The Emergence of a Computer Integrated Manufacturing Facility: A Case Study

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ABSTRACT

This paper outlines the results of a case study of a large manufacturing firm that is transforming its techno-organizational culture toward a form of computer integrated enterprise. It focuses on the developmental experience of its "factory of the future" in the context of corporate-wide re-structuring. The case study method uses a form of critical discourse analysis of written and spoken texts which mark the unfolding internal changes within this firm. To organize the case study meaningfully, four overarching research questions were designed to address the findings and summarize the implications of such a development on issues related to Taylorism, computing technology, anthropocentric design, and workplace democracy. The case study reveals that the corporate transformation is laden with labor conflicts and institutional contradictions as it strives to achieve greater operating efficiencies via computing technologies, organizational innovations, and cultural renewal.

Keywords

CQI, CIM, FOF, anthropocentric, technocentric, Taylorism, neo-Taylorism, neo-Fordism, workplace democracy

PROLOGUE

During the 1980's and until quite recently a certain class of institutional discourses and practices have been on the rise in the United States, Europe, and elsewhere. For national security, economic growth, and general well-being, many government agencies, industry leaders, and trade associations have been advocating major rethinking and reshaping of corporate industrial practices to counter real and imagined global economic threats.

A number of firms have instigated major shifts in corporate policies and strategies which involve campaigns of Total Quality Manufacturing (TQM), Continuous Quality Improvement (CQI), and others.

Corporate re-engineering and re-inventing rhetoric has been evident throughout the industrial landscape in this period. These corporate discourses and practices have focused on several techno-organizational concerns including the importance and empowerment of the individual worker, promotion of a more self-managed workplace, participatory organizational decision-making by employees, facilitation of cross-disciplinary design and production teams, and the realization of more open channels of organizational communication. These discursive practices are generally intended to construct efficiently run, "high performance" workplaces that promise reduction in design and production cycle times. Such corporate strategies also promise reduced operating costs, flattened organizational hierarchies, narrower organizational spans, in part achieved through work-process standardization and consolidation of operations.

Moreover, these corporate plans also stipulate lower labor (human) levels through automation technologies, promotion of "leaner manufacturing," and an improvement in labor relations. Furthermore, many such corporate re-structuring plans and developments are in the midst of corporate-wide integration and consolidation of traditional tasks, job descriptions, and organizational functions in both the office and the factory.

As part and parcel of the above general vision, plans, and discursive practices, corporate goals and objectives are being realized, in part, by the ubiquitous use of computing technologies and information networks. These technologies have increasingly become an integral part of the emergence and the institutionalization of a new techno-organizational infrastructure usually named Computer Integrated Manufacturing (CIM) or Enterprise Integration (EI).

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A CASE STUDY METHOD

As part of my doctoral dissertation[1] I recently conducted a case study of a major manufacturing concern, Kadco[2], which is undergoing such changes as outlined above. The case study was conducted in the 1990-1995 period. Kadco, in its many operations, has been and continues to be in the midst of re-structuring and transforming its constellation of operations toward a realization of CIM. The material or findings of the case study was divided into two basic parts: 1) a general description of the overall internal corporate transformation which is in the process of integrating all of its key operations or CIM elements, and 2) a specific focus on the development of a Factory of the Future (FOF) facility, a major manufacturing CIM element.

In the spirit and multidisciplinary tenor of Science, Technology, and Society (STS) studies, this case study provides a non-objectivist, value-sensitive and interested writing on the technological, organizational, and cultural character of the unfolding CIM phenomenon. Its methodological conception and analytical perspective attempt to model the phenomenon in a primarily textual mode that produces a particular contextualized writing constructed from a reading of selected internal and external texts. This mode of inquiry seeks a provisional, non-totalizing, and non-reductionist understanding of CIM. It is based on a critical discourse analysis[3] of the written and spoken texts of CIM at Kadco that mark the particular internal technological practices and organizational culture in the context of the politics of production. It is a certain ethnographic account of discursive practices that mark the genealogy of the emerging corporate transformation toward CIM as inscribed in particular events, speeches, documents, newsletters, video accounts, meetings, trip reports, telephone conversations and interview statements.

