

REAPING THE ADVANTAGES OF INFORMATION AND MODERN TECHNOLOGY: MOVING FROM BUREAUCRACY TO HYPERARCHY AND NETCENTRICITY

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ABSTRACT

This article focuses on 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 culture in public organizations. Evans and Wurster (1997) have argued 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.” We believe that we ignore the views such visionaries as Evans and Wurster 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 folks to surrender position or power without a struggle. Furthermore, homo sapiens’ need for leaders is evidently instinctive, deeply rooted in our simian brains. The need for hierarchy buttresses the status quo, even where the powerful are neither wise nor unselfish.

INTRODUCTION

In an international context, public management arrangements differ significantly from country to country, but also regionally and locally. One reason for these differences may be different civic cultures with differing views of the state and its institutions. This may appear to be obvious, but it is highly important when public management reform models are proposed and transferred from one country to others such as was the case (and still is

to some extent -- especially from developed to developing nations) with, for example, the new public management. Scholars in public management as well as international practitioners should be aware of the impact civic culture has on the possibilities and limits of concept transfer between different jurisdictions.

Having advanced this view, one precondition for a better consideration of cultural elements in public management reform is a better understanding of culture itself. Among the public management community, cultural theory has gained considerable attention. There are, however, other concepts for the analysis of cultural factors that may be relevant have not been explored to any great extent. To guide this exploration we suggest the following questions:

- What are the effects of civic culture on public management reform, and what are the effects of reform on civic culture?
- What is the influence of religious concepts on public management arrangements?
- New public management's lingua franca is English. This is, non-English speaking countries have had to translate the concept into their own language. What is the impact of this fact on different understandings of public management reform concepts and processes worldwide?
- How and through which processes do different cultures influence public management governance arrangements?

In this article we address these questions through concentration on the rationale for and methods of adoption of emergent technologies in public organizations, with emphasis on the role and impact of new information technology (IT) and its influence on organizational design and behavior.

Contemporary public sector organizations are changing significantly as they embrace information and other modern technologies to become more effective in meeting the service preferences of citizens. Part of this transition involves reformulation of thinking about organizational design. We argue that to become more effective many public organizations must respond to changes in their environments to respond to the more contingent nature of the contexts in which they operate. Some of the increase in contingency, and consequent greater uncertainty faced by public organizations with respect to how to respond, results from fairly dramatic shifts in culture that affect citizen public service preferences. Other factors influencing contingency and response include the new economics of organizations, globalization of economies and increased international market competition, demographic and workforce composition changes and the rapid pace of development of new technologies, especially information technology (IT). The fundamental problem for most public organization is how to modify their design and structure to better accommodate environmental and cultural change and to operate more effectively in consort with other organizations, including those in the non-profit and private sectors.

This article focuses on 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 culture in public organizations. Evans and Wurster (1997) have argued

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.”

We believe that we ignore the views such visionaries as Evans and Wurster 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 folks 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, we will look closely at cases based upon recent encounters with e-government in the United States: the 2004 presidential election, and the American military’s development of a world-wide information grid. These 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.

CULTURE CHANGE CONCEPTUALIZED

IN THE NEW 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 which 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

