Technologically Coded Authority: The Post-Industrial Decline in Bureaucratic Hierarchies

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> "Once fully established, bureaucracy is among those social structures which are the hardest to destroy...As an instrument of rationally organizing authority relations, bureaucracy was and is a power instrument of the first order for one who controls the bureaucratic apparatus...Where administration has been completely bureaucratized, the resulting system of domination is practically indestructible" (Weber, 1978, p. 987).

The indestructibility of bureaucratic structures prophesied by Weber seems no longer a stable truth. More and more corporations in America are experiencing the de-layering and flattening of bureaucratic hierarchies. Bureaucratic authority in the workplace suddenly seems less visible and repressive. Is it reasonable to see such changes as signifying the end of bureaucratic management, as some scholars seem to suggest (e.g., Kanter, 1991)? Does post-industrial management – with its flexible work systems – introduce extensive autonomy in the workplace, reducing the level of immediate worker control? The shift in the structures of workplace governance, I argue, is not from more to less governance. The new forms of management are increasingly embedded in technology itself without reducing the efficacy and effects of earlier bureaucracies. In particular, I identify the role of programming languages – a rather understudied component of the workplace – in the emerging complex of organizational governance.

In an ideal-typical sense, the new form of management – or what I call *algocracy*, i.e., the rule of algorithm – shifts from its industrial predecessor chiefly in two respects. First, domination is less and less distributed through elaborate worker hierarchies; rather, it is increasingly effected through information and software systems that structure the possible forms of work behavior. Second, algocratic governance appears to partly transform the early subject-object relationships, where a superordinate as an observing subject must watch over the work of a subordinate. This shift is marked by an authority relation enabled through information systems and networks, where all are subordinated as nodes in such

networks. My argument relates the continued disintegration of vertical management to the emerging architecture of information systems.

I begin by discussing certain organizational transformations that are seen as undermining the importance of bureaucratic hierarchies and vertical integration. I pay special attention to the reduction in the layers of middle-management widely discussed in literatures of sociology as well as economics, business and management. I then distinguish among three modes of organizational governance – bureaucratic, panoptic, and algocratic – and emphasize the salient features of each in terms of three different ruling mechanisms: *office*, *surveillance*, and *code* respectively. The logic of algocratic forms of governance is explored methodically to demonstrate how algocracy differs from other forms. Although the chief contribution of this article is to organizational theory, the argument has its origins in empirical research conducted in New Jersey (U.S.A.) and Delhi, Noida, Gurgaon (India) in 1999-2000. Based on 50 formal and a similar number of informal in-depth interviews with programmers and executives of some 20 firms in the U.S. and India, this research focused on how India-based software companies provide a variety of software-enabled services to corporations in the U.S. This article uses some of the data collected from this research to provide clarity and illustration to what is primarily a theoretical endeavor. I end with some ideas about a research program that stems from this fresh space for questioning.

Transformations of Work and Bureaucracy

Recent years have witnessed immense changes in the American workplace. The postwar "Fordist" mass-production systems – with extensive bureaucratic hierarchies, standardization, and routinization that divested workers of decision-making and authority, but enabled high productivity and stable jobs (Harvey, 1989; Womack, et al., 1990) – are yielding to what is generally called a post-Fordist regime of flexibility, customization, and specialization (Piore and Sabel, 1984; Harvey, 1989). This transformation seems to have many consequences. On the negative side are frequent layoffs, temporization of work, and displacement of workers, as permanent jobs are increasingly replaced by temporary and part-time work with an increase in the number of people moving from regular positions to contingent ones (Pfeffer and Baron, 1988; Lozano, 1989; Callaghan and Hartmann, 1991; Doeringer, 1991; Aronowitz and DiFazio, 1994). This newly achieved "numerical flexibility" (Wood, 1989) affords organizations a way to dispense with peripheral workers while offering more participation and authority to core workers (Thomas, 1994; Graham, 1995); yet, all types of workers feel "the frustration of upward mobility without a ladder" (Cappelli, 1997). As "downsizing" has become a major route to cost reduction, many firms increasingly externalize and sub-contract other firms to reduce areas of functional tasks (Harrison, 1994; Smith, 1994; Aneesh, 2001).

There has also been a commensurate positive view of such changes not only in business and management literature about lean, less bureaucratic, participative management (Rayner, 1993; Sayles, 1993; Tomasko, 1993; Morris, 1995); a

number of social scientists have also discussed the rise of decentralized, de-hierarchized, "post-bureaucratic" organization, characterized by upskilled work, a centrality of knowledge workers, and increased worker autonomy (Bell, 1973; Hirschhorn, 1984; Block, 1990; Clegg, 1990; Attewell, 1992). Although the adoption of new flexible work systems varies with firms and industries (Osterman, 1994), such systems are said to have resulted in the empowerment and reskilling of workers and flattened hierarchies (Heydebrand, 1989; Kanter, 1991). Many big corporations are chastised for still being confined in "bureauspace" – the mechanistic culture of bureaucracy (Kanter, 1996) while Michael Piore (Piore, 1996) discerns a resurgence of small business and entrepreneurship, the decentralization of power and responsibility in large organizations, and claims that the contemporary emphasis on network organizations disproves historical visions of Weber, Schumpeter, Marx, contained in ideas of bureaucratization and alienation. The re-engineering of business organizations, especially in the United States, also seems to mark the relative decline of managerial work – the epitome of bureaucratic authority, rendering whole layers of middle managers and their staffs redundant.

