies a second, perhaps, less obvious corollary to the basic Coasian insight: the conditions that wreck markets also impair organizations and governments. Consequently, as Robert Gibbons (2003) explains, the organizations we observe tend to be less efficient than the markets we observe, even when they are more efficient than the markets they replace; the government agencies we observe tend to be less efficient than the private organizations we observe, even when they are more efficient than the private organizations they replace.

Gibbons' corollary to the basic Coasian insight is illustrated in Figure 1, which plots the declining efficacy of markets, organizations, and government as transactions difficulty increases. At the critical values of transaction difficulty shown by the dotted lines, markets and organizations and organizations and governments are both equally efficacious; to the right of first vertical dotted line, organizations are more efficient than markets; to the right of the second, government is more efficient than private organizations.

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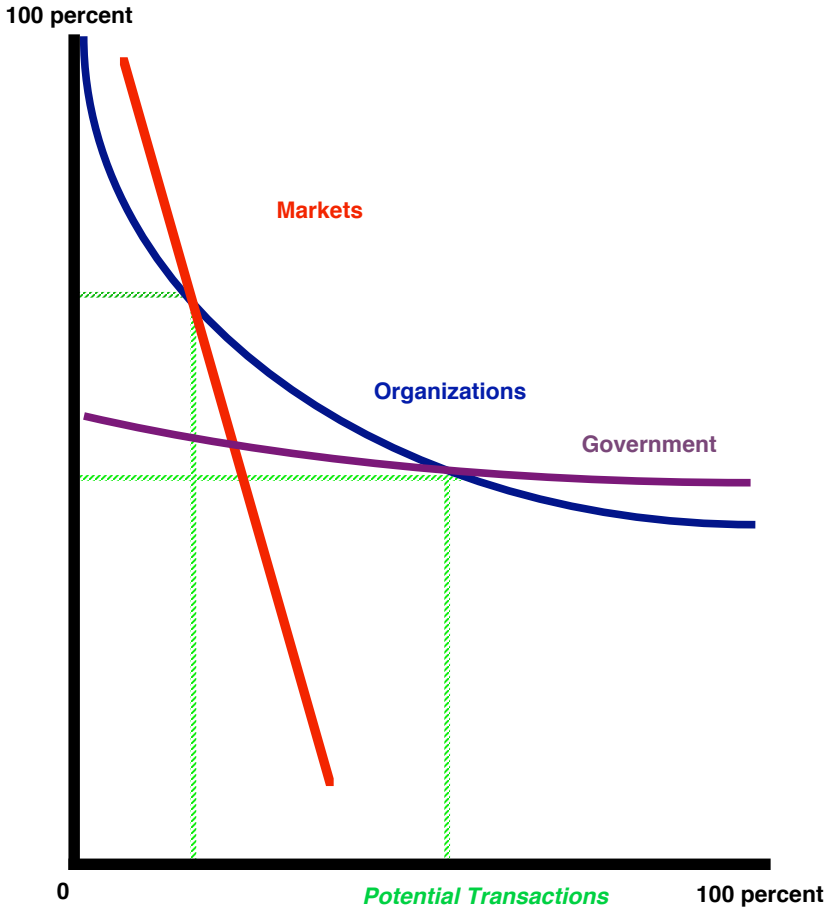
[2] While my involvement in Oregon's Computing and Networking Infrastructure Consolidation (C-NIC) project was not as intimate as Sandy Borins' participation in the development of Ontario's e-government initiatives, it was fairly thorough. Several of the key project participants were former students, friends, or relatives. They not only kept me apprised of events, they often used me as a sounding board for their ideas and occasionally solicited my advice. Moreover, several of my colleagues at the Atkinson School served as external project advisors. We met monthly throughout the academic year to share notes on the project.

Figure 1: ***The Relative Efficacy of Alternative Governance Mechanisms***



The evidence seems to support Gibbons' corollary. Where the production of privately consumed goods and services – steel, banking, even telecommunications – is concerned, private organizations are usually observed to be more efficient than state-owned enterprises. Finally, it also might be noted that Gibbons' corollary is entirely consistent with the observation Gil Reschenthaler and I (1996) made a while back: reducing the cost of information should increase the efficacy of markets relative to organizations and of non-governmental organizations relative to government. Because, improved communications technology, logistics, and IT have all reduced the cost of information, it is reasonable to infer that both sets of vertical dotted lines shown in Figure 1 have shifted to the right.

This observation most emphatically does not mean, however, that the most efficient technology, let alone set of social/institutional relationships, must necessarily win out in the end. Technological development is not a coldly rational, self-regulating economic process, which proceeds automatically along a singular path. Even if one sets aside the contested nature of efficiency, the evolution of social constructs is precisely analogous to natural selection, a process that is inherently path dependent,[3] a fact made patently obvi-

[3] Paul David (1985) defines path-dependence in the following manner: "A path-dependent sequence of economic changes is one of which important influences upon the eventual outcome can be exerted by temporally remote events, including happenings dominated by chance elements rather than systemic forces."

ous by English spelling in the first case and the platypus in the second. Moreover, the evolution of social constructs is not entirely a Darwinian process but is at least partially a Lamarckian one. Human agency intervenes at every stage to order arrangements to suit felt needs and wants. We shape economic arrangements, social relationships, and technological developments at the same time they shape us.

Instead, we would stress the normative power of these observations: not that Y will cause X, but that if you want Y, you should do X. E. Brynjolfsson and L.M. Hitt (2000) provide compelling evidence that computers do increase performance: where both are compared to industry averages, an eight percent increase in IT assets is associated with a one percent increase productivity. They emphasize, however, that the payoff to IT investment varies substantially across firms, even in the same industries. Measurement error may explain some of this variation. IT measurement focuses on tangible assets – hardware and, in some cases, software. Intangible assets – investments in human capital, business process reengineering, and organizational culture – are usually overlooked, although in successful IT projects, systems implementation and deployment typically account for 75 percent of total project costs. In explaining this phenomenon, Brynjolfsson and Hitt stress not the level of effort given to IT systems implementation and deployment but the manner in which systems are implemented and deployed. They argue that if we want the high productivity that IT promises, it is not sufficient to invest in computers and software, our organizations must also adopt a specific relational architecture, set of processes or routines, and culture.

Brynjolfsson and Hitt refer to this pattern of practices as the digital or netcentric organization. They insist that IT and digital organization are complements: firms that simultaneously adopt the digital organization and invest more in IT have disproportionately higher performance. They imply that adopting any of the seven practices of highly effective netcentric organizations in isolation may actually hurt performance, although their evidence speaks only to a couple of the practices and to investment in computers. Five of the characteristics of digital or netcentric organizations are often found in high performance organizations, especially those operating in hazardous environments that call for high reliability on the part of their members (Weick & Sutcliffe 2001). These organizations consistently maintain focus and communicate goals, foster information access and communication throughout the organization, link incentives to performance, hire the best people, and invest in human capital (Pfeffer 1998; see also Ichniowski & Shaw 2003; Dixit 2002; Lazear 2000; Ashe 1990).

Moving from analog to digital processes[4] and distributing decision-rights to front-line

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(p. 332) In other words, economic arrangements are partly a function of systemic change; but they are a function of random, fortuitous events as well. Moreover, systematic forces include culture, position, and power – people, institutions, and competing values – and not merely payoffs.

[4] Moving from analog to digital processes means reconfiguring processes to exploit the power of IT to perform a variety of tasks rather than merely using IT to perform steps in existing processes. This is not a new problem nor is it necessarily an easy one. First the technology must be ready. Then someone must grasp its full potential and figure out how to configure work to extract every advantage from it. Here the early history of the moving assembly line in the American automobile industry is instructive. Its development required two fundamental technological advances that took decades to achieve: tougher metals, which were

personnel are the practices that truly distinguish the netcentric organization from more traditional bureaucracies. The first is inconceivable without computers; the second is a recipe for disaster where people lack a clear sense of mission and the motivation, capacity and information needed to accomplish their missions. It makes sense that implementing either of these practices in isolation could degrade organizational performance. The architecture that distinguishes the netcentric organization from more traditional bureaucracies was, perhaps, first clearly articulated by Michael Hammer (1990) in his rules for business process reengineering:

- Jobs should be designed around missions and goals rather than functions (functional specialization and sequential execution are inherently inimical to efficient processing);
- Those who use the output of an activity should perform the activity; the people who produce information should process it, since they have the greatest need for information and the greatest interest in its accuracy;
- Information should be captured once and at the source;
- Parallel activities should be coordinated during their performance, not after they are completed;
- The people who do the work should be responsible for making decisions and control built into their job designs.