As the case study progressed it became clear that executive-promoted corporate vision and plans were designed to re-structure and re-direct the workplace toward an operational CIM techno-organizational culture as defined, articulated, expressed, and inscribed in a spectrum of written and spoken discourses. These discourses or texts embody the goals, values, and direction of techno-organizational culture changes desired by Kadco and its leadership who authorize, promote, and foster their progressive institutionalization. The case study addresses four research questions:

1) What are the dominant characteristics that mark the corporate transformation toward CIM?

2) What role do advanced computing and information technologies have in the context of CIM and cellular (flexible) manufacturing in bringing forth an anthropocentric workplace (discussed below)?

3) To what extent does CIM depart from traditional, Taylorist or technocentric production modes?

4) Does an anthropocentric mode of production provide a sufficient framework for the emergence of workplace democracy?

What is signified by technocentrism and anthropocentrism? It is argued[4] that internal organization of the factory of the past, in the context and confluence of a capitalist political economy and the predominance of instrumental reason, institutionalized technoscientific and socioeconomic forces to objectify and commodify workers.

At the turn of the twentieth century, a particular relations of production reached a new apogee, especially in the United States, with the emergence of Taylorism. The American engineer Frederick W. Taylor introduced a systematic process for the radical rationalization of work known as Scientific Management. Taylorism became a predominant mode of production and gained the support, albeit not wholeheartedly, of many industrialists. These management principles may be summarized as follows: (1) Shift all responsibility for the organization of work from the worker to the manager; management should do all the thinking relating to the planning and design of work, leaving the workers with the task of implementation; (2) use scientific methods to determine the most efficient way of doing work. Design the worker's task accordingly, specifying the precise way in which work is to be done; (3) select the best person to perform the job thus designed; (4) train the worker to do the work efficiently; (5) monitor worker performance to ensure that appropriate work procedures are followed and that appropriate results are achieved.[5]

In this system, workers are collectively exploited to

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[1]Shakarian, Arek The Emergence of Sociotechnical Computer Integrated Manufacturing at a Large Corporation: A Case Study, Ph.D. dissertation, University of British Columbia, November 1996.

[2] Fictitious name of a North American firm.

[3]Foucault, Michel The Archaeology of Knowledge New York: Pantheon Books, 1972, Appendix, "The Discourse on Language."

[4]Marx, Karl Economic and Philosophic Manuscripts New York: Vintage, 1975 pp. 335-336.

[5]Morgan, Gareth Images of Organization London: Sage, 1986 p. 30.

maximize productive efficiency. Time and motion studies of working habits, a characteristic of Taylorism, treated the individual worker as an object, at times characterized as a stupid animal like an Ox.[6] Scientific Management, with its rationalistic, scientistically ordered organization of work coupled with the privileged position of management over labor may be labeled as technocentric. The intrinsic dehumanization of this mode of work is well established and quite exhaustively documented. Subsequent humanizing management practices, most notably the Human Relations school led by its chief protagonist Elton Mayo at Harvard, attempted to soften the blow delivered by the technocentric agenda of Taylorism.

The Taylorist discourses and practices produced the fractionalization and fragmentation of work while objectifying the worker, conceiving him/her as just another factor of production. General characteristics of this mode of work are: deskilling of tasks, objectification of worker's knowledge, hierarchical and centralized corporate decision structures, and non-creative routinized work that privileges the organizational machine over the human being.

This technocentric mode of work is allegedly being transformed by a radical re-structuring of organizational practices at some corporate sites, such as Kadco. Increasing attention is focused on organizational schemes that purportedly produce a more anthropocentric workplace environment that priveleges the individual over the machine. These emerging modes of work allegedly support the enhancement of worker's skills, promote more team-based production processes, decentralize organizational decisions, encourage creativity in the context of flatter hierarchical structures.

CASE STUDY SUMMARY

Analogous to the above outlined trends, Kadco executives also initiated two major and interrelated corporate strategies in the late 1980's to radically transform the firm from a traditional large manufacturing operation with a bureaucratic multi-layered hierarchical structure to a comprehensive re-structuring corporation that adopts a number of new techno-organizational and cultural features.