The managerial revolution in the nineteenth century was an important event in the history of business enterprise. On the one hand, salaried managers as the "visible hand," according to Alfred Chandler (Chandler, 1977) replaced the "invisible hand" of market forces in coordinating the economy and allocating its resources, marking the change from small traditional family firms to large bureaucratic business enterprises. On the other hand, the rise of a non-owner managerial stratum separated *ownership* from *control*, making the binary class analysis of orthodox Marxist social theory questionable (Burnham, 1960; Geiger, 1969; Marshall, 1977). Long insulated from job insecurity, middle managers, however, seem highly vulnerable to job displacement since 1980. The restructuring undertaken by 89 of the 100 largest corporations in the United States since 1980 resulted in substantial management layoffs (Fortune, 1985). Capelli (Cappelli, 1992) found that during the mid-1980s, after controlling for individual and industry characteristics, managers were found to be more susceptible to displacement than were other workers, experiencing proportionately greater job loss from attempts to restructure and downsize organizations, and from plant closings. According to the Bureau of Labor Statistics, the number of unemployed managers in 1990 was 12 percent higher than it was in 1989 (1990). Numerous articles in both scholarly and popular literature chronicle the wholesale elimination of management layers and a non-availability of comparable positions for the displaced professionals. According to a survey conducted by the American Management Association (1995), while middle managers comprise only 5%-8% of the American work force, they made up 18% of the total level-identified jobs that were eliminated between 1988 and 1995. In contrast to vertical gradations and specialized division of labor of industrial bureaucracies, there is an emergence, according to many scholars, of a "two-tier" structures, where middle-level positions are eliminated (Hodson, 1985; Noyelle, 1987; Burris, 1993).

In their role as bureaucratic authority, managers have long enjoyed the image of a group shielded from the displacements associated with economic and organizational changes. Entrepreneurs and managers have been clumped together as members of the same social group by virtue of their position in economic enterprise, and the common problems and experiences to which their positions expose them (i.e., problems of productivity and efficiency). Further, managers, as controlling subjects, have been the ones who have made layoff decisions. But the harbinger of change, the protected supervisor of the workplace, is steadily becoming a casualty of change. The displacement of middle-managerial positions, I shall argue, relates with a vulnerability and decline in their functional significance introduced by computer systems; there is a certain dilution of managerial authority that merits attention. A vertical disintegration of corporations combined with the relative autonomization of internal units and individuals appears to question the Weberian thesis of strict office hierarchies as a defining aspect of modern organizations. I argue that it is precisely the decline of office hierarchies that makes Weberian argument more relevant than ever. I propose that some of his ideas themselves contain a hint for a shift from bureaucratic to algocratic governance.

Bureaucratic Governance

In modern times, the most important analysis of authority and power came from Max Weber (1978) in the early twentieth century. Within the framework of his ideal type of legal-rational authority, he systematically studied the rise of modern bureaucracy as a new form of power and governance. For Weber, bureaucracy represents an "efficient" ideal-typical apparatus characterized by an abstract regularity of the exercise of authority centered on formal rationality. It is marked by authority relations that erode old modes of trust and social hierarchies of estate *(ständ)* and honor, replacing them with "rational techniques" of domination. Weber situates bureaucracy within his theory of power, domination, and legitimacy, where domination is legitimized on the basis of "legal-rational rules" in contrast to "tradition" or "charisma."

One of the modes of Weber's theory construction is to formulate purified action orientations. In order to explain legal-rational domination, he shows how legal-rational action orientation emerged from a struggle against monarchical absolutism in the Continental Europe, a struggle that denied the legitimacy of any law based on precedent rather than statute (Bendix, 1960). Thus, in legal-rational governance, people who occupy positions of authority cannot act as personal rulers, and the people who obey legal rational authority are not "subjects;" they are "citizens" who obey the "law" rather than the official who enforces it. Modern bureaucracy, as opposed to earlier bureaucracies of Egypt, China and medieval Europe, reflects the imperatives of such legal-rationality, which is "formal" and not "substantive." By "formal", Weber implies a juridical formalism, where procedures of a lawsuit emerge as a peaceful contest according to fixed "rules of the game." For instance, if one cannot afford an expense to document a piece of information relevant to the lawsuit, one may be forced to

surrender certain rights to which one is legally entitled. Purely "substantive" and ethical considerations for justice cave in to the care for the predictability of its "formal" procedures.

The development of modern rational bureaucracy, being dependent on formal procedures, a money economy, the free market, and the expansion of administration, is characterized by written rules in a hierarchy of specialized official positions; impersonal offices that must be clearly distinguishable from incumbents and their private life and property; and recruitment based on qualifications, and not on personal will of the master or leader. Weber's discussion of bureaucracy is embedded in the dual context of legal-rational mode of domination and technical imperatives of formal rationality that require an efficient, methodical calculation and refinement of means to achieve an end. Thus, according to Weber, "business management throughout rests on increasing precision, steadiness, and, above all, speed of operations" (Weber, 1978, p. 974). The technical imperatives of rationality such as the speed of communication create a profound pressure for "speeding up the tempo of administrative reaction toward various situation. The optimum of such reaction time is normally attained only by a strictly bureaucratic organization" (p. 974).