Of course, every social construct has precedents. Hammer's rules reflected not only the promise of IT but also the assumptions underlying Toyota's system of flexible production, which had invited considerable attention from students of organizational design in the late 1980s and early 1990s. Toyota's system was intended to reduce work-in-progress inventories and manufacturing cycle time and increase product quality, thereby increasing economic value added by conserving both plant and equipment and working capital. The Toyota system holds that nobody but the front-line worker adds value, that front-line workers can perform most functions better than specialists, and that every link in the value chain should be perfect (Womack, Jones, Roos, 1990). This system, which had, in fact, also been, but far less influentially, pioneered by IBM and Bell Labs in the United States, features several of the elements of netcentric organizations: multidisciplinary teams, whose members work together from start of job to completion of a project, the devolution of power down to teams that do an organization's work, and a more equal distribution of knowledge, authority, and responsibility. Add computers and digital proc-

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needed to make jigs and bits for high-precision cutting, turning, boring, milling, and stamping machines, and small-scale electric motors, which were needed to run them. High-precision manufacturing machines were needed to produce truly interchangeable parts and small-scale motors to liberate workflow from the tyranny of a single central source of motive power and the need to transmit it via belts, shafts, and gears. These were necessary, but not sufficient, conditions for the invention of the moving automobile assembly line. Both were put in place when Ford Motor's Highland Park plant was designed in 1910. It wasn't until 1914, however, that its managers and engineers fully grasped the potential of interchangeable parts and machines run by small-scale electric motors and reorganized automobile manufacturing accordingly, doubling the plant's productivity at a stroke. The actual reorganization took only a few months. Recognizing the possibilities inherent in the new technologies and figuring out how to take advantage of them took years. It then took additional decades for the processes pioneered by Ford to become widespread throughout automobile industry and to be adopted in other industries. Given this story, it is, perhaps, no surprise that the industry that has most fully exploited the power of IT is the IT industry itself.

esses and the system is complete.

The power of netcentric organization to transform productivity was evident first in the computer industry. Many of the characteristics of netcentric organizations were already common practice in this industry and, owing to their technological expertise, its leaders were themselves well positioned to grasp IT's possibilities inherent and to figure out how to reconfigure basic business processes to take advantage of them, although actually doing so often took many years. IBM's Business Continuity and Recovery Services facility in Dallas TX was an early example of a complete netcentric organization. It explicitly mimicked the self-organization of markets. Everyone was either a customer or provider, depending on the transaction, which transformed the facility into a network of voluntary exchanges. Each exchange was a closed loop involving four steps: request from a customer and offer from a provider, negotiation of the task to be performed and definition of success, performance, and customer acceptance. Until the last step was completed, the task was unfinished. IBM used powerful computers to track these loops and monitor the progress of each transaction. This system empowered workers, eliminated boundaries and bottlenecks, and substantially boosted productivity.

Can government copy the netcentric model, organizing itself into alliances of networks, sharing top management, core competencies, and a common culture, and using computers to chart activities and operational flows? Can it use real-time information on operations made possible by modern IT systems to pass the exercise of judgment down into the organization, to wherever it is most needed, at service delivery, in production, or to the client? Can government abandon its hierarchies, its need to push operating decisions to the top of the organization, or its stove-piped functional organizations? Can it consistently maintain focus and communicate goals, foster information access and communication throughout the organization, link incentives to performance, hire the best people, and invest in human capital, as well as computers and software? The benefits are there, but so too are the costs. Adopting the netcentric organization is problematic in several ways, two of which are crucial: lack of understanding that certain practices matter and that these practices must be adopted together, as part of a complementary system, and the unwillingness of the people at the top to share authority.

The 2004 Presidential Campaign

Electoral campaigns may seem a trivial test of netcentric principles. But American presidential campaigns involve millions of volunteers, thousands of professionals, and billions of dollars. Moreover, for many elected officials, campaign leadership is the only executive experience they ever get. Lacking other executive experience, what they learn on the campaign trail strongly influences administrative practices in office. Political campaigns are also endowed with certain of the characteristics that facilitate the adoption of netcentric architectures: a clear focus and shared sense of purpose, open communication throughout the organization, and bright, intrinsically motivated participants.

A survey of candidates' websites in the presidential primaries clearly demonstrated that most simply used the net as an alternate channel for information available via other me-

dia. Use of this channel undoubtedly facilitated communication with the ten to 12 percent of the population that relies of the World Wide Web for news and with reporters, who tend to be fairly net savvy. Many reporters find it easier to take information from press releases on the Internet than from faxes and to use the web to search through position papers for inconsistencies and to compare and contrast the stances of the candidates. There were two salient exceptions to this generalization, however: Howard Dean's use of the web to identify likely supporters and to ask them for money and the Bush campaign's use of the internet to get out the vote on Election Day.

The Dean campaign was remarkable for its ability to raise funds from small donors (<$US250). Democrats have customarily relied more heavily on very large donors – wealthy individuals, trial lawyers, and teachers' unions primarily – and federal matching funds than have Republicans, who have relied on direct mail campaigns to raise funds. The Dean campaign was so good at raising money that it could afford to forgo federal matching funds (along with the spending limits they entail) and eventually announced that it would no longer accept large individual and corporate donations. While the Dean campaign failed (many of its IT workers were recruited for John Kerry's presidential campaign, where they substantially contributed to the Democrats' success in raising and spending more than the Republicans during the presidential campaign[5]), Howard Dean was later elected Chairman of the Democratic Party. Under Dean, the Democratic Party has raised two dollars for every three raised by the Republicans, despite its incumbency advantage. As Chairman, Dean's successes have relied on the precisely the same organizational and IT know-how that carried him a surprise lead early in the race for the Democratic nomination for the presidency – his failures have largely been the result of an inability to keep his feet out of his mouth, also just as before.

Openness has been one of the keys to Dean's success in the use of the Internet for campaign purposes. The Republicans and, initially, the Kerry campaign merely solicited e-mail responses to their press releases and position papers. Most messages received an automatic reply appealing for support. In contrast, Dean's campaign network classified and posted the comments to the web and invited responses from viewers. They also asked viewers to copy comments to friends and to invite them to link to Meetup.com. This had the effect of creating an extensive community of online participants. According to the *Toronto Star* ("Web Plays Wild Card in US Election," Oct. 19, 2004), over 13,000 in April 2003, 61,000 in July, and 110,000 in October. Meetup peaked in February 2004, with 189,000 participants.

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[5] In 2000, the only fund-raising category in which Democrats beat Republicans was $1 million plus donors. They remained ahead in this category in 2004 and caught up with them in other categories. United States law limits individual contributions to candidates, parties and political action committees to a biennial maximum of $101,400. There are no real limits on soft money contributions – where donors spend their money to support a candidate or issue directly, rather than donate to a party or one or more of its candidates. Small donations are worth more than an equivalent amount of large donations because the federal matching rate decreases with the size of contributions. During presidential primaries, for example, the federal government matches only the first $250 of an individual's contributions to eligible presidential candidates. On campaign finance in the United Sates, see the see the mini-symposium on the Bipartisan Campaign Finance Reform Act of 2002 in the summer 2005 issue of the *Journal of Policy Analysis and Management*.

Furthermore, potential supporters identified themselves through their willingness to participate in the on-line community. Only after people were involved in the Dean campaign did it solicit their financial support. This also what experienced fund-raisers (e.g., those who work for universities and other charities)do. Not surprisingly, the response rate to Dean's solicitations was between four and ten times higher than his competitors'. Of course, this meant that the Dean campaign organization had to mobilize and train a large number of individuals to monitor traffic on the web, identify potential supporters, and tailor appeals for support to them. It also meant that the campaign had to use its computers to chart volunteer activities and communications traffic so that it could afford to pass the exercise of judgment down into the organization to the volunteers communicating directly with the other members of the online community. As Democratic Party Chairman, Dean has installed this same system. Perhaps its most astonishing feature is that most volunteers supply their computers and work from their own homes, schools, or offices.

The Republican effort to get out the vote on Election Day was every bit as fascinating. The problem both parties face is insuring that likely supporters actually vote. Both parties maintain extensive databases on registered voters, paying special attention to party members and independents, especially identified supporters and those with characteristics that would predict their support at the polls. They also try to determine who has voted and who has not and to encourage those who haven't to do so. This means reminding voters with absentee ballots to mail them in, monitoring polling places to identify those who have not voted and phoning or visiting the laggards to persuade them to vote. In presidential elections, special attention is usually given to potential supporters who vote intermittently in by elections.

Forty years ago this process relied heavily on local organization and local knowledge. Data, which are now typically supplied in digital format by county clerks and frequently updated, often in real time, and warehoused by the national party organization, were laboriously coded by hand on note cards maintained at the precinct level. While a few well-organized patronage machines could rely on street-level adherents to know their constituencies so intimately they could predict not only who would vote but also how, most simply maximized turnout, leaving it to the fates to sort things out. The electoral advantages that accrued to large-scale, centralized data base management transformed this process. When voter data was combined with modern political/market research and the use of giant call centers, national campaign managers could determine which voters to target to maximize the vote count in their favor given the resources available. This had the result of reducing overall turnout *vis á vis* earlier times, but of increasing the predictability of outcomes. It also resulted in the centralization of the process.