The stated purpose of these plans was to create a more efficient, productive, and competitive enterprise that meets the competitive challenges of global capitalism. The two major corporate strategies that laid the groundwork and outlined the CIM plan and vision were: a Japanese inspired program and culture of CQI, and a major computing and information-based automation strategy. These major Kadco strategies and plans set in motion concurrent and interdependent developments to transform it toward a new corporate operating structure and culture named CIM. Although these two plans covered Kadco in its totality, a major manufacturing unit, the Factory of the Future (FOF), was to be developed along a European-inspired corporate philosophy of Sociotech.

Sociotech principles valorize corporate/union cooperation, employee participation in organizational decision-making, and general employee involvement in the design and running of the workplace with self-directed teams. The FOF was to be a radical departure from Kadco's traditional culture vis-à-vis manufacturing similar to General Motors' Saturn plant and Volvo[7]. Great enthusiasm was displayed by those workers who were initially introduced to the new Sociotech paradigm at a key 3-day workshop jointly sponsored by Kadco with participation from the blue and white collar unions. With its major philosophy of "joint optimization" of workplace social and technical processes, the Sociotech ideal was promoted in the midst of the corporate-wide computing automation plans to re-structure production toward a highly automated, computing and information technology monitored and controlled cellular manufacturing configuration.

The FOF also consolidated previously disparate production sites into a computer integrated manufacturing facility. It was a prototype production site representing the major manufacturing element of CIM supporting the corporate-wide agenda to informationally interlink all the computer-mediated CAD and CAPP techno-organizational processes in the office to the CAM[8] production processes within the factories.

The principal goals and objectives of these corporate-wide CIM plans were expressed by Kadco executives and documented in various texts. These were: decrease operating costs by 25% every subsequent five years and reduce production cycle time by 50% via standardized work processes, consolidated organizations, and integrated

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[6]Dickson, David The Politics of Alternative Technology New York: Universe Books, 1975 p. 56.

[7] See for example Joe Sherman In the Rings of Saturn London: Oxford University Press, 1994; and also Dietrich Brandt Advanced Experiences-European Case Studies on Anthropocentric Production Systems, Second Version, Proposed on behalf of FAST (Forecasting and Assessment in Science and Technology) for the International Conference, "Production Technologies, Social Organization and Competitiveness," Gelsenkrichen 24.-27.9.1990.

[8]CAD (Computer-Aided Design), CAPP (Computer-Aided Process Planning), CAM (Computer Aided Manufacturing).

operations. In other words, they intended to achieve these goals by a comprehensive production time and organizational space compression of its many functions and departments.

Kadco executives and leaders also desired a significant cultural change exuding a less authoritarian, more participatory and harmonious working relationship among all employees irregardless of rank, title, position, or class. They also sought more openness in interorganizational communications and to deconstruct traditional barriers between organizationally different groups. In this corporate culture each member would understand their role in the hierarchy vis-à-vis the overall vision and mission of the firm. The corporate rhetoric also valorized the individual as "the most important resource." These corporate-wide plans and cultural changes were being gradually institutionalized throughout Kadco and the FOF from the late 1980's through the 1990's.

The case study findings revealed that the institutionalization of these plans produced a number of political, cultural, and techno-organizational contradictions. As the often heard rhetoric of "win-win" and "working-together" was slowly being institutionalized and the techno-organizational cultural transformation was underway, major cracks began to appear. Attempts to apply U.S. Department of Labor's Interest-Based Bargaining approach to harmonize management and labor relations turned sour as conflicts and antagonisms surfaced between them. In this period, Kadco had already begun "downsizing" its workforce by about 30%, especially those employees categorized as "support." Both white and blue collar employee trust and morale diminished significantly as many felt that the company exhibited a hostile attitude, contrary to the newly forming corporate culture. During contract negotiation posters were designed by the white collar union (WCU) which lampooned Kadco's CQI philosophy and practices. Some executives felt threatened during this period and reemphasized their power and legal right to control the distribution of pay. The emerging corporate techno-organizational culture seemed to be in jeopardy.