Many scholars have questioned Weber's idea of the technical superiority of bureaucracy, showing how actual bureaucracies are fraught with informal structures and conflicting interests of subgroups. They also dispute the notion that formal rules are efficient. Bureaucratic formal rules could be dysfunctional with unintended consequences, as the rules become ends in themselves rather than means to ends (Merton, 1949; Selznick, 1980). Informal practices are shown to be more efficient than rigid adherence to inflexible formal rules (Blau, 1967) and formal rules may be employed by members of bureaucracies to pursue their own interests in opposition to official goals (Crozier, 1967). The above kind of post-Weberian research, despite its successes, has misunderstood Weber's approach, reducing the wider context of what Habermas (1984) calls the "bureaucratization of the lifeworld" to narrow concerns for organizational efficiency. In fact, the question of "efficiency" as an object of analysis is itself made possible by discourses of instrumental rationality, which is institutionalized in actual bureaucracies. Weber himself acknowledges that "...the bureaucratic apparatus also can, and indeed does, create certain definite impediments for the discharge of business in a manner best adapted to the individuality of each case..." (Weber, 1978, 974-75). To say that Weber did not describe "real life" is to have an impoverished notion of the real. He appeared to be more concerned with the imperatives of formal rationality that produce a whole series of effects in the real by acting as grids for the perception and evaluation of things. To Weber, for instance, the discretionary acts of modern bureaucratic officials are vastly different from the discretionary acts in earlier forms of administration, because in modern bureaucracy, even the discretionary acts require an appeal to, and evaluation of, impersonal ends; one cannot openly confess personal favors and arbitrariness (Bendix, 1960). This orientation toward impersonal rules transforms

the real world in significant ways. The question is not whether Weber's ideal type was accurate; rather, whether there are other modes of governance that may compliment Weber's diagnosis of modern organizational forms. Michel Foucault's (1979) notion of Panoptic forms of disciplinary power has attracted enough scholarly attention recent years (e.g., Zuboff, 1988) to deserve a detailed analysis as an added dimension of organizational governance.

Panoptic Governance

Panoptic governance, in short, is governance by continuous surveillance. Foucault borrows the concept of *Panopticon* from Jeremy Bentham's eighteenth century design of prison architecture in which all the cells, arranged in a circular fashion around a central tower, were made visible from the tower top:

> By the effect of backlighting, one can observe from the tower, standing precisely against the light, the small captive shadows in the cell of the periphery. They are like so many cages, so many small theatres, in which each actor is alone, perfectly individualized and constantly visible. The panoptic mechanism…reverses the principle of the dungeon; or rather of its three functions – to enclose, to deprive of light and to hide – it preserves only the first and eliminates the other two. Full lighting and the eye of a supervisor capture better than darkness, which ultimately protected. Visibility is a trap (Foucault, 1979, p. 200-01).

Foucault uses the example of the Panopticon to highlight deeper transformations in systems of governance in modern societies, reflected in the tendency to surveillance. One of the major effects of the Panopticon was to "induce in the inmate a state of conscious and permanent visibility that assures the automatic functioning of power," Foucault (1979, 201) further explains,

> In view of this, Bentham laid down the principle that power should be visible and unverifiable. Visible: the inmate will constantly have before his eyes the tall outline of the central tower from which he is spied upon. Unverifiable: the inmate must never know whether he is being looked at at any moment; but he must be sure that he may always be so.

The principles of this system of governance, according to Foucault, have spread throughout the social body with generalized disciplinary effects. A gradual extension of such mechanisms to all social realms in the last three centuries have resulted in what he calls the "disciplinary society" with the primacy of cellular structures. Therefore, it is not surprising that "prisons resemble factories, schools, barracks, hospitals, which all resemble prisons" (Foucault, 1979, p. 228). We can easily extend his analysis of disciplinary effects of surveillance mechanisms to contemporary life. The growing prevalence of video cameras in shops, stores, and

workplaces, and their use for disciplining the traffic on the streets have the effects of inducing in people "a state of conscious and permanent visibility that assures the automatic functioning of power." These surveillance systems share many features of the Panopticon, where the inmate is "totally seen, without ever seeing" and at the other end of power relations (in the central tower) "one sees everything without ever being seen" (Foucault, 1979, p. 202). In the contemporary world, surveillance is exercised not merely through camera-like devices; it is also put into effect through computer technologies that record the behavior of the user for the same purpose. Combining imaging and tracking technologies with relatively invisible practices of what is called dataveillance, computers seem to have enhanced the power of surveillance.

Surveillance systems at the workplace, even more than earlier industrial bureaucracies, implement the model of invisible authority and visible workers at the workplace. The new information systems can invisibly translate, record, and display the worker's behavior, making it universally visible without the managerial eye, which is now inscribed in the system itself. As Shoshana Zuboff (Zuboff, 1988) points out, information technologies not only *automate* operations (that is, replace the human body by technology to carry out similar processes); they also *informate* operations, that is, they also generate information about such operations (for example, by keeping a log of each and every step of a process). The generation of information about work behavior and productivity has obvious disciplinary effects on the worker. While the *gaze* of the information systems does not pose an immediate threat of being rebuked or discovered, it is more universal as it freezes all work activity for possible future scrutiny. Logs of labor make escape a theoretical impossibility. For instance, to detect manufacturing defects in products, "the same PC that is used to conduct the functional test also logs the test result by product serial number and technician. These results are then logged to a database, tracked over time and routinely analyzed to identify common failures. Failures can be statistically linked to specific technicians...." (Quiggle, 1997, p. 194). Software systems have not only appropriated the function of failure detection, which is no longer subject to managerial oversight; they have also made it difficult for the worker to escape the organizational gaze. There is a variety of enterprise-level software systems (e.g., LittleBrother), for example, that keep an ever-watchful eye on employees' internet behavior, offering real-time monitoring in addition to generating customized reports automatically. Similarly, there are also small hardware devices that carry out similar surveillance functions. KeyKatcher, a maker of a small keystroke logger that records employees' keystrokes for scrutiny, advises employers to "use the KEYKatcher to monitor employee computer usage compliance. Employees will spend less time browsing the internet and sending e-mails if they are being monitored" (KEYKatcher, 2001).