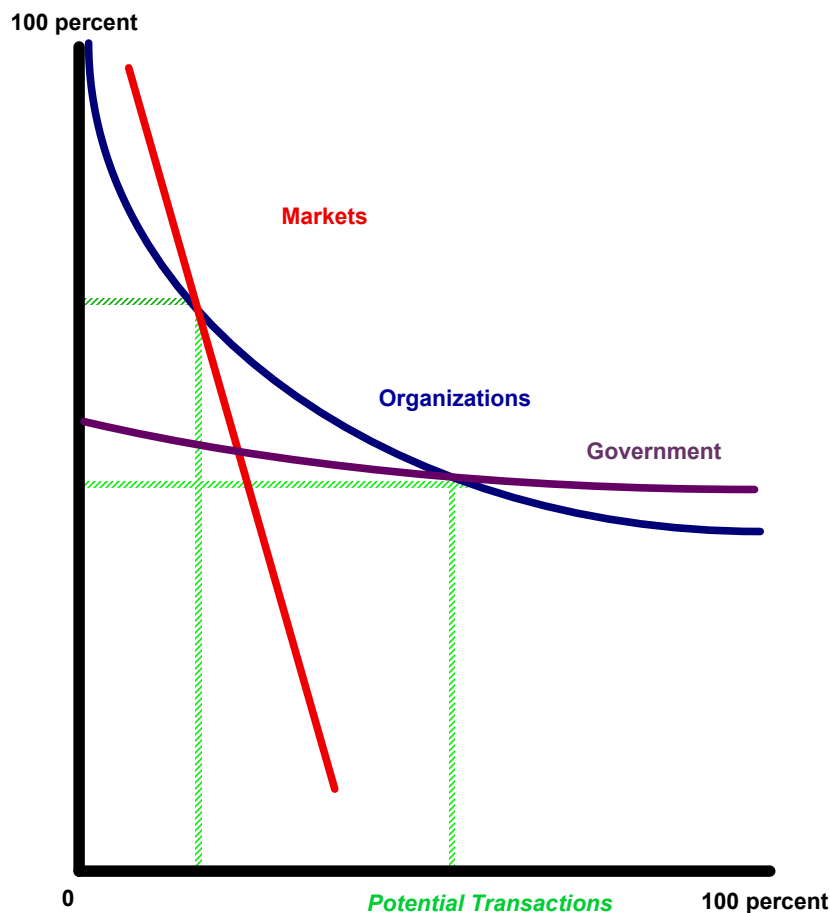
could be compensated to behave like competitors -- if information costs were lower. And, bargaining between self-interested individuals could eliminate externalities, without the intervention of government -- if transaction costs were zero. Much the same logic applies to the choice between organizations 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 will 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 though 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 though 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.

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: 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.

Figure 1: The Relative Efficacy of Alternative Governance Mechanisms



Source: Thompson, 2006, 67.

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, a fact made patently obvious by English spelling in the first case and the platypus in the second. For our purposes we accept Paul David's (1985) definition 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." (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.

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. Brynjolfsson and 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 and distributing decision-rights to front-line 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 it. 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 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.

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 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 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.

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 of the 1990s embodied the view 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 also been pioneered by IBM and Bell Labs in the United States, featured 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. With the addition of computers and digital processes and the system was complete.

To support the importance of sustaining multidisciplinary teams, teamwork and equal distribution of knowledge as a critical element of Toyota's netcentric-oriented organizational success, when this system was weakened, Toyota began to experience uncharacteristic problems in sustaining production quality. Preserving the company's reputation for quality became a significant issue in July, 2006 when Toyota announced the need to recall vehicles due to various problems. The issue became a national scandal when Japanese police accused Toyota executives of concealing product defects over an eight year period (International Herald Tribune, 2006). At the same time another Japanese corporate giant, Sony, recalled a large number of faulty computer laptop batteries and admitted to production quality control failures. These incidents led to a national debate in Japan in 2006 over the issue of whether the quality of industrial production, quality control, worker incentives, and even the quality of Japanese school systems, had weakened substantially.

Explanations for these lapses in quality of production and control ranged from criticism of deterioration in the work ethic of Japanese workers to the influence of introduction of Western-style management methods. Thus it was reported:

Some have also begun to blame the decline on recent American-style management changes, like performance-based pay, the end of traditional life-time job guarantees and increased use of temporary workers in order to cut costs. Many economists and corporate managers now say these changes, adopted in the 1990s as Japan groped for ways to revive its floundering economy, sapped employee morale and frayed the sense of teamwork that underpins a commitment to quality (International Herald Tribune, 2006, 14).

For example, in 1993 Fujitsu adopted a performance-based pay system (PBP). However, by the mid-2000 the firm abandoned the system, returning to an emphasis on group performance. Thus, computer systems and netcentric methods work only in tandem with employee education and training, and proper systems of motivation. Indeed, by the mid-2000s many American firms and public sector entities had phased out performance-based pay systems and the academic community had thoroughly debunked the efficacy of such approaches, finding that PBP had damaged worker productivity due to the introduction of compensation inequities of various types (International Herald Tribune, 2006, 14).

With these lessons in mind we may observe that the power of netcentric organization to transform productivity is dependent on a number of variables, including good human resource management. The role of new technology in enhanced productivity is highly evident as was first demonstrated in the computer industry. Many of the characteristics of netcentric organizations were already common practice in this industry by the 1990s. Owing to their technological expertise, its leaders were themselves well positioned to grasp the possibilities inherent in the technology 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, Texas, 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 and substantially boosted productivity.