In 2004 the Democrats relied on this basic process, although they executed it with exceptional competence and zeal. As Matt Bai reported ("Who Lost Ohio?" *New York Times Magazine*, 11/21/04) the Democrats focused on 'hard yeses:' "They found stalwart Democratic voters – the base – and pounded them with mail, phone calls and visits to make sure they went to the polls." The masters of modern field organizing, the Democrats "dismissed the Republican effort as an exercise in self-delusion, insisting that volunteers

could never build a turnout model to compete with professional organizers."

In contrast, the Republicans used the Internet to transform the process. They made data on voters, their intentions and their propensities, information from the phone banks and polling places available to local volunteers and relied upon them to interpret the data and to use the Internet to coordinate their own efforts. To participate in this process all interested volunteers had to do was enter their zip codes on a webpage: the system provided a targeted list of neighborhood voters, a map showing the locations of their residences, estimates of the time required to visit them, and a set of talking points. The rest was up to the volunteers. In other words, the Republicans used the Internet to distribute information and decision-rights to front-line personnel and depended upon them to figure out how to leverage the resources available locally. Consequently, Republican volunteers were consistently faster off the mark and responded more appropriately to the emerging situation than their more centrally directed Democratic counterparts.

The final result was the largest voter turnout in numbers of any American election in history and as a percentage of the potential electorate (voting eligible population) the highest since 1968 (turnout levels were exceptionally high by historical standards during the 1950s and 1960s). Fifty-five percent of the voting eligible population voted for a presidential candidate, versus 50 percent in 2000 and 48 percent in 1996. See http://elections.gmu.edu/voter_turnout.htm. And, while this is by no means certain, many serious analysts now attribute the Republican margin of victory to success in getting out the vote on Election Day. According to census figures, closeness influenced turnout. Minnesota, one of the most closely contested states, for example, had the highest turnout rate. Hawaii, which the presidential candidates ignored until late in the campaign, had the lowest. In the fifteen states with the closest presidential races, 60 percent of the voting eligible population voted for president versus 47 percent in the 15 least competitive states (see Table 1).[6] Moreover, Republican success at getting voters to the polls evidently reversed what started out to be a clear win for the Democrats (Bai, 2004).

Table 1: Percentage of Eligible Population Voting for President, 15 Closest Races

1996	2000	2004
45	***55***	***60***

Zack Exley, director of online communication and organization for Kerry-Edwards 2004, was subsequently reported to have said in reference to the Republican voter mobilization campaign, that, "The right is beating the left at what used to be our game: grassroots politics, real democracy. Ironically, we were a little more 'command and control,' which

[6] The natural log of margin of victory in the presidential race explained 10 percent of the cross-sectional interstate variance in the log of voter participation in 2004, 1 percent in 2000, and 7 percent in 1996, with slope coefficients of –3, -1.3, and 1.9, respectively (the first of the coefficients can be interpreted to mean that a 1 percent increase in the vote margin resulted in a three percent decrease in voter turnout – the slope coefficient for 1996 could be interpreted to mean that closeness doesn't always count in elections. However, the 1996 election wasn't expected to be close. Other contests probably influenced turnout in that election more than the presidential race. Demographics and weather are also significant determinants of turnout.) Author's analysis.

doesn't really reflect the way the Democratic Party works."

Another manifestation of this difference is that the Democrats were far more concerned with security than their Republican counterparts. Not only did they have a strong preference for partisan web-campaign firms, they worked hard to keep Republicans out of their system. Despite the fact that my research assistant was a former Democratic Party county central committee member and had the necessary urls and passwords, he couldn't access login page for the Democratic presidential get-out-the vote campaign, evidently because his IP address wasn't pre-registered. In contrast, he easily accessed the Republican volunteer system.

Global Information Grid

The search for consensus as to which practices matter is dramatically reflected in the US defense department's experimentation with netcentric warfare.[7] The US defense department and the uniformed services are seriously trying to figure out how to utilize the power of IT to increase the agility of combat forces and the speed and effectiveness with which the military is deployed to achieve political ends without combat. The backbone of this initiative is the integration of the Department of Defense's communications and computer systems into the Global Information Grid or GIG.

The GIG is a distributed network that is designed to spread processing power across a network of thousands of processors, servers, and routers located around the world. The diverse computers that make up the network will be linked together via a communications system that automatically routes and relays information from source(s) to destination(s) through any available medium or node. The GIG's communication system will use technologies pioneered by the Defense Advance Research Projects Agency's packet radio project as well as landlines, both of which rely on the Internet's open-systems standards and protocols to facilitate interoperability among its component elements. This communications network will allow the computers in the grid to exchange information, share workloads, and process information to provide users with information about local operating conditions[8] and to help them figure what they need and to get it when they need

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[7] One might be inclined to skepticism. Military organizations have earned a reputation for conservatism. In part this a necessary consequence of their need for resiliency and reliability in the face of combat attrition. Moreover, Jane Fountain (2001a: 167-192) has described the failure of an early experiment carried out by the U.S. Army's 9th Mechanized Division (HiTech) at Ft. Lewis, Washington, with a network enabled information system. The failure of this experiment was at least partly due to the unwillingness of its senior officers to abandon hierarchy or to push operating decisions down into the organization. Nevertheless, Thomas Hughes (1998: 5) reminds us that the very first netcentric organization may well have been the Defense Advanced Research Project Agency's ARPANET project. Started in the late 1960s, the project was characterized by "a flat, collegial, meritocratic management style as contrasted with a vertical, hierarchical one; the resort to transdisciplinary teams of engineers, scientists, and managers in contrast to reliance on discipline-bound experts; the combining of diverse, or heterogeneous, physical components in a networked system instead of standardized, interchangeable ones in an assembly line; and a commitment by industry to change-generating projects rather than long-lived processes."

[8] For example, status information on the enemy, friendly forces and neutrals, and terrain and weather information. Information will be supplied by users, local and regional sensors and processed by intelligent

it. Information and related services will be available to any and all 'net-ready' users, meaning connected to the GIG, with an adequate interface to enable the acquisition and presentation of information.[9] When the GIG is complete, everyone in the American military will be able to communicate with everyone else. The architecture of the GIG will eliminate the need to channel information, thereby eliminating the tradeoff between information richness and reach – or so its advocates claim.

The grid is designed to be scalable to several levels or tiers of networks. At the highest level, it will comprehend all sensors, information processors, and users from satellites in geosynchronous orbits on down – all the military's processors, servers, and routers, the communications grid, and stored data and metadata registers and catalogs. (Metadata describe and classify the information to which they are appended, including its source, description, intended use, pedigree, and security classification. Hence, they allow users to convert data into useful information.) The next tier might be a wide-area network comprehending a regional command, the next a medium-area network comprehending all the combat and support teams conducting operations in an area, and finally a local-area network comprehending the participants of a combat team or rapid reaction force.

Like most high-tech organizations, the GIG will rely on quasi-market mechanisms to link customers and providers (sensors, weapons platforms, and intelligent agents, as well as people), and to ensure that users have access to the information and services (bandwidth, etc.) that they want when, where, and how they want it. Depending on the transaction, a user may be either a customer or a provider. Department of Defense policy envisions that users will post all of the information they collect or produce so that it can be immediately available to those who need it. In addition to tracking the progress of transactions and providing management for the system of exchange, the GIG's infostructure will supply:

- Metadata posting and collection;
- Searchable catalogs advertising the availability of services and information on the GIG. These catalogs will contain information that describes the capabilities of the service, the necessary inputs to use the service and the outputs of the service;
- Discovery mechanisms to locate and identify information to support user tasks, including flexible access control mechanisms to facilitate information visibility and availability (while hiding information where there is an explicit need for security beyond that afforded by the network);
- Agent-based mediation services to translate, fuse, and aggregate data elements into information to meet the needs of diverse users ranging from individuals to teams and organizations, and to sensors and/or weapons systems.

These software agents will use metadata to package information for users. They are supposed to filter and deliver the right information to the right user automatically. That is to

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agents.

[9]For example, a rifleman's processor could be a thin client dedicated to supporting a human-computer interface (with voice recognition, heads-up display, speech synthesis, and communications). It need not have its scarce computing capacity tied up providing other information-related services. Computing resources to support a user can reside anywhere on the grid.

say, these agents will be made aware of the user's situation and information needs to provide relevant information without a specific user request. Software agents are intended to multiply the resources available to users by gathering and transforming raw data into actionable information to support operations, in the same way that users would, were the agents unavailable, thereby freeing them from routine information processing chores and allowing them to devote their attention to operations.