STUDY IMPLICATIONS: FOUR RESEARCH QUESTIONS

Before addressing the four specific research questions I make some general concluding remarks about the case study findings at the FOF, in particular, and Kadco, in general.

First, there should not be any doubt that the relentless and continuing effort of executive led and promoted corporate cultural changes are radically transforming Kadco's lifeworld. Significant shifts in how people function within and without their organizations have marked the transforming corporate culture. Many of the new organizational discourses and practices have become institutionalized. It is as if a whole new society, an internal world and concomitant worldviews have been constructed with characteristic language, values, symbols, and icons. Alternative views are entertained, but must ultimately be aligned and harmonized with top-down mandated perspectives, values, and goals. So pervasive is the inculcated monoculture at Kadco that even its CEO later raised some concerns over the disturbing and growing uniformity in employee thinking and organizational practices. Yet, the dominant corporate rhetoric and discursive practices of CQI and the rest of the programs continue to mold the workplace in its own image. The power of culture as it is repeatedly articulated and expressed by corporate elites in a culture of power is also progressively, even at times reluctantly, being assimilated by employees and other "stakeholders." This has fostered the formation of a new regime of production, even in the midst of conflicts and contradictions.

Second, the emerging techno-organizational infrastructure of CIM has already contributed to the demands of new computing based skills and modes of work in the office and factory. Many categories of skills are being redefined as the locus and focus of work is increasingly centered around computer-laden workstations. Increasingly, workers have become more attached to their local computing machinery. With the plethora of design, analysis, text-processing software tools which are also electronically interlinked within and without Kadco, a new spatiality of work is being constructed causing traditional organizational boundaries and means of inter-organizational communication and information to be blurred. What is experienced as "real" is increasingly being mediated through computer constructed images, texts, signs, and symbols. The organizational lifeworld is progressively experienced through the digitized and simulated world(s) of "cyberspace."

Third, at the FOF, the particular mode of institutionalization of advanced automation technologies and concomitant workplace culture to achieve an integrated cellular manufacturing environment has been generally unsuccessful. The many techno-organizational failures and shortcomings stem from three basic practices: 1) the original Sociotech organizational plans and approach profoundly raised expectations among FOF workers as they were to be co-participants in the design and operation of the factory. But, as the FOF began to take shape employees felt that their ideas on how to run the plant were not being seriously considered by management resulting in mutual

mistrust; 2) consistent with corporate plans to significantly reduce labor, the "downsizing" at Kadco and FOF further contributed to the low morale of shop floor employees in particular; and 3) some of the advanced computing technologies did not perform according to corporate plans and were eventually discarded. Technocentric automation concepts vis-à-vis human skill and knowledge have played an important part in undermining a smooth manufacturing operation at the FOF.

Fourth, the existing hierarchical corporate structure and undemocratic organization of work also jeopardized the FOF transition process toward a self-managed, team-based workplace environment. Corporate and union disagreements over many of the emerging practices in the workplace ultimately proved detrimental to the realization of the kind of workplace envisioned. Issues of unequal economic power became glaringly evident as existing corporate values categorize labor as a cost of production, as another resource. The potential democratizing possibilities of the corporate re-structuring inscribed in the Sociotech agenda are subverted and contradicted by this fundamental economic practice which pits capital against labor. Contrary to concerted corporate efforts to depoliticize and relativize the realities and effects of class and power in the workplace, the very corporate policies and rhetoric created even greater conflict between FOF and its employees.

Research Question #1

The first case study question restated here is: What are the dominant characteristics that mark the corporate transformation toward CIM? I have identified four major unfolding characteristics as follows:

1) The corporate transformation toward a CIM-type enterprise exhibits design/production time and organizational space compression. The stated purpose of these strategies is to significantly cut production costs. Dominant Kadco rhetorical discourse articulated by executives but also reiterated by many workers helps to justify corporate re-structuring. A sense of urgency marks such discourse stemming from claims of real or imagined global competitive threats;

2) neo-Fordist and neo-Taylorist modes of work are being promoted, particularly on the factory floor where workers are urged to be multi-skilled and trained to function as interchangeable (flexible) resources within and across manufacturing cells, achieved in the context of an emerging corporate culture which attempts to harmoniously colonize workers into its regime of production;