Managerial enterprise is clearly related to the exercise of control through the *watch* or the *look*, i.e., making the worker, and the work performed, more visible for the managerial eye. One of the early management pioneers and successful

managers Robert Owen (1771-1858) described his introduction to managing workers as follows:

> I *looked* very wisely at the men in their different departments, although I really knew nothing. But by intensely observing everything, I maintained order and regularity throughout the establishment, which proceeded under the circumstances far better than I had anticipated (Owen, 1857, p. 31-32).

The phenomenon of the *look* is crucial to the exercise of managerial authority. Phenomenogically, Sartre (Sartre, 1966) has described the "look" as an attempt to capture the freedom of the other. Being watched or being visible limits the possibility of different modes of being to a frame of reference established through existing power relations. Foucault's (1979) concept of the "gaze" carries similar import. The *look* or *gaze* employed in surveillance systems is an instrumentally interested look. It is not only the responsibility of authority to look at the worker, but also the responsibility of the worker to keep themselves in a position from where they can be easily looked at. The panoptic *look* does not take place behind the back of social language; it carries defined expectations; scales against which one will be, and is being, judged. The *look* distinguishes good from bad; therefore, it is important not only for punishment but also for reward. It is important, therefore, for the employees to be visible, especially when they are performing well, as there seems to be less possibility of good work being noticed than bad work going unnoticed. Visibility thus emerges as an intrinsic aspect of panoptic governance.

Both bureaucratic and panoptic forms of power derive their efficacy by what Weber would call formal rationality; that is, they transform certain "formal" aspects of governance whereby power no longer flows from persons; it is more and more embedded in rules, positions, architectures and devices. Algocratic governance also uses formal rationality, or rather, pure reason of symbolic logic, to produce another set of effects. It is the third mode of organizational governance. While bureaucracy signified the *rule of office* and the Panopticon symbolized the *rule of gaze*, algocracy exemplifies the *rule of code*.

Algocratic Governance

Bureaucratic domination was exercised by making people accept the authority of impersonal rules and regulations. Technical imperatives of algocratic governance, however, do not require bureaucratic orientation and authority relation to the same degree. Programming technologies have gained ability to structure possible forms of behavior without much need for orienting people toward accepting the rules. Under the algocratic mode of governance, work is controlled not by telling the worker to perform a task, nor necessarily by punishing the worker for their failure, but by shaping an environment in which there are no alternatives to performing the work as prescribed. For example, while filling in the "fields" on a

computer, a bank teller cannot type in the wrong part of a form, or put the address in where the phone number goes. Software templates provide pre-existing channels that guide action in precise ways. Within an algocratic framework, authority does not need legitimacy in the Weberian sense, because there are either no alternative routes or such routes are themselves pre-given and programmed. There is no comparison that can be used to de-legitimate authority. This is what I imply by *algocracy*, where authority is more and more embedded in technology itself, or more specifically, in the underlying code, rendering the hierarchical system of authority relations less useful. Thus, the indestructibility of bureaucratic structures predicted by Weber is less valid despite (or because of) the continued advance of formal rationality. Contemporary forms of management increasingly rely on algocratic governance embedded in software codes and templates, without completely replacing the order achieved through typical bureaucratic organization.

Programming languages have empowered the smart machine with the ability not only to point out the incorrect steps taken by the user, but also to suggest at times the correct method to the ignorant worker. Unlike the unlettered machines of the industrial age, the new machine has the ability to communicate commands as an authority in addition to faithfully carrying out commands of the worker. The ability of the computer to assume the role of the controlling authority – apart from being the object of work – turns the unidirectional relationship with industrial machines on its head.

I identify a set of factors that allow us to talk and think about algocracy as a distinctive mode of organizational governance.

[TABLE 1 ABOUT HERE]

This comparison does not imply that these are separable organizational forms, as they actually are three dimensions of governance that exist side by side in actual organizations. However, the supremacy of a particular dimension of governance has specific effects in actual organizations. Algocratic governance implements a flatter, network-based power relation, where all are subordinated as nodes in computer networks, giving rise to what is called "horizontal corporation." As Manuel Castells (Castells, 1996, p. 176) points out, "The main shift can be characterized as the shift from vertical bureaucracies to the horizontal corporation." The decreasing significance of managerial hierarchies, I contend, does not imply the decline of "management" or the liberation of the worker; rather, the new structures are invested with a different form of power. The continued disintegration of vertical management may in fact be linked with the rise of technologically coded authority. For the sake of convenience, we may explore algocratic governance along three lines: *work structure, workflow, and work-related decisions* to understand its connection with vertical disintegration and horizontal integration. As work structures themselves become "templates" of

organization, there is a need to rethink what we mean by organizations and work structures.

Work Structure

Organizations are above all specific cases of *organization* or the structuring of work. Most research on bureaucracy has tended to focus on real organizations populated by people and bounded by walls. Against this sociological realism, Weber's original idea of legal-rational *organization* of organizations was a little lost. With the analysis of algocratic governance, I wish to get to back to the basis of organizations, that is, *organization*, or the *ordering* of work. As I pointed out earlier, the basic difference between bureaucratic governance and algocratic governance is that the organization of the first revolves around impersonal, written rules that everyone must adhere to, whereas the second is based on underlying codes that do not necessarily require rule adherence, as they tend to channel work behavior along programmed logics. Let me describe how banking software is developed by programmers in India for a U.S.-based bank and how this code then governs actual work behavior. A systems analyst described the development and function of such application software as follows:

> Application software is…like banking as an application. What we do is support your daily requirements for banking applications like daily branch opening, your account handling, your money transfers, everything, the routine tasks for which there is a need to build the software. It's very routine because most rules are documented. You just have to implement those business rules into software programs.