The GIG relies on workload sharing and packet switching for resiliency. The grid will operate reliably despite the destruction of many of its components or communication nodes because data and workloads can be stored and processed throughout the network and information is automatically routed through its undamaged nodes via surviving radio transmitters and landlines. Moreover, according to David Alberts and Richard Hayes (2003: 197) automatic packet-switching network protocols and algorithms could protect communications nodes in ways never before conceived through cover, concealment, and deception. For example, network-level protocols could make every node look the same (in a traffic analysis) as every other node, thereby limiting an adversary's ability to identify and target high-value nodes such as command and control centers. Similarly, network-level protocols could, if the system detects an attack, change its waveforms to mimic a radar site or even the radio signals of an enemy unit. Finally, The Department of Defense is developing hard to intercept and detect waveforms for ground-based communication networks.

It is a cliché to say that the World Wide Web like its namesake, full of bugs and dirt. To defend against information attack, capture, or corruption the GIG will rely on commercial technology for conducting secure transactions, such as internet protocol security, secure socket layers, public key infrastructure and key distribution mechanisms, encryption algorithms, intrusion detection systems, and inexpensive biometric systems (fingerprint readers and retinal scanners). To protect against hackers, spyware, computer viruses, or massive denial of service attacks, the GIG will rely on approaches such as sandboxing, code-signing, firewalls, and proof-carrying code. However, as even its champions acknowledge, these approaches have yet to be implemented, tested, or standardized.

Based upon most contemporary press coverage, the Iraq War represented the apotheosis of netcentric warfare. A more balanced discussion of events, written by Joshua Davis, appeared in *Wired Magazine*.

> The war was a grand test of the netcentric strategy in development since the first Gulf War. At least, that's the triumphal view from the Pentagon briefing room. But what was it like on the ground?… I tracked the network from the generals' plasma screens at Central Command to the forward nodes on the battlefields in Iraq. What I discovered was something entirely different from the shiny picture of techno-supremacy touted by the proponents of the Rumsfeld doctrine. I found an unsung corps of geeks improvising as they went, cobbling together a remarkable system from a hodgepodge of military-built networking technology, off-the-shelf gear, miles of Ethernet cable, and commercial software.

Nevertheless, Davis was favorably impressed with the system cobbled together. Known

as "Geeks" to the soldiers in the field,[10] the system tracked every friendly unit, weapons platform, and soldier in the theater and plotted their positions in real time on a digital map, together with all known enemy locations, plus a lot more: battle plans, intelligence reports, maps, online chats, radio transcripts, photos, and video. Soldiers accessed this system through a portal known as the Warfighting Web, which ran over the military's Secret Internet Protocol Router Network in much the same way as the public Internet.

Geeks facilitated the major operational innovation of the Iraq War: swarm tactics. In the earlier Gulf War, coalition forces advanced in a traditional linear formation, with each unit assigned sole responsibility for a specific portion of the front or held in reserve. Coordination was achieved and fratricide avoided through careful attention to the boundaries assigned the attacking units. Then, as each unit advanced, it would sweep its assigned corridor clear of adversary forces. If it met with unexpected resistance, higher command could redeploy neighboring or reserve units to overcome or in some cases seal off an exceptionally obstinate foe. Unfortunately, maintaining a continuous front is costly both in terms of manpower and equipment. Resources must be spread out all along the line and in echelon behind it. Moreover, units advancing in linear formation often cannot move any faster than their slowest element; they sometimes have no option but to engage forces blocking their assigned line of attack, battling on the periphery rather than going for the heart of the enemy's defenses; and they are easy to locate and, therefore, attack.

In the Iraq War, allied units were spread out like polka dots over the battle-space and charged with the destruction of enemy command, communications, and control centers, and supply lines. When allied units encountered strong fixed defensive positions, they often merely noted the locations and by-passed them. Dangerous enemy offensive units were engaged and, through self-coordination of local air, land, and sea forces, overwhelmed. This was possible because Geeks allowed soldiers to keep track of each other, even when they were out of one another's sight, and to come together rapidly and stealthily from all directions. Of course, dispersed attack formations avoid many of the drawbacks of a linear formations: forces are much more likely to be used to good effect, thereby saving on resources; the swarm can move forward as fast as its fastest elements – speed and surprise tend to degrade the efficacy of an adversary's response (Coram 2002); dispersed forces are hard to attack and nearly impossible to attack successfully when they move faster and concentrate firepower more accurately than their opponents.[11] The allied swarm used Microsoft Chat to coordinate action – concentrate, attack, and disperse, combine and recombine – of myriad, dispersed, maneuver units. When a problem developed, a soldier would radio a Tactical Operations Center, where the problem would be typed into a chat session and addressed by anyone online – from experts at the Pentagon to the

[10] Geeks refers to the network set up to fight the war. It's not an acronym but a nickname for the Operation Desert Freedom Theater of Operations Command, Control, and Communications Grid. However, its operators called it the G3C system, which might have suggested the nickname.

[11] The worth of dispersed formations in desert warfare isn't a new discovery. General Erwin Rommel used dispersed formations and swarm tactics against the British in North Africa during World War II, typically taking personal command at the most decisive spot of the operation. Although his tactics were unquestionably effective, visitors from the German General Staff were often nevertheless appalled by Rommel's flagrant disregard for sound principles of war.

AWACS overhead or combat teams nearby. According to Davis, not only did technology change the way allied forces maneuvered, it also changed the way they thought.

On the negative side, several observers have noted that allied forces lacked a system of systems (Cordesman 2003; Boyne 2003). Many of the information systems available at the outset of the Iraq War remained service specific. As a consequence, a network had to be quickly improvised from these systems under difficult circumstances. Not surprisingly, this improvisation worked best between the highest levels of command. The net was probably weakest at the battalion level and below. But even platforms that were relatively well integrated into the net, U.S. Air Force fighter planes and bombers, had problems with interoperability, communications, and data flow, as well as in procedures and computer support. These problems often showed up in an inability to redirect aircraft in mid-flight away from targets that had been destroyed or to surviving targets in a timely manner. As Anthony Cordesman (2003) explained:

> The US and its allies simply [did not] have a fully effective and reliable set of sensors, processors, and methods to support netcentric warfare with reliable battle damage assessment or to provide such data quickly enough to support near-real-time allocation of force assets for either tactical or targeting purposes.

Network communications problems also sometimes hindered the ability of logistical units to synchronize their movements with the combat teams they supported, causing delays in resupply. Indeed, orders from higher commands often simply out ran the ability of lower level combat and support units to interact and coordinate with each other. These problems were evidently due to doctrinal and training failures as much as to technological and equipment failures, although Davis noted that one Army analysis of information problems during the Iraq War focused on the need for improved energy sources to replace batteries.

The GIG is supposed to provide the information and telecommunication services needed to fix these problems (well, perhaps, not battery life). It will enhance the ability of soldiers to make sense of the situations they find themselves in and support collaboration, both of which are essential to promote a high level of shared awareness and to create the conditions needed for effective self-synchronization. However, the GIG won't fix what Cordesman (2003, p. 280) describes as the tendency of bandwidth creep "to push information to virtually all potential users and to centralize decision making and review." He concludes:

> It is far from clear that today's problems are truly bandwidth problems as distinguished from a failure to create efficient systems that limit the need for bandwidth, and equally unclear that careful review has been made of where the flow of information should stop, of how much information can really be used, and of the need to delegate and limit information flow.

The champions of netcentric warfare within the defense establishment go much further in denouncing existing military systems of command and control and affirming the need for fundamental changes. They argue that the military's culture, architecture, decision-making processes, and basic operating routines must be transformed to exploit IT's promise. In turn, these changes – expanding lateral information flows; increasing con-

nectivity and interoperability, collaboration, and experimentation, forming and deploying small, agile, specialized teams; and devolving much (but not all) command authority downward – call for equally fundamental changes in the way military units are configured, trained, and equipped.

One of the key change agents in this process is the defense department's Command and Control Research Program, currently directed by David S. Alberts.[12] The Command and Control Research Program has produced a series of reports dating back to the mid-1990s outlining the changes the military must embrace to enter the information age. The most recent report in the series, *Power to the Edge: Command...Control... in the Information Age* (Alberts & Hayes 2003), reiterates the conclusions of its predecessors but goes much further in emphasizing the importance of flattening command hierarchies and of devolving power down to combat and logistic teams.

Although the Command and Control Research Program has not referenced this literature, the organization they prescribe is essentially Brynjolfsson and Hitt's digital or netcentric organization (see Table 2). To folks who have learned about the US military from old war movies, this looks like an impossible stretch. To those more familiar with the modern military, however, Alberts and Hayes can be understood as saying merely that the armed forces as a whole should look more like the Special Operations Command, with its joint headquarters, exercises and training, tactics and doctrine, its relatively high degree of interoperability and equipment standardization, and its tailored task forces, composed of units that are brought together to accomplish a given mission or accomplish specified objectives, and are then reorganized or reconfigured to take on new responsibilities. Further, Alberts and Hayes' combat and logistics units would look like special forces units: relatively small, highly skilled, multi-disciplinary teams, with a lot of rank, but not many levels of command. This would still be a big stretch, but almost by definition not an inconceivable one.