3) significant planned and actual elimination of office and factory staff, particularly those classified as support or overhead are creating an internal competitive and marketized workplace conditions where groups of workers become both suppliers and customers in their interorganizational relations;

4) the company with formal support of both white and blue collar unions are attempting to forge cooperative "win-win" relationships that mask and obscure the differential relations of power between all enterprise "stakeholders," in particular and most importantly, the authority and power relations between management and labor. Yet such attempts are still ridden with traditional workplace conflicts which are especially apparent during periods of both white and blue collar union strikes against Kadco as the different interests of capital and labor are poignantly expressed in the discourses and practices of a predominantly class-based corporate infrastructure.

The above statements briefly describe the dominant thrust of Kadco's re-structuring direction interpreted in the context of both the external and internal texts vis-à-vis the emergence of CIM. Its executives and management, on behalf of the interests and logic of capital, are primarily concerned, whether wittingly or unwittingly, in satisfying corporate interests in the context of expressed rhetoric about imagined or real competitive pressures. The discourses of "national security," "economic growth," "quality improvement," "value-addedness," and "working together," among others, are intertwined with a set of organizational practices which are intended to reduce production costs and increase organizational efficiencies. Thus, in the emerging mode of CIM, production time is even more radically conceived as a commodity, to be continuously measured, reduced, and compressed with no apparent sense of its potentially dire human consequences.

Also, increased management control of the space of work is sought via the cellular arrangement of CIM where labor mobility and task flexibility is exploited. This labor flexibility on the factory floor is desired so that each worker may substitute for another by a strategy to increase worker skill levels through "skill-based pay" schemes. Labor, as that particular form of human resource that contributes to the cost of production, is to be either eliminated or minimized in this new workplace. Work is being re-structured in the context of both increased levels of automation on the factory floor and the office with resulting intensification of work for remaining workers. Finally, in concert with and in contradiction to the above plans and emerging practices, labor peace and worker harmony is being sought and inculcated in the emerging regime of work.

To summarize, Kadco executives are using extensive technical, organizational, political, economic, and cultural

means to meet the demands for lower production costs and greater organizational efficiencies, and as a result are increasing their power and control over many aspects of a computer-integrated, business process standardized, and organizationally consolidated corporate operations. However, contrary to the above desired re-structuring, class antagonism and labor unrest did surface and was particularly pronounced during contract negotiations. Many workers, even some in managerial ranks, are victimized in this process as large numbers have lost their jobs and those remaining are under increased threats to conform to a peculiarly disturbing characteristic of corporate reality which rhetorically seduces and colonizes organizational members to uncritically and loyally follow executive constructed versions of corporate reality.

Research Question #2

The second case study question is: What role do advanced computing and information technologies have in the context of CIM and cellular (flexible) manufacturing in bringing forth an anthropocentric workplace?

Even when one eschews technological deterministic perspectives as I do, it is difficult not to be overwhelmed, impressed, amazed, and engrossed by recent advances in computing and information techniques. It is quite misleading to suggest, however, that the undeniable computational power, speed, and range of flexibility, the capacity for storing immense quantities of data, information, rules, procedures, and simulations of all varieties of workplace related physical and organizational models and processes are emerging in a vacuum, divorced from the social and organizational contexts of operation.

For example, the automation of higher levels of human cognition (design and planning functions) is being attempted with varying degrees of success (design) and sometimes failure (planning). However, what is intended, or desired to be, in part, inscribed in the computer and information based machinery are the social texts, the value-laden discursive practices, symbols, semiotics, signs, and icons that form an internal machinic construction of the complex web of external human and social relations. The internal machinic code does not so much re-present these external texts, but constitutes a certain machinic dialect which operates in a complex interdependence vis-à-vis its human, organizational, and social context. Whether CIM-related computing and informational technologies help or hinder the realization of a more human-centered or anthropocentric workplace is dependent on these extra-machinic texts.