Installed on the transnational platform of a bank's distributed computer networks, these applications turn rules and routines into algorithmic code, acquiring a certain power of structuring, for instance, how a bank teller would perform her tasks. Let us see how this kind of bank application guides and governs a bank teller's work behavior in her own words:

> You log on, do your password, then your screen opens...there are functions on the top, that say twenty one is a cash advance, twenty two is..., and it does nothing until you put in the number for the transaction you're going to do. Then there is a list of the amount—is it cash, is it check, does he want cash back...and [the relevant screen] pops up; if it's over a certain amount, another screen pops up and says, did you check ID. So, it's pretty basic, it takes you step by step through the transaction. It says, now give the customer this much money, and asks you if this amount is correct. And so you fill in numbers for all the sections, hit enter, it will take you to the next step. You will validate the thing you're holding – the check, the slip, the transaction – and then it asks if there is anything else you want to do for the customer. And you say yes, or no.

This example of algorithm-based structure clearly demonstrates how the worker's subjective orientation or adherence to rules is less important than following the steps suggested by the program, which tends to disallow other ways of doing work. Even if organizations use a graphical interface that seems to offer more choices for the worker, all choices are already pre-programmed. Such software applications are not confined to banks alone; their use is quite widespread in many different kinds of organizations: airports, hospitals, department stores as well as state institutions like the Department of Motor Vehicles to cite a few. Algocratic governance relates to this programmability of work. Most institutions in the United States have injected the dimension of algocratic governance into their existing bureaucratic controls.

The dominance of algocracies has not yet reached its highest point. In my interviews, many systems analysts corroborated the findings of Salzman and Rosenthal (Salzman and Rosenthal, 1994) that institutions prefer to replicate the previous work structure into software systems despite the systems analysts' contention about their inefficiency. This insertion of algocracies into bureaucratic work structures is taking on different forms. Corporate attempts to completely re-engineer their organization through various Enterprise systems (e.g., ERP or Enterprise Resource Planning systems) not only exemplify efforts at avoiding the inefficiencies of earlier systems; they also point to a rethinking of the very structure of organization. Just as the organization of McDonald's tends to utilize certain fixed principles (e.g., the physical arrangement of the kitchen and counter along with cooking devices and workers) in their franchises around the world, it has become possible to create templates of work organization coded in software programs that can be customized to a business's particular needs. In a certain sense, software companies in India are in the business of selling *customized organizations*, complete with ready-made templates and modules of supply chain management, payroll, job costing, sales force automation, product lifecycle management, and customer relationship management.

Algocracy also points to another kind of organizational governance – governance by *simulation*. It would be a mistake to think of the term "office" in Microsoft Office suite as merely metaphorical, as this Office does contain folders, files and databases that can fill up real file cabinets in real offices; it does contain an accounting department that can download real data from the banks and process it; soon it will also contain a secretary that can take dictation. Numerous customized enterprise software systems being developed by software vendors in India do not merely represent the real; rather, they produce the real. These simulated organizations running on silicon chips do not necessarily follow real organizations; rather, they precede them. Reality follows the simulacrum, which is "…the generation by models of a real without origin or reality: a hyperreal" (Baudrillard, 1983). Enterprise software systems are not merely the automation of existing processes, as many software professionals themselves understand it; they also relate in a deeper sense to an imagining of processes that do not yet exist but need to be born. Quite like models of cars and machinery designed through CAD

(computer aided design) systems, simulated models of organizational processes facilitate a controlled outcome. Elaborating upon the concept of simulation, one of the computer scientists stressed various advantages of simulating expensive products "in the mind of your computer. If you are doing a space shuttle, for instance, they can't afford to send five space shuttles to figure out some mistakes first. So, they simulate everything inside a computer to see if it will work." Similarly, coded templates of organization do not only mimic and express already existing structures; they also reflect the rise of a technology that can potentially program an imagined system of governance even before it actually exists. There are surely a number of failures in the implementations of such imagined processes, but failures themselves point to a definite transformation in conceptions of control and governance. Programmability means governability.

Algocratic governance allows corporations to experiment with a different physical structure as well. If the same organizational template can be accessed via remotely located data servers, corporations attain the ability to tap globally dispersed cheaper human resources with more ease. Some major software companies already have a structure where their teams are based in both the U.S. and India, working on the same project within an algocratic framework. One CEO describes this work practice as follows:

> So there are several components. There twenty people working in the U.S. and 20 people in India. They are doing different things. But the mother ship is the same; it goes into the same product. So you are working on the same database, you are working on the same code. You are working on the same thing…we are sharing…a data server [and] we are working on those systems. Except for the fact that we are in India, we could be sitting across the room from those people and working.

I would not go as far as this claim to working across the room, but transnational data servers do allow a certain immediacy and structure that was not possible earlier. Due to algocratic governance structures, there is a development of vendors that specialize in providing staff from different corners of the world to corporations that agree to use their platform code. I reproduce the statement of one of such companies below followed by a screen shot of their platform:

> [This company] offers a unique solution that combines the benefits of contingent staffing with virtual access to a global workforce. Using [the company's] technology to break the geographic constraints of traditional staffing, companies can now deploy remotely located knowledge workers in a task-based environment. In other words, the [company's] system enables customers to define their work as tasks that can then be dynamically assigned to a global network of virtual knowledge workers (MagicStaff, 2002).