At the same time that Alberts and Hayes call for the devolution of power to the edge, they are cognizant that authority and accountability are essential features of any system of command and control. Organizations that fail to allocate responsibility for performance, to align responsibility with authority, or to hold individuals accountable for the exercise of responsibility and authority are predestined to muddle and to the pursuit of sectarian interests. Their point is that is possible to move from a "concept of command that is tied to an individual commander to a concept of command that is widely distributed."

Rather than issuing detailed orders about what to do, when to do it, where to do it, and how to do it or even specifying objectives each unit is to achieve, and leaving the details of when, where, and how to the units, Alberts and Hayes would have headquarters assign missions to the units involved, but leave decisions about how they are to be achieved to the units involved to workout for themselves – they refer to this decision-making process

[12] Dr. Alberts is Director, Research and Strategic Planning, Office of Assistant Secretary of Defense for Networks and Information Integration. Prior to this he was the Director of the Center for Advanced Concepts and Technology and the School of Information Warfare and Strategy at the National Defense University.

as self synchronization. They assert that effective self-synchronization requires headquarters to provide a clear and consistent understanding of command intent; appropriate rules of engagement, and sufficient resources. These measures would high guide but not dictate details to subordinates. In addition, effective self-synchronization requires quality information, shared situational awareness; and competence at all levels of the task force and 360-degree trust – in information, subordinates, superiors, peers, and equipment.

> The Network Centric Warfare concept of self-synchronizing forces is a statement of the requirement for massive improvements not only in flexibility but also in adaptability. The elements of such forces will need to be extremely competent and inspire confidence in the other force elements about that competence. They will also have to trust one another, recognizing the value of synergistic efforts and their ability to rely on one another to achieve them. They will need to be supported by networks that allow them not only to share information but also the tools that they need to develop situation awareness and situation understanding. They will also need to task reorganize on the fly. (p. 158)

Table 2: Characteristics of Industrial Age and Information Age Organizations

Mass Military	Netcentric Military
Centralized expertise and coordination	Dispersed expertise and self coordination
Vertical integration and channeled communication	Horizontal integration and extensive communication
Large formations	Small formations
Many layers	Few layers
Specialized functional units	General purpose units
Extreme division of labor	Extensive cross-training
Narrow skill requirements	Broad skill requirements
Low training requirements	Very high training requirements
Mass and firepower	Speed and precision
Ponderous	Flexible/Agile
Sequential action and maneuver	Continuous action and maneuver
Heavy reliance on resources held in reserve to deal with the unexpected	Capacity to redeploy quickly
Limited situation awareness	High degree of shared situation awareness
Formal relations with subordinates, supporting units, and suppliers	Long-term, trust-based relationships
Low emphasis on social learning and information sharing	High emphasis on social learning and information sharing
Slow to adapt	Quick to adapt

To get from here to there, Alberts and Hayes make two critical assumptions. The first is that GIG will be constructed pretty much on time and on schedule. The second is that the American military will continue to experiment with netcentric warfare/organization, that its basic principles will be vindicated, and that this vindication will lead to consensus as to which practices matter, the recognition that these practices must be adopted together,

as part of a complementary system, and, ultimately, to the willingness of people at the top of the uniformed services to share authority.

So far development and deployment of the GIG is pretty much on schedule. This success largely reflects the military's willingness and ability to lavish resources on what is essentially an unproven concept. Few if any other organizations could afford to be so extravagant. The one area in which the GIG is admittedly behind schedule is in protecting the space-based segment of the GIG from attack, especially its resiliency in the face of information attack. This is not now a primarily a money problem. Rather, it seems that the military has so many platforms under development that there simply aren't enough skilled aerospace systems engineers to go around. Since many of the platforms under development for the military reflect the assumptions of an earlier era, one might conclude that this constraint is a harbinger of more serious conflicts to come.

My point here is that the defense department's resource allocation process, like most government budget processes, is incremental in nature. It is better at preserving the human, material, and technological capacities of existing institutional arrangements and functional communities than at creating new ones. That conclusion holds *a fortiori* where it is necessary to scrap the old to bring into being the new. For the next few years, the American military can continue to pursue parallel tracks to the future, what Alberts and Hayes refer to as the modernization track versus the transformation track, but at some point migration paths from one track to the next must be put in place. Alberts and Hayes seem to agree, they argue that (224):

> [C]apabilities are usually a product of DoD's stovepiped planning, budgeting, and acquisition processes (all of which are material-dominated) and a requirements process that is backward looking. While power is currently distributed, being vested in the Services and Agencies, this power topology is clearly antithetical to jointness and far from the warfighter edge. Over the years, there have been numerous attempts to improve the system to make it more joint and responsive to warfighters' needs. To date, these efforts have been only marginally successful because they have not fundamentally transformed these processes into edge-oriented ones. The adoption of an edge-oriented approach to the main function of DoD, the conduct of military operations, demands that these supporting processes be transformed as well.

In other words, it's not certain that we get from here to there. The Air Force, which has thought long and hard about the need to make the transition to a space and air force, still hasn't figured out how to change its resource allocation process to make it actually happen (Barzelay & Campbell 2003). What Alberts and Hayes propose looks a lot harder.

Moreover, reasonable people might conclude that the GIG and the vision of netcentric warfare it reflects misconstrues in the basic security problems of the 21st century. Low-intensity or asymmetric combat looks more like policing than it does the conventional wars the GIG was designed to fight. This fact has become increasingly evident in Iraq in the period following the defeat of Saddam Hussein's conventional military forces. British units in Iraq during the occupation have been much more effective in the areas under their administration than have American. Moreover, American efforts to apply the IT practices utilized by some metropolitan police forces to control crime in the United States

have not met with success. Perhaps, this is because the problem in Iraq is analogous to Chicago's policing problem, which is dominated by criminal activities carried out by organized gangs,[13] rather than New York's, which is dominated by disorderly individuals. Gang control requires the cultivation of community support and a great deal of human intelligence. Those are not the kinds of skills the United States military has cultivated.

Oregon's Computing and Networking Infrastructure Consolidation Project

The state of Oregon is not on e-government's leading edge, as is Ontario or even neighboring Washington State. Many of its large-scale IT development and information projects have been documented fiascos. Indeed, its best-known recent information innovation utilizes a 19th century technology, Oregon's highly successful vote-by-mail program, which has greatly increased voter participation and satisfaction and significantly reduced voting errors (especially those due to mismanagement of polling places).[14] Nevertheless, e-government in Oregon has had some notable successes.

It was one of the first jurisdictions to put procurement on the web. This process started with putting invitations to bid online. This was initially seen as a channel selection decision and was justified in terms of cutting distribution and mailing costs, but it led to a huge increase in inquiries from potential suppliers. The state's procurement officials quickly discovered that they could eliminate most immaterial inquiries by providing open access to incumbent contracts and contractor performance and still substantially increase the number and quality of bids. Eventually this led to a decision to certify all suppliers meeting or exceeding specified standards. These standards are periodically reviewed and upgraded based upon actual contractor performance, which has resulted in considerable savings to the state. At the same time it must be acknowledged that, although Oregon's government to business channel is fairly well developed, the business to government channel much less so. Oregon's procurement officials still cannot satisfactorily handle responses to invitations to bid and most requests for proposals on line.

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[13] Interestingly, the term network has been applied to guerrilla, revolutionary, insurgent, and terrorist forces for nearly 100 years. Al Queda, for example, fits the definition in terms of lateral information flows, specialized teams, and devolved authority. Regardless of the success or failure of the GIG and any organizational transformation it inspires, military formations will undoubtedly tend to become more like those of their foes.

[14] Under Oregon's vote by mail (VBM) system, ballots are sent to registered voters approximately two weeks prior to the election. Voters fill out their ballots on their own time, researching candidates or ballot initiatives if they want, and then return the ballot either through the mail or by taking it to a drop-off site, which largely offsets the effects of inclement weather on turnout. Completed ballots are inserted into an inner secrecy envelope, which is sealed, and then placed into an outer envelope, which is signed. Every voter signature is verified before ballots are tallied, which goes a long way to insuring the integrity of the ballot. The cost of elections is also lower, despite reliance on clerical employees to verify and tally ballots, because VBM avoids the cost of voting equipment. Most importantly, voter turnout has increased. In the 2004 presidential election, 85 percent of Oregon's registered voters cast ballots. The ballots are also more complete, perhaps, because voters have time to research all the candidates and measures that have been referred to them. Even for lower-profile elections – school bond elections and primaries – turnout is typically twice that of most other states.