Can government copy the netcentric model, organizing itself into alliances of networks, sharing top management and core competencies, investing in multi-disciplinary teamwork 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.

NETCENTRICITY AND THE 2004 U. S. 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 media. Use of this channel undoubtedly facilitated communication with the ten to 12 percent of the population that relies on 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 primarily 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 entailed) 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 ultimately substantially contributed to the Democrats' success in matching Republican campaign spending), 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 has 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 for his successes – 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* (October 19, 2004, 27), over 13,000 in April 2003, 61,000 in July, and 110,000 in October. Meetup.com peaked in February 2004, with 189,000 participants.

Furthermore, potential active supporters identified themselves through their willingness to participate in the on-line community. Only then did the Dean campaign solicit their support. 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, including push polling, 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 volunteer 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, using the Internet to transmit orders to volunteers in the field and to check on results.

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. As a result, 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 any American national election in recent history. And, while this is by no means certain, many serious analysts now attribute the Republican margin of victory to their success in getting out the vote on Election Day. Moreover, this success evidently reversed what started out to be a clear win for the Democrats.

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 doesn't really reflect the way the Democratic Party works." (Exley, 2004)

THE EXAMPLE OF THE U. S. DEPARTMENT OF DEFENSE GLOBAL INFORMATION GRID

The search for consensus on organizational design and the types of practices that matter most to evolving public organizations is dramatically reflected in the US defense department experimentation with netcentric warfare. One might be inclined to

skepticism. Military organizations have earned a reputation for conservatism. In part this is a necessary consequence of their need for resiliency and reliability in the face of severe harm. Moreover, Fountain (2001a) 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 their operating decisions down into the organization. Nevertheless, 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."

The U. S. 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 communications and computer systems into the Global Information Grid or GIG. In this article we present and analyze the GIG as if it was fully deployed by the U.S. Department of Defense (DOD), which is not the case presently but remains a goal and priority of the DOD.

The GIG is conceived of as a distributed network 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 cooperatively process information to provide users with information about local operating conditions such as the 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 agents to help them figure what they need and to get it when they need 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. 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.

When the GIG is complete, everyone in the American military will be able to communicate with everyone else on the basis of shared standards. The architectures of object-oriented programming and packet switching in telecommunications 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.

As with 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 infrastructure 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 automatically. That is to 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, is 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 layer, public key infrastructure and key distribution mechanisms, strong 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. (Davis, 2005)

Nevertheless, Davis was favorably impressed with the system cobbled together. Known as "Geeks" to the soldiers in the field, 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, along with denying them supplies. 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. The worth of dispersed formations in desert warfare is not a new discovery. German General Erwin Rommel used dispersed formations and swarm tactics against the British Army in North Africa during World War II, typically taking personal command at the most decisive spot of the operation. Although these tactics were evidently effective, visitors from the German General Staff were often nevertheless appalled by Rommel's flagrant disregard for sound principles of war.

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 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 Cordesman (2003, 280) 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 re-supply. 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, except perhaps for 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 will not fix what Cordesman (2003: 280) describes as the tendency of bandwidth creep "...to push information to virtually all potential users and to centralize decision making and review." He concluded:

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. (Cordesman (2003, 280)

The champions of netcentric warfare within the defense establishment go much further. They argue that dramatic changes must be made in the military culture, architecture, decision making processes, and operating routines to exploit the full promise of IT. In turn, these changes -- expanding lateral information flows; increasing connectivity and interoperability, collaboration, and experimentation, forming and deploying small, agile, specialized teams; and devolving much (but not all) command authority downward -- call for equally dramatic 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. Dr. Alberts is Director, Research and Strategic Planning, Office of Assistant Secretary of Defense for Networks and Information Integration. 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 (see text box). The most recent report in the series, *Power to the Edge: Command...Control... in the Information Age* (Alberts and 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. To those who have learned about the U. S. 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 (Alberts and Hayes, 2003). This would still be a big stretch, but almost by definition not an impossible 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 their exercise of responsibility and authority are predestined to muddle and the pursuit of sectarian interests. Their point is that it 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." (Alberts and Hayes, 2003, 45)

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 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. (Alberts and Hayes, 2003, 144)

To get from here to there, they rely on 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 has remained 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.