[FIGURE 1 ABOUT HERE]

The ability of organizations to employ workers not located within the walls of their organization does not mean that the centralized structures of organizations will suddenly disappear. As corporations must abide by national regulatory laws, their structures will continue to carry the conventional image of firms located in specific national spaces with definite physical address and staff. But the expansion of algocratic regime points out a certain blurring of enterprise boundaries within the existing framework. The explosion of practices commonly described in economistic terms as *subcontracting* and *outsourcing* signals a business-to-business integration established through the rule of code. If customers call their bank in the U.S., using their 1-800 number and the phone rings in a firm located in India that can provide various services by directly accessing customers' accounts in real time via data servers, there is a development of a governance structure that extends beyond the unitary model of organizations registered with the state. If travelers are automatically given the option of renting a car from a rental company on the website of an airline after purchasing an air ticket, this organizational integration is clearly a result of code-based governance, or more precisely, SOAP (Simple Object Access Protocol) Toolkit, which allows workflows not only within an organization but also between separate firms.

Workflow

One of the important roles of managerial, especially middle-managerial, layers in bureaucracies has consisted of coordination and integration of the intra- and inter-divisional workflows to effectively achieve organizational goals. As Chandler (Chandler and Hikino, 1990) explains, in the modern multi-unit bureaucracies, with their factories, sales, purchasing offices, and research laboratories, managerial layers have been responsible for coordinating and integrating the flow of work within and among units. Each unit has its set of lower-level managers, whose activities are monitored and coordinated by middle-level managers, operating at multi-unit levels. The latter, in turn, are monitored and coordinated by top-level executives. Algocratic templates of workflow seem to appropriate this middle managerial role, enabling information networks to provide immediate and safe passage between different units in the process of distribution and production without the need of an intermediary. In many companies, factory workers can schedule and coordinate their own production, as they have direct data links to major retailers, getting sales data before their better paid more senior managers (Kanter, 1990). Such direct workflows are possible for transnational organization of work as well. Indian software companies have developed network-based information systems, facilitating purchase order creation, status monitoring and goods delivery for companies like Gap that are directly connected with their globally scattered vendors. Clearly, by computer networks, I do not imply those network forms of organizations that require high degrees of mutual knowledge and trust as discussed, for example, by Walter Powell (Powell, 1990); rather, my analysis relates to code-based interaction within and among firms that

does not require the same amount of mutual trust and knowledge. For example, a purchase order application installed on the machines of buyers and suppliers creates a code-based network where work progress and order status are instantly available on everyone's screens in the network.

Algocracies employ a variety of network codes that govern workflows according to underlying schemes, constituting a complex of techniques for control and access: electronic firewalls, gateways, packet filters, and proxy servers. Firewalls, for example, can examine each message entering or leaving the network, and block those that do not meet the specified security criteria. Firewalls can be implemented in both hardware and software, or a combination of both. Similarly, packet filters can look at each packet entering or leaving the network, and accept or reject it based on user-defined codes. Algocratic governance is itself a combination of all such techniques, such as network codes with their electronic protocols, coordination, and architecture aid human nodal points with data servers. Internet-based groupware packages integrate standard desktop applications to let organizations build far-flung project teams and transcend the need for coordination and integration through managerial layers.

The emergence of bureaucracy was intimately related to the problem of managing information and records about different units in the process of production. Record keeping was a major technology of power (Boyes-Watson, 1995) allowing better managerial control over the work process. Assisted by mass storage devices and eternal memory, algocracies also act as systems of permanent registration, coding all information in digital formats complete with electronic management and control. The real time data storage application means the data is collected and entered into the system once, and everyone can look at the same thing simultaneously, though with differentiated access for data manipulation. It implies that information now flows directly between lower level units to top management, with the reduced need for middle-managers. The findings of many studies that computerization is correlated with fewer hierarchical levels and two-tier occupational structure (Hodson, 1985; Noyelle, 1987; Smith, 1993; Wellman, et al., 1996) does not necessarily mean looser control or the absence of authority. It points to a transformation in systems of governance, a migration to programmable governance based on the rule of algorithms, of signs and codes. The symbolically coded governance also affects decision-making processes at work.

Work-related Decisions

Many software applications, with their ability to calculate precise probabilities of different outcomes, can potentially drag the processes of managerial decision-making from the heights of human acumen, knowledge, and intuition to a routine agreement with the decisions proposed by software programs. Thus, managerial decision-making in some areas may be reduced to technical tinkering under algocratic governance. In this regard, a technical person may be able to perform

the managerial job much more effectively. It is not surprising that the so-called corporate re-engineering is centered around what is termed as broad job definitions (Osterman, 1994), meaning that two or more jobs could be handled by the same person. I found that engineers, especially those with management degrees, were in high demand as managers both in India and the United States due to their technical knowledge about information systems, and their ability to wring every drop of functionality from software applications.

In the financial world, the domination of technical calculation in decision-making based on exact probabilities is on the rise while the tacit and intuitive dimensions of managerial training as well as the knowledge of financial and market behavior decline in importance. As an example of such decision-making, even in matters as grounded in long-term training as the behavior of financial markets, programs are developed and designed to speculate without the help of a financial manager. Although managers still enjoy higher status, their decision making powers are increasingly coming under the rule of code, as software systems (e.g., Stock Smart and Meta Stock) used by financial brokerages are able to provide online real portfolio management, earnings analysis, research, industry roll-ups and stocks alerts, while watching markets for the client. An analysis of the explosive rise in the online participation of ordinary Americans in stock markets in the 1990s must include the variable of embedded algorithms.