The government to client interface is an equally interesting story. The State of Oregon provides very few services directly to clients. Most are provided through local agencies, with the state monitoring funding and eligibility. Two salient exceptions are the departments of vocational rehabilitation services and employment. Despite the fact that they are in different agencies, their service providers work together out of the same local offices and serve many of the same clients. When vocational rehabilitation placed the full menu of services on their intra-net and allowed (later required) clients to design their own rehabilitation program, their counterparts in employment quickly copied the voc-rehab interface and processes. From a client perspective they aren't really differentiated. Moreover, all employment related public services offered by Oregon governments can now be accessed by the public through a single portal – WorkSource Oregon. In the counties that fully participate in Oregon's welfare reform program, clients use a similar on-line interface to design for themselves an assistance/training/rehabilitation program leading to employment.

In the past few years, the State of Oregon has also successfully standardized and consolidated its public web portal[15] and its intranets and somewhat less successfully its access to the Internet.

The computing and networking infrastructure consolidation (C-NIC) project is ultimately aimed at providing the same kind of horizontal linkages between agencies, functions, and programs for purposes of policy analysis that currently obtains with respect to purchasing and, to a lesser extent, the delivery of human services. The goal of the CNIC project was to combine the largest of the over 30 data centers currently run by various State agencies into a single shared data center. Infrastructure consolidation was seen as the first step in a fairly long process leading to greater shared services. These may ultimately include migration to standard human resource and financial management applications and ultimately a common enterprise resource planning system aimed at planning and monitoring various

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[15] Oregon's web portal is a copy of the US government's portal. Both reflect web traffic. Consequently, while both emphasize online services, when I looked at FirstGov.gov's home page, it explained how to register for disaster assistance, find government benefits, shop government auctions, replace vital records, apply for government grants, get or renew a passport, and apply for social security, where Oregon.gov explained how to get health insurance, find a job, pay Oregon taxes (paying taxes will likely pop up on FirstGov's home page shortly after the first of the year), find Oregon road maps, and register a car or to vote. Both explained how to renew a driver's license (although that isn't a federal function, people evidently ask) and apply for a government job. Both also provided multiple directories of government agencies and functions and zip-code indexed links to elected officials. Both provided links to reference information, but FirstGov featured data and statistics, forms, graphics and photos, and laws and regulations, while Oregon.gov highlighted weather, travel and tourism information, direct access to live librarians, and whale watching. Two features of FirstGov that Oregon.gov lacks are homepages for businesses, other governments, and federal employees, plus kids, parents, homeowners, hunters, Americans abroad, college students, and other special audiences, and an extensive FAQ library. Oregon.gov is also harder to navigate laterally. On the other hand, it looks nicer. Neither uses the Internet to break new ground. For the most part the information they provide was available through other media. Few if any of the online services provided are new services. In this sense they are neither better nor worse than most government portals, although some local governments have been more creative. For example, some now provide comprehensive public access to operating data and records through Electronic Data Retrieval and Management Systems (EDRMS) on a read-only basis. The kind of groupware available on military operating grids is also missing, as are the AI clients used to make sense of complex data.

governmental functions and processes and ensuring progress towards common purposes (e.g., those adumbrated in Oregon's Benchmarks, see Scavo & Shi, 2000).[16]

For students of e-government C-NIC reflected two noteworthy choices. First, its designers chose to consolidate all of the state's data processing and storage at a single location. Indeed, the only alternative they formally considered was consolidating processing at two locations. Second, most existing state databases were built around agency general ledgers rather than geographic locations. Consequently, they look more like business' accounting information systems than the geographic information systems typical of local government or defense's GIG. C-NIC wasn't going to change that

While C–NIC is the most ambitious technology and organizational change project ever undertaken by the State of Oregon, it was largely inspired by two fairly mundane considerations. First, existing data centers were highly vulnerable to physical attack. Three small explosive devices, properly located, could have shut the state down for weeks. Second, existing server capacity was underutilized most of the time, but was insufficient to meet peak demands as configured. According to the C-NIC business plan prepared by Accenture (June 16, 2004), pooling server capacity would reduce the number of servers needed by one-fourth, allow a further reduction in the staff/server ratio from 1/13 to 1/40, and provide year-around 24-7 service. Because of the state's problems recruiting and training highly qualified IT professionals, the promise of personnel savings was seen as doubly attractive by C-NIC's governing board and not particularly threatening by the individuals concerned.

Nevertheless, given this problem diagnosis, the best prescription would seem to be grid computing, something like the GIG, for example. However, as the State's former IT manager, Mike Freese, explained (October 4, 2005), Oregon lacked "the technical expertise to implement grid computing." He continued, "The best solution to an IT problem is useless if it cannot be implemented, so we looked for an 80 percent perfect answer that we could actually pull off – from this perspective, consolidation was a no-brainer." In other words, alternatives to consolidation were never seriously considered. Moreover, considerable bipartisan legislative support existed for IT consolidation. Indeed, legislative interest preceded executive commitment to shared services. This materially enhanced the feasibility of the project, since legislative approval for the undertaking was a foregone conclusion. On the other hand, it also meant that C-NIC missed the legislative scrutiny an administrative proposal its magnitude would normally receive prior to authorization and owing to the timing of the legislative session, escaped it entirely, despite the occurrence of subsequent project delays and other problems.

The formal justification for C-NIC was expressed largely in terms of standardization, specialization, and operational cost-efficiency. The business case looked at operating

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[16] Alfred Ho (2002) alleges that the Internet encourages a transformation from the traditional bureaucratic paradigm, which emphasizes standardization, departmentalization, and operational cost-efficiency, to one that emphasizes coordinated network building, external collaboration, and customer services, "one-stop shopping" and customer-oriented principles in Web design. As this case demonstrates, the transformation is by no means inevitable or irresistible.

cash flows and depended primarily upon personnel reductions from consolidation to produce an expected payback of 22-25 months, with a payback of 55 months under the most "pessimistic" assumptions. Construction of the hardened facility, installation of mainframes, and configuration of the new network architecture was supposed to be complete by the end of 2005, with migration of operations from the three largest existing data centers to the consolidated data completed by the end of 2006. As it happens the project has fallen almost a year behind schedule, which should increase transition costs about fifty percent and delay the benefit flow from the project by at least one year. Moreover, it appears that the initial personnel savings from consolidation were overly sanguine, a possibility not contemplated by the business case. Nevertheless, if the project is reformulated as a standard capital budgeting problem, it should still produce net benefits of about $25 million, given a life of 25 years and a discount rate of five percent, which, in this instance, is the equivalent of a discounted payback of 77 months or an internal (real) rate of return of approximately 10 percent, ignoring any benefits accruing to greater security, substantially increased peak capacity, or learning-curve effects.[17]

Most of the delays associated with the project resulted from governance failures. These have been manifested in an inability to make timely decisions, but the dithering over policies and priorities seems to reflect deeper difficulties.

First, there was the conflict over the independence of the data center and the governance role of shared-services board. C-NIC's designers drew a sharp distinction between shared and centralized provision of support services. They assumed that data processing would be consolidated into a stand-alone business unit that would be owned by its clients and whose only mission would be client service. They further assumed that the consolidated data center would negotiate service-level agreements, specifying standardized services and mutually agreed upon rates, with each agency, relying on quasi-market mechanisms to link the center to its clients or customers By making data processing the unit's sole purpose, they hoped "to elevate the importance of this back-office function to front-office status" and, thereby, "increase customer focus and employee motivation and ownership." This logic was outlined in the shared-services governing board's initial report, *Shared Services: A Strategy for Reinventing Government* (DAS, August 2004). A clear and compelling discussion of the distinction between shared and centralized service units can also be found in Michael Barzelay's *Breaking through Bureaucracy* (1992), although he refers to the former as customer-focused staff agencies. The organization described by the shared-services governing board in its initial report is, of course, basically Brynjolfsson and Hitt's digital organization,

[17] Author's analysis. The 25-year project life was suggested by the planned life of the facility, which accounted for a substantial part of the up-front cost of the project. Once the consolidation is in place, it will pay for itself in five years, which is a reasonable payback period for a IT project of this kind, again not considering any of the service benefits that justified the project in the first place. The use of a five-percent discount rate is specified by DAS. It is based on the state's average nominal cost of capital and is arguably too high for an analysis focusing on real cash flows. So, even from a purely pecuniary point of view, this looks like a reasonably attractive project.

Nominally all of the members of the shared services governing board endorsed this vision. However, DAS was responsible for managing the C-NIC project. DAS is not only Oregon's central control agency (budget and financial management); it also supplies other agencies with a variety of support services – space and facilities, maintenance and landscaping services, utilities, the motor pool, etc. As it happened, project management gradually evolved into program management and, whether by accident or design, the consolidated data center came to be treated a simply another arm of DAS. Unfortunately, customer service is rarely if ever a high priority of control agencies. DAS is no exception to this rule. Its priorities are central control, economy and efficiency, and adherence to rules. Even if DAS had in this instance been truly concerned with providing the consolidated data center's clients with the best possible service, past experience with its service delivery practices might have led them to doubt its good intentions. Consequently, DAS's unilateral rejection of the shared services concept, which had led to the creation of the shared service board in the first place, disgruntled some of the agencies represented on it.