In another sense, the complex interdependence of different internal and external social relations may motivate possible alternative conceptualizations of work, work procedures, and organizational processes. This may lead to the conceptualization of different roles for machines and humans corresponding to alternate design goals, objectives, and values. Alternative techno-organizational designs, configurations, arrangements, and social values, in part, may become inscribed, programmed, or "written" in the advanced computing and information infrastructure of CIM. These machinic codes and texts therefore may embody Kadco's discursive practices and values which are historically, socially, and geographically constituted. As such, they are also inscribed by the larger social and cultural environment within which it operates. It is in these senses that the role of such computing and information technologies is assessed to be either contributing to a more human-centered workplace or not.

So what is the verdict? I conclude that elements of both technocentrism and anthropocentrism are, in general terms, inscribed in the machinic processes at Kadco. In the context of hierarchically mandated corporate goals of increased automation and further elimination of human labor under the values and modes of production marking capitalist relations of production, the computational and informational infrastructure, for example, the CAPP system, may be considered to be technocentrically structured (rule-based design, objectification of human knowledge), conceived and constructed to reduce the number of process planners who represent a human component of the cost of manufacturing under capitalist accounting categories.

Another element of CIM is the CAD technology, which on the one hand has essentially enables a whole new techno-organizational means to integrate design, while on the other hand has been designed to completely eliminate the traditional modes of drafting. Nevertheless, it has opened a new techno-organizational space, perhaps a contradictory space, within which designers now cooperate more closely and holistically (human-centered) as their coordinated designs, enhanced by this new technology, are conjointly performed in a more cooperative manner in contrast to traditional modes of work where greater fragmentation of the division of labor was the norm. Yet, perhaps contradictorily, since current designers are at the same time further isolated and physically removed from direct human contact both at the local organization site and also geographically (or spatially) as they operate predominantly through the mediating presence of this technology while ensconced at their individual workstations.

Moreover, work measurement metrics, task monitoring, and job tracking, which form part of the corporate re-structuring vision, plans, and practices are also enhanced

by the intrinsic power of CIM computing and information technologies. The use of metrics have, in part, broached latent conflicting conditions in a workplace where organizational power and its accountability are distributed and stratified hierarchically, undemocratically, and ultimately along class divisions.

Such techno-organizational practices also undergird the utilitarian or instrumental space where the radical rationalization (or automation) of work processes in the name of efficiency may assume priority over their potentially de-humanizing effects. If, however, metrics are thoughtfully designed to monitor, track, and perhaps aid in the improvement of work processes and organizational performance in a workplace context which openly practices and promotes human-centered values and democratic practices, their potential intrusive violence may be critically assessed, resisted, and mitigated. Human-centered and democratic workplace conditions may help to minimize such obtrusive measures contrary to hierarchically organized undemocratically governed workplace where metrics may otherwise be used indiscriminately to track and monitor people, either openly or in secret, creating a virtual Big Brother or Panopticon workplace culture.

Also ambiguous is the generally enhanced conditions of communicative networks which enervate the emerging organizational culture of CIM at Kadco. Corporate agendas, policies, news, organizational rhetoric, and cultural propaganda all circulate in these computer and information based communicative networks accessible to most employees. Yet, organizational members, empowered and encouraged by a more open communicative culture, whether technologically mediated or not, may otherwise be unwilling or uncomfortable to express their thoughts and feelings openly and freely in the CIM structure and culture. Unfettered communication, in the emerging culture at Kadco, is therefore not guaranteed on either the Web or other internal communicative networks if and when an employee wishes to express freely critical thoughts and ideas internal to the organization without fear of reprimand.

Therefore I conclude that Kadco, although practicing some anthropocentric means expressed through its CIM technologies is primarily engaged in the rationalization of work and automation of human labor and is constructing a more technocentric workplace in conjunction with these technologies.

Research Question #3

The third case study question is: To what extent does CIM depart from traditional, Taylorist or technocentric production modes?

First, Taylorist organizational practices create fragmented and de-skilled work which are conducive to increased levels of management control of work processes and workers. Since the emerging techno-organizational culture has valorized team-based cellular manufacturing where multi-skilled training and work would be the norm, this suggests a reversal of a traditional Taylorist agenda and may be considered to be anthropocentric.