Perhaps, more than any other area, it is in transnational financial markets that algocracies dominate complex decision-making. A near explosion of currency trade in the last twenty years has resulted in a situation where the annual value of traded derivatives now far exceeds the value of global production. The complicated currency derivatives[1] cannot be based on mere intuitive decision-making. They need complex algorithmic models of possible future risks in order to tame chance. In fact, "the invention of complex derivative structures [is itself], in no small part, capital's adjustment to new technology" (LiPuma, 2001). The importance of sophisticated applications coded with equations to price relationship between risk, volatility, and time is undeniable for the speculative financial markets, especially when, as LiPuma notes cleverly, "it's no longer the real economy driving the financial markets, but the financial markets driving the real economy" (LiPuma, 2001).

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[1] "Derivatives" is a collective term for securities whose prices are based on the prices of other (underlying) investments, such as stocks, bonds, commodities, or currencies. The main derivatives are: futures, options, swaps, warrants and convertibles. The attractions of derivatives from an investor's point of view are: large profits can be made on a small stake, because they offer 'leverage'. Because derivatives are essentially a bet on which way the price of the underlying instrument is going, one can make money whether the market goes up or down, which is not true if you invest in shares where one only makes a profit if the share price rises. Derivatives can be used to reduce the risk (or hedge) of an investment in the underlying instrument. In general, derivatives are high-risk investments and not suitable for the ordinary investor.

Code-guided decision-making is clearly on the rise. Most investment groups increasingly employ software loaded, for instance, with the Markowitz mean/variance model to govern the risks and rewards of alternative investment strategies. The rise of algocracies affects the decision-making process of some hallowed professions as well. A physician's expertise of diagnosis and treatment is yielding to standardized data bases coded with current medical advances, whose enormity and sheer pace are difficult to govern by doctors themselves (Skolnick, 1996). Drawing on research around the world, doctors can use such programs for drug tracking, diagnosis and treatment (Lang, 1997). Bell's (1973) social forecast about the rise of a post-industrial society, based on an "intellectual technology," is coming true. However, contrary to some of his expectations, it is not the knowledge worker who has acquired the greatest importance; algocracies with their templates and expert systems have emerged as the backbone of what Castells calls the Network Society.

Bureaucratic and panoptic forms of governance have never been confined to organizations alone. They have deeply influenced the general social structure as well. Just as bureaucracy reminds us of the bureaucratization of the lifeworld (Habermas, 1984), and panoptic governance has come to populate our streets, homes and shops with surveillance devices, algocracy too extends beyond organizations, as the rule of code directs a person's action operating automatic teller machines in a logical step-by-step approach and the code behind Internet transactions channels customers' behavior along specific directions. Programming has emerged as a form of power that structures possible forms of action in a way that is different from bureaucratic and surveillance systems. The promised introduction of XML-based web services also points to a direction where software will no longer be sold as a "thing" to be purchased but as "code" that will provide various services to the user on demand. This transition is discussed among programmers as a shift from "products" to "productized services." Corporations that plan to provide such services expect not only greater profits, but also greater control over the whole process through algocratization of services and commodities.

Conclusion: A Research Program

The rule of code or algocracy is in fact part of a new widespread discursive formation under which phenomena are understood and analyzed in terms of *code*. It is not merely work that emerges as a problem of coding; our existence itself is understood in terms of code, i.e., genetic code. The biological realm becomes a system of information transmission via DNA strands; human genome emerges as a *book* of life. The widespread discourse of *code*, *language* and *information* refers to a different discursive space on which it has become possible to inscribe labor and life. Thus, *coding* emerges as an *a priori* method of ordering confused and chaotic world, its surfaces and boundaries, carrying hidden parameters that determine the way life and world confront one another. It is no mere accident that

programming and *coding* are intrinsic to an emerging transnational labor order, producing different relations of power, authority and governance. The rule of programming code or *algocracy*, I have argued in this article, adds a third dimension to the already existing *bureaucratic* and *panoptic* systems of governance.

As programming languages increasingly become an ever-present horizon of work, there is an immense opportunity to develop a research program that addresses a number of issues raised by the organizational adoption of the algocratic modes of governance. There are some studies that have investigated the matter in terms of new efficiencies and flexibility gained by organizations, but they have done so mostly within the paradigm of economic instrumentality. There are other studies that have directly dealt with the problems and promises of "code" but only with regard to the Internet and its emerging laws (Lessig, 1999). We need to know considerably more about the factors that explain the ecology of code-based governance structures. I sought to point to a number of key issues, but we have only begun to examine the relationship between governance structures and work experience. What is the role of state policies in the development of particular algocratic management systems? The new systems are embedded not only with functionality but also with mechanisms for worker control. What systems are resisted by workers and why? One of the key characteristics of code-based systems is clearly their programmability, resulting in ever-changing algocratic forms in order to attain new functionalities and new orders of governance. How does it affect the worker in terms of skill requirements? At a glance, it does seem that this requires a frequent renewal of skill sets for both software writers who need to keep abreast with latest languages and technologies (e.g., C++, Java, Java beans, Pearl etc.) and software users who must learn ever-changing applications. Is their a relationship between programmability and temporary and flexible employment?