As a formal matter, the conflict over the independence of the data center and the ownership role of the shared-services board has still not been fully resolved, although DAS seems to have triumphed de facto. While there was still a chance that the shared-services board would retain ownership of the consolidated data center (and that ultimately DAS would divest itself of its service delivery function), the state's chief information officer, who had operational responsibility for the project (and who was also personally committed to the shared-services concept), was willing to move ahead only when he had the support of both the shared services governing board and his superiors in DAS. The event that marked the victory of the centralized approach to support service delivery over the shared services concept was his resignation from DAS.

Arguably, there was never any real doubt that DAS or its traditional bureaucratic vision would win in the end. While efforts were made to stress external collaboration and networking in the C-NIC development process and to encourage a customer orientation on the part of the providers of support services, the mindset of most of the participants in the process remained resolutely bureaucratic, with greater emphasis on the defense of turf than transformation. As noted earlier, the rationalization for C-NIC itself was expressed largely in terms of standardization, departmentalization, and operational cost-efficiency. Perhaps the failure of shared-services can, in part, be explained by the fact that the shared services governing board, was made up of the heads of participating agencies (Administrative Services, Consumer and Business Services, Corrections, Education, Employment, Forestry, Housing, Human Services, State Police, Revenue, Transportation, and Veteran's Affairs), all of whom were comfortable with existing organizational practices and largely unfamiliar with digital organization or even the basics of IT. Indeed, when the project began, fewer than half of the board members answered their own e-mails. Another factor of some importance is that C-NIC really didn't require significant reengineering. In many respects it was merely a case of paving the cow paths. Consequently, the project didn't really force the participants to rethink basic assumptions and, for the most part, they didn't.[18]

[18] For example, the shared services governing board never discussed making database information available to the public. See Landesbergen 2004 and Landesbergen & Wolken 2001.

Second, establishing a program management (as opposed to a project management) office has been repeatedly delayed. The program management office was supposed to be put together from personnel drawn from longstanding functional units, who had worked with different kinds of data and applications processing styles. C-NIC's designers assumed that personnel from different processing centers could be gradually integrated into a single functioning team with a common mission, regardless of their prior task-orientation or role. Cross-functional integration has proved very difficult for the C-NIC project management team. This too was partly due to agency distrust of DAS. As it became increasingly clear that things were going to be done DAS's way or not at all, their erstwhile partners turned increasingly uncooperative. Nevertheless, given differences in client needs and stakeholder perspectives, integration would probably have been very difficult even if DAS hadn't grabbed control of the data center (see Tan & Pan, 2003).

From the New Economics of Organization to Networks

To make sense of these three stories, the idea of a value chain, one of the central organizing concepts in the contemporary management literature, is useful. A value chain is simply an arrangement of activities or tasks undertaken to add or create value. Economists presume that governance arrangements make value chains more efficient. That is, they are a means of managing the sum of transaction – search, bargaining, negotiation, and enforcement – and holding costs. Of course, this is an oversimplification, but it is often a useful starting place in the analysis of institutional arrangements.

As we have seen, the traditional transaction cost framework posits two polar types of institutional arrangements:

- The market, which at the limit is a completely deconstructed value chain
- The hierarchical, vertically integrated organization, which at the limit is a completely self-contained value chain

Of course, most real value chains are composed of both markets and organizations.

There is often a tacit presumption in this sort of analysis that the mass production of manufactured goods is the normal mechanism through which organizations create value. Under this mechanism, the lion's share of the value created derives from the production or fabrication process, a repetitive or cyclical process. Consequently, most of the costs incurred in creating value vary directly with the rate and/or volume of output. These presumptions imply a particular division of labor, one in which like activities or tasks are grouped together and performed sequentially and each node in the value chain or network is an event signifying completion of a discrete task. Hence, value chains are typically portrayed as linear networks of activities in which events follow sequentially from one to the next until the process culminates in the enjoyment of the good or service in question. A complex value chain might have many tributaries, but its flow is unidirectional. Except where so-called overhead services contribute to the value chain, its activities can be coordinated via simple push-pull mechanisms, with communication concentrated at the links in the process.

There is another important tacit assumption in this sort of analysis: information is very costly and must be carefully husbanded. Consequently, this presumption further implies that the main issue confronted in the governance of value chains is vertical integration, not only to maximize economies of scale, but also to minimize overheads through economies of scope.

In one of the most widely accepted formulations incorporating this perspective, two attributes of primary and intermediate products or services suffice to answer the question of how their place in the value chain should be governed: excludability and exhaustibility. Both non-excludability and non-exhaustibility give rise to divisible prisoner's dilemma games, which often preempt efficient voluntary governance arrangements and, where that is the case, call for coordination by fiat or hierarchy.

The main normative prescription that flows from this perspective is that goods or services that are characterized by excludability and exhaustibility, so-called pure private goods, ought to be supplied via voluntary exchange, i.e., markets. Goods or services that are both non-excludable and non-exhaustible, so-called pure public goods, ought to be subject to hierarchical control. It is usually further presumed that a public-goods value chain involving final goods and services that benefit a large share of the citizenry should be managed by the state or one of its subsidiaries. Of course, this formulation logically suggests two additional patterns: excludable, non-exhaustible goods and services, so-called toll goods, and non-excludable, exhaustible goods and services, so-called commons goods, externalities, or spillovers. Under the old structure-conduct-performance paradigm the former called for some form of administered contract (at the limit, government regulation of price and entry) and the latter an M-form organizational design[19] or, at the limit, government process controls to increase the spillover when a good or decrease it when a bad. Table 3 depicts the traditional normative logic of vertical integration.

The final assumption of the structure-conduct-performance approach to transaction-cost oriented value-chain analysis is that the coordination of interdependent cooperative activities is easier under an organizational hierarchy than in markets. In turn, the coordination advantages of organizations supposedly derive from the internal homogeneity of their systems of internal contracts: communication systems, including budgets, incentive regimes and authority structures. A corollary of this assumption is that organizations that rely on a small number of suppliers or distributors can write contracts that will, at some cost, constrain the opportunistic behavior of those with whom they deal.

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[19] Because value-creation strategies are usually conceived along product-market lines (single product, differentiated products, multiple products) and because the M-form structures provide a general manager for each product line (rather than for regions or functions), the M-form is broadly endorsed as the mode of organizing and managing large, multiproduct organizations whose products are by definition heterogeneous. The broad outline of the M-form structure is one where substantial decisional authority is decentralized to agents, within the context of well-specified rules determining how agents will be rewarded for their efforts. According to this perspective, the management process mainly involves acquiring and deploying assets and, to influence this process, principals must establish a consistent set of delegated decisions, performance measures, and rewards. Organizational units in such a setup participate in quasi-voluntary value chains linked by transfer prices. Managerial rewards are based on economic quantities of interest to principals, such as returns on capital employed (holding plus embedded transaction costs).

Table 3: The Traditional Logic of Vertical Integration

Service Characteristics	Excludable	Non-excludable (economies of scope)
Exhaustible (constant or increasing costs)	***Market***	***M-form organization***
Non-Exhaustible (economies of scale)	***Administered contract***	***Hierarchy***

There is a fair amount of evidence supporting the logic of this formulation. Arguably, for example, the main thrust of the regulatory reform movement of the 1970s and 80s and the privatization of state-owned enterprises was to align governance mechanisms with characteristics of the goods and services produced. In the private sector, mergers and acquisitions that conform to the dictates of this formulation are usually successful. Those that do not almost inevitably destroy stockholder value. Finally, Scott Masten, in a study of defense businesses, showed that non-exhaustibility (economies of scale) and non-excludability (economies of scope) directly influenced vertical integration. Where intermediate products were both complex and highly specialized (used only by the buyer), there was a 92 percent probability that they would be produced internally; even 31 percent of all simple, specialized components were produced internally. The probability dropped to less than 2 percent if the component was unspecialized, regardless of its complexity.

Nevertheless, it is increasingly apparent that the principles of hierarchy, levels of graded authority, and a firmly ordered system of super- and subordination and formal contractual mechanisms are at best imperfect solutions to the problems caused by divisible prisoner's dilemma type games. One of the best ways to conserve on transaction costs is through the elaboration of trust-based, relationships of mutual dependency. These can be reflected in intra-organizational cooperation or take the form of inter-organizational alliances. For example, Toyota's legendary just-in-time manufacturing process, which produces dramatic reductions in components, work-in-progress, and finished goods inventories and thereby holding costs, does not depend on vertical integration. Instead, Toyota relies on a few suppliers that it nurtures and supports. The members of the Toyota alliance have substantial cross-holdings in each other and Toyota often acts as its suppliers' banker. Toyota maintains tight working links between its manufacturing and engineering departments and its suppliers, intimately involving them in all aspects of product design and manufacture. Indeed, it often lends them personnel to deal with production surges and its suppliers accept Toyota people into their personnel systems.