Out point here is that the U. S. defense department's resource allocation process, like most budgetary 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:

[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. (Alberts and Hayes, 2003, 284)

In other words, it is 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 has not figured out how to change its resource allocation process to make it actually

happen (Barzel and Campbell, 2003). What Alberts and Hayes propose looks a lot harder.

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. 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. 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 or, at the limit, government process controls to increase the spillover when a good or decrease it when a bad.

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, multi-product 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).

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.

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 1980s and the privatization of state-owned enterprises was to align governance mechanisms with the 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 conform almost inevitably destroy stockholder value. Finally, in a study of defense businesses, Masten (1984) 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. A better way 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 U. S. 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.

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 some cases, beneficial to treat every responsibility center in an organization as an investment center, including those providing overhead services. Our basic point is that there is more than one way to skin a cat, to cite a familiar value chain problem.

More significant, given our 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 other words, overheads and purchased services and components account for ninety percent of costs. Consequently, value is now defined more in terms of the quality 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.

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), as we have seen, 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. Much the same could be said about the building and construction trades. 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. 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 resistant to rethinking received doctrine. Fortunately, however, we have some empirical knowledge about managing projects, which is the closest analogue we have to the more general problem of horizontal integration (see Table 1).

Table 1: The Logic of Horizontal Integration

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

Source: Thompson, 2006, 81.

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.

CONCLUSIONS

We believe that networks represent a means to move from bureaucracy and hierarchy as means for coping with complex problems to consensus decision making through the use of netcentric systems and quick learning in organizations. In this regard, we believe that networks can be influenced by stakeholders and participants, but cannot be "managed" *per se*. True networks of the type defined by Evans and Wurster (1997) cannot be managed. Instead, they evolve spontaneously as entities relatively free of control and management by any party. We acknowledge that there is a school of thought which views networks as manageable (see, for example, O'Toole and Maier, 2004; Kickert et al, 1997), but we do not agree with this perspective.

With respect to how hyperarchy, netcentricity and quick learning can facilitate organizational decision making and action through the use of new technology, for our purposes 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 that may be used to achieve desired results:

- Standardized component
- Standard formulation
- Innovative formulation

There is also a hierarchy of administrative applications that goes from redeployability to asset specificity. In most cases, this involves moving from a primary focus on dealing with process design consideration to a primary focus on dealing with process context factors. These include (a) the organization's mission and purpose, (b) its constitution or governance structure, (c) its culture and the basis of its strategic thinking, and (e) its installed knowledge base. Clearly in our view, the process design factors are easier to deal with than are the process content factors.

Redeployable applications are what we usually think of when we talk about technology, i.e., equipment and operating software. Process design, organizational design, and capacity for use sometimes get lumped together under the rubric of business process reengineering, although there are distinct disciplines concerned with each of the three kinds of administrative applications -- process engineering, organizational design, and change management or knowledge management -- that focus upon the development, stabilization, and operation of job or organization-specific assets which can, in practice,

only be given meaning and effect by process context factors. Clearly, the basic payoff from continuous and substantial effort at investment in the first set of applications results from investment in the second. The focus of this article is 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. The issue that must soon be faced is: what do the new technologies mean for the democratic process itself and for the prospect of enhanced citizen engagement? Democracy may be easier to achieve in the workplace than in society. Work is central to our lives but government and its functions are not, which implies an important relational distinction. At work, participation in governance is a benefit, in society writ large it is a cost. For democracy to work as it should, this cost must be borne but, the incentives to participate are so widely dispersed in society that the absence of participation is understandable, if regrettable. This fact explains why governments so often fail to manage their business affairs properly, why corruption is prevalent in democratic and quasi-democratic political systems, and why public organizations are so resistant to management reform.

There is little reason to question the pace of change and contingency in the cultures and environments within which public organizations must operate in today's world, nor that public organizations of all types must respond to such change. Not all such change will involve evolution towards netcentricity and hyperarchy. More moderate adjustments to change are far more likely to be made before such organizations consider more radical reformulation of their design, structure and modes of operating internally and in conjunction with other organizational entities. However, we suggest that as a result of cultural and environmental change and increased contingency, some movement towards hyperarchical design and netcentric operation is inevitable if public organizations are to become more responsive citizens and to their clientele base in the twenty-first century. As culture changes so must the organizations that serve the newly emergent demands and preferences of new culture and environmental circumstance.

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