Further, what is the connection between algocratic forms of management and globalization? Earlier, I made a brief comment on how such governance structures facilitate distributed networks of firms and corporations at a transnational level. Does this mean that the current round of globalization differs from the earlier periods of capital expansion mostly in terms of algocracy? Studies of globalization must engage with not only the substantive flows of capital and commodities but also with algocratic modes of integration that make such flows possible in the first place. The programmability and inter-translatability of processes require us to rethink the categories with which we try to make sense of organizational change and governance and assess their effects on laboring populations.

Figure 1

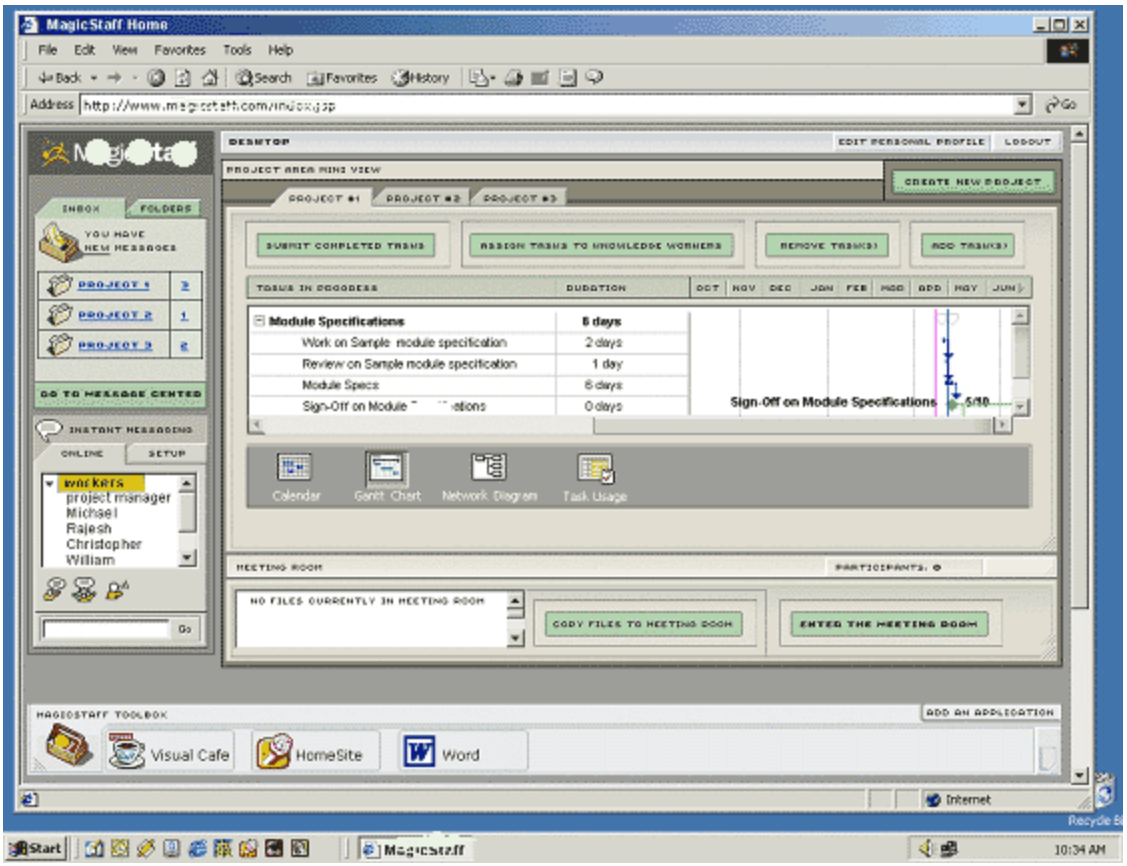
MagicStaff Home
File Edit View Favorites Tools Help
Address http://www.magicstaff.com/index.jsp
DESKTOP
EDIT PERSONAL PROFILE
LOGOUT
PROJECT AREA MINI VIEW
CREATE NEW PROJECT
PROJECT #1
PROJECT #2
PROJECT #3
SUBMIT COMPLETED TASKS
ASSIGN TASKS TO KNOWLEDGE WORKERS
REMOVE TASK(S)
ADD TASK(S)
TASKS IN PROGRESS
DURATION
OCT NOV DEC JAN FEB MAR APR MAY JUN
Module Specifications 6 days
Work on Sample module specification 2 days
Review on Sample module specification 1 day
Module Specs 6 days
Sign-Off on Module 0 days
Sign-Off on Module Specifications 5/10
Calendar
Gantt Chart
Network Diagram
Task Usage
INBOX
FOLDERS
YOU HAVE NEW MESSAGES
PROJECT 1
PROJECT 2
PROJECT 3
GO TO MESSAGE CENTER
INSTANT MESSAGING
ONLINE
SETUP
project manager
Michael
Rajesh
Christopher
William
Go
MEETING ROOM
PARTICIPANTS: 0
NO FILES CURRENTLY IN MEETING ROOM
COPY FILES TO MEETING ROOM
ENTER THE MEETING ROOM
MAGICSTAFF TOOLBOX
ADD AN APPLICATION
Visual Cafe
HomeSite
Word
Internet
Start
MagicStaff
10:34 AM

Table 1: Typified Comparison of Forms of Organizational Governance

Forms of Governance			
Key Features	**Bureaucratic**	**Panoptic**	**Algocratic**
Dominance	Hierarchy	Surveillance	Code
Action Imperative	Procedures	Visibility	Programmability
Flexibility	Low	Medium	High
Integration	Vertical	Horizontal	Horizontal
Managerial Power	High	Medium	Low

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