Toyota's alliance members share much more than a marketplace relationship with each other. In a very real sense, Toyota and its suppliers share a common purpose and destiny. Yet, Toyota has not integrated its suppliers into a single, large bureaucracy. It wants its suppliers to remain independent companies with completely separate books – real profit/investment centers, rather than merely notational ones – selling to others whenever possible. Toyota's solution to the cooperative games created by spillovers and toll goods

appears to work just fine. Note that the means of reinforcing trust-based alliances often includes the exchange of hostages – surety bonds, the exchange of debt or equity positions, or quasi-vertical integration. Quasi-vertical integration is common in both the automobile and the aerospace industries, and, of course, it is standard procedure for the Department of Defense to provide and own the equipment, dies, and designs that defense firms use to supply it with weapons systems and the like.

Moreover, modern information technology has made it economically feasible in a number of cases to exclude users and to design and apply demand-based multi-part tariffs to deal effectively with problems of non-exhaustibility, thereby deconstructing vertically integrated value chains. Under, multi-part transfer prices, the service delivered is decomposed to reflect underlying cost drivers and priced accordingly (your home phone bill is an excellent example of a multi-part tariff). Even where sequential value chains remain bounded by a single organization, these innovations often allow intra-organizational exchanges of services, tangible assets, knowledge, and skills to be governed by laissez-faire transfer prices, in which the buying and selling units are completely free to negotiate prices and to deal or not to deal.[20] The point is that there is more than one way to skin a cat, to cite a familiar value chain problem.

More significant, given my purpose, is the fact that technology, primarily information technology, but also the technology of social cooperation (mechanisms, processes, doctrines), has rendered traditional mass production methods obsolete by removing value added from the fabrication stage of many value chains. For many final goods and services, direct labor costs at the fabrication stage are now trivial and raw materials and components do not add value at that stage of the process. This means that most of the costs incurred in creating value do not vary directly with the rate and/or volume of output, but have other drivers. Moreover, modern fabrication technologies are largely available to any producer willing to make the necessary investment.

In a typical modern hi-tech value chain, most of the value is added in product development and design, logistics, materials handling, delivery, post-delivery servicing and maintenance and in customer relations – in government this has probably always been the norm. What this means is that overheads and purchased services and components account for ninety percent of costs. Consequently, value is defined more in terms of the quality

[20] Formerly, in most large complex organizations in the private sector, value chains were typically governed by centralized resource-requirements planning systems. Even where transfer prices were used, the financial performance of a processing unit that contributed directly to a value chain was typically measured against a standard unit-cost target; staff units were not a direct component of the value chain and were typically treated as discretionary expense centers. Only final product-market lines were evaluated in terms of return on investment or economic value added. The reasons for this are complex, but they go to difficulties associated with expensing intermediate and joint products. Consequently, attempts to find the costs of intermediate and joint products or to price them were often either excessively arbitrary or prohibitively costly. In contrast, final products have always been relatively easy to price and expense following generally accepted accounting practice. Recent advances in information technology, managerial accounting, and organizational design have made it possible and, in many cases, beneficial to treat every responsibility center in an organization as an investment center, including those providing overhead or back-office services, as proposed, for example, by Oregon's shared services board with respect to data processing.

and heterogeneity of goods and services, their availability when and where they are wanted and convenience of use, and consumer awareness and knowledge of product or service attributes, than in terms of cost or price.

Of course, this transformation reflects the fact that mass production entailed costs as well as benefits. These costs took the form of mismatches between individual tastes and preferences and product characteristics. The classic illustration of this phenomenon is Henry Ford's dictum that customers could have any color Model T they wanted, as long as it was black (blue in Canada). This potential misallocation of resources arising from the mismatch between tastes and the product homogeneity induced by mass production is directly comparable to the problem of providing public goods in a jurisdiction where people have different preferences for the good (i.e., where people cannot vote with their feet and zoning doesn't achieve efficient sorting) but face an identical tax price. In that case, where the quantity of the good provided is democratically determined (i.e., it reflects the preferences of the median voter), half of the citizens get more of the good than they want (they would rather not buy as much of the public good as they are made to) and half less (i.e., they would be willing and able to buy more). Technological changes mean that in many cases it is no longer necessary to bear these costs to obtain the benefits of productive efficiency even where value chains are concerned with manufactured goods.

Elsewhere the standard model of the value chain, based as it was upon the technical and social imperatives of the mass-production of manufactured goods, was probably never the best way to think about value creation. The delivery of services, for example, has generally involved at least some accommodation to the needs of the individual recipient. Treating service delivery, especially government service delivery, like manufacturing almost necessarily meant trying to fit it into Procrustean bed. Consequently, it may be argued that what has changed in recent years is that manufacturing has simply become more like other value creating activities.

If true, these facts ought to change the way we think about value chains in some fundamental ways, especially government's. Instead, of linear networks of sequentially dependent activities, it may make more sense to think of value-chains as parallel networks involving reciprocally interdependent relationships through which activities are simultaneously carried out. Consequently, critical paths or PERT networks are better metaphors for these value chains than are directed or linear graphs. This is the case because holding costs can often be minimized by parallel processing where all the participants in the value chain have full access to information about every aspect of the process. The activities and tasks that comprise a value chain and the technologies used to perform them still determine its optimal arrangement and its governance structure, but the main coordination problems to be solved nowadays typically involve horizontal rather than vertical integration.

Unfortunately, the logic of horizontal integration isn't very well developed or understood, in part because students of management haven't fully appreciated the need to rethink the problem of coordinating activities when information costs are low or of organizing to create value via parallel processes. Organizational economists have been especially re-

sistant to rethinking received doctrine. Fortunately, however, we have some empirical knowledge about managing projects, which is perhaps the closest analogue we have to the more general problem of horizontal integration.

Table 4: The Logic of Horizontal Integration

Project Characteristics	Developmental Process	Known Process
Multiple Core Competencies Required	***Alliances (voluntary collaborations involving multiple-organizations)***	***Systems management (hierarchical coordination involving multiple-organizations)***
Multiple Personal Competencies Required	***Teams (voluntary collaborations within a single organization)***	***Project management (hierarchical coordination within a single organization)***

The logic of transactions or information cost implies that networks are neither a distinct kind of relationship, nor necessarily superior in performance to other kinds of value chains, nor even uniquely more difficult to sustain than value chains comprehended by single organizations. "The principles of hierarchy," "levels of graded authority," and "a firmly ordered system of super- and subordination" are inimical to democracy. They are also increasingly inimical to high performance. Nowadays, it seems clear that high performing entities are more likely to be designed around team-based collaborations that successfully spread authority and responsibility throughout the organization and thereby mobilize the collective intelligences of their members.

In any case, it is reasonable to conclude that there is a hierarchy of technologies – from easy to hard, low risk to high risk, low payoff to high payoff:

- Standardized component
- Standard formulation
- Innovative formulation

And a hierarchy of applications, which goes from redeployability to asset specificity, or from a primary focus on dealing with process design factors to a primary focus on dealing with process context factors (purpose, organizational constitution and culture, and installed base of strategic thinking), which is much the same thing to me.

Equipment	Operating software	Process design	Organizational design	Capacity to use

The first two kinds of applications are what we usually think of when we talk about technology; the last three sometimes get lumped together under the rubric of business process reengineering, although there are disciplines concerned with each of the three sets of applications – process engineering, organizational design, and change management or knowledge management – which focus upon development, stabilization, and operations.

But the basic payoff from investment on the left side results from investment on the right side. Unfortunately, a lot of understanding of the left side is needed to figure out how to configure the right. Too often top policy makers in government lack the know-how to do so.

Second, the focus of this chapter has been on the use of information technology to improve communications and business efficiency for government departments and agencies. Governments at all levels are grappling with these issues. Another issue that must be faced is the meaning of the new technologies for the democratic process itself and for the prospect of enhanced citizen engagement? My focus in this chapter has been workplace democracy, of a sort. Work is always central to our lives; governments and their functions rarely are, which implies an important relational distinction. In society writ large, participation in governance is often a cost; at work, it's often a benefit. Consequently, e-democracy may better meet the circumstances of the workplace than of the polity, in terms both of workability and of practicability. Most people's mental models of productive organizations seem to be relentlessly hierarchical, however. This is a big barrier to enhanced citizen engagement, although that is what the digital organization demands.

Furthermore, in a recent, comprehensive assessment of administrative practices, Carolyn Heinrich and Larry Lynn (2005) demonstrate that government has been particularly resistant to the devolution of authority. They conclude that administrative practice is definitely not "shifting from hierarchical government toward greater reliance on horizontal, hybridized, and associational forms of governance." Indeed, they speculate that the American "system of constitutional authority … is necessarily hierarchical." If that is the case with respect to the American system with its checks and balances, it must hold *a fortiori* with respect to parliamentary systems on the Westminster model with their firm traditions of hierarchical accountability and ministerial responsibility.

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