Second, intensification of work measurement and metrics that monitor a host of production parameters increases both temporal and spatial control of work by managers, even when such metrics (e.g. video measures of work processes) are conducted by workers themselves under self-directed teams. These practices are highly reminiscent of work efficiency measures characteristic of Taylorist time-and-motion studies, and hence may be labeled neo-Taylorist.

Third, work is increasingly being standardized and formalized and where variations, not just in parts and products, but people are to be minimized. These practices constitute a de-humanization of work and hence may be categorized as technocentric in contrast to human-centered work which may display a high(er) degree of freeplaying creativity.

Fourth, workers who are empowered to make more job-related decisions in the emerging self-directed teams find themselves facing stiffer competition from other workers according to the proposed "skill-based-pay" schemes. These conflicting conditions are both technocentric and anthropocentric. Increased decision-making, namely, more involvement in decisions that affect the worker, is clearly contra-Taylorist. However, this brings stiffer competition with other workers who may even be team-mates. This creates an internal Social Darwinist condition (technocentric vis-à-vis Taylorism) in the workplace where workers who are more fit, i.e. have accumulated more skills irregardless of their seniority status, are more likely to survive the next "downsizing" since they would be considered to be a more "valued human resource."

Fifth, traditional organizational power and control roles associated with management and supervision are also in the process of change. The transforming hierarchical organizational structure is also threatening their authority, creating uncertainty and ambiguity among these individuals. These organizational instabilities are producing more conflicts and contradictions between management and labor as the control of the work process change at the FOF.

Finally, a cybernetic model of CIM seems to be emerging at the FOF where the factory rhythm is preset by master schedules and Just In Time (JIT) processes are the norm and a hierarchical communicative structure between

management and labor is marked by discursive practices that signify complex control systems (feedback, feedforward). Yet, both management and labor, albeit in different capacities, power relations, and roles, are "enframed" and embedded in this non-human CIM infrastructure. This constitutes a certain technocentric mode of work beyond Taylorism. It requires a new mode of analysis to understand this "enframing" cybernetic regime where human beings occupy and are occupied by such non-human complex techno-organizational entities irregardless of their user-friendly features or even if they have been constructed with participatory design criteria and values.

In conclusion, contradictory conditions exist at Kadco and the FOF such that elements of both technocentrism (neo-Taylorism), and anthropocentrism uneasily co-exist in the emerging complex CIM infrastructure. From a local, team level perspective, many anthropocentric practices (e.g. multiskills, self-directed teams, self-inspection of parts quality, self-maintenance of cell machinery) depart from traditional Taylorist practices, yet these practices are embedded in a corporate level, management monitored (e.g. metrics), and computing system driven (e.g. JIT) regime of work that exhibits technocentric characteristics of neo-Taylorism. Perhaps the emerging regime of production could be characterized by paraphrasing Taylor's statement: In the past the System was first and in the future the person must be first....and the System must be more first.[9]

Research Question #4

The fourth case study question is: Does an anthropocentric mode of production provide a sufficient framework for the emergence of workplace democracy?

First, the emergence of a cooperative, more anthropocentric workplace is negated by increased competition among workers and their persistently voiced fears of losing their jobs. Corporate strategies and management decisions have a direct bearing on their very livelihood. Such crucial decisions, however, are not in their jurisdiction, as workers serve in an undemocratically controlled organization even though they may be represented by white or blue collar unions.

Second, although early enthusiasm and expectations of being equal partners with management and participating in key design decisions were quite high, many workers became increasingly disappointed at their levels of participation as: 1) the Sociotech culture waned and Japanese CQI culture became dominant, and 2) management co-opted significant decisions from both blue and white collar workers since they, according to both factory and office workers, were primarily concerned about receiving feedback in the hierarchical structured cyberneticized CIM regime. This negated, perhaps, a possible transition or evolution (not in any deterministic or organicist sense) from a nascent anthropocentric workplace, as envisioned originally at the FOF, to a workplace structured to incorporate a mixture of representative and participatory democracy where all members of the workplace have the legal right to engage in organizationally and culturally legitimated democratic expression of workplace decisions.

Third, managers, as "process owners," wield more power and control when using depersonalized and depoliticized metrics. Management is induced to extract greater efficiencies from work processes with the application of such metrics and are specifically rewarded by their superiors according to measured performance levels.

Fourth, since workers, in effect, constitute another resource, component, and production cost in the cyberneticized regime together with parts, products, and processes, distinctions between humans and machines/processes are not seriously valorized when Kadco managers are using such metrics. As discussed above, in a democratically based organization (e.g. Mondragon)[10] such issues would be more openly and freely evaluated in an environment which is legally and culturally structured with democratic and anthropocentric principles.

Fifth, the governance of teams in an undemocratically run workplace poses serious morale problems since contradictions and conflicts are created when inter-rivalry and competition among workers is intensified by the very corporate strategies which are conceived, in part, to foster a more cooperative, harmonious, and anthropocentric workplace.

Sixth, executive elites attempt to undemocratically construct an organizational and corporate Reality by a number of "impression management" schemes and ritual-

[9] A play on Taylor's statement: "In the past man has been first; in the future the system must be first," Taylor, Frederick Winslow The Principles of Scientific Management New York: Norton, 1967 (1911) p. 7.

[10] This seems to be generally the case as reported by R. Morrison in We Build the Road as We Travel Philadelphia, PA: New Society Publishers, 1991; Mondragon does not promote production "inefficiencies," according to its charter, but defines its operating capital as "community" or "social" capital (see for example p. 98).

laden rhetoric. This practice reinforces and legitimizes paternalistic conduct and constructs a corporate culture, which, in its extreme expression, is devoid of anything but their version of a proper, appropriating, and totalizing vision of the corporate lifeworld.

Seventh, in contrast to a more democratic and self-managed organization, employees (including management) are mandated to align and harmonize their work and jobs to top level executive established goals and objectives in the corporate hierarchy. This is practiced under a friendly hegemony of "pay for performance" management schemes which institutionally controls and coerces organizational members to loyally follow the dictates of the regime of production, a regime where economic power, in the form of pay and other perquisites, is directly controlled by Kadco management (this was one of the most hotly debated issues during a WCU contract negotiation). This lack of ownership and the highly skewed, unfair, and uneven sharing of the corporate produced economic fruits generated, for the most part, by both factory and office workers in the context of the labor power of new CIM technologies have created alienated feelings of not belonging, not having ownership or "buy in" and have also contributed to major morale problems in the office and in the factory.

It is quite clear that Kadco has not embarked on a sure path toward democratizing the workplace. Yet, due to certain anthropocentric practices which are emerging there under the CQI agenda and the waning Sociotech practices at the FOF, some seeds may have been inadvertently and unwittingly planted which may later flower under the right organizational politics and cultural conditions to begin a movement that demands not only anthropocentric modes of work, but a workplace which is indeed radically anthropocentric, i.e. is both structured and cultured democratically.

EPILOGUE

Finally, and perhaps ultimately, the case study helped reveal that, contrary to the emerging corporate cultural rhetoric on the importance of people for Kadco's success, the potential power of the CIM automating technology is designed, in part, according to corporate plans to displace workers consistent with the traditional categorization of workers as labor and hence considering them as a cost of the production process. This widely accepted practice poses a particularly glaring contradiction when workers are asked to contribute in reducing production costs and help the corporation thrive or survive. This ultimate anti-human-centered corporate practice has not gone unnoticed by some Kadco management. For example, this sentiment was voiced in a recent Kadco engineering management meeting: "...many of the engineers believe the company equates engineering to the cost of doing business and a reduction in engineering is a reduction in the cost of doing business."[11] Such cost accounting characterizations of engineering may contribute to a host of organizational contradictions and behaviors among engineers (e.g low morale). From another study the conclusions were drawn that: 1) Cellular manufacturing is as much about people as machines; 2) On those areas where the cell approach is beginning to work it is due to the shop floor worker; and 3) Employees must be allowed involvement in cell design and process design or they will not own cells.[12]

I note in closing that the particular story of CIM at Kadco and the FOF is not over. The many techno-organizational and cultural changes have created institutional conditions which demand a critical re-examination of the fundamental assumptions of work which is in the midst of a radically shifting political economic environment of local/global capitalism and the presence/absence of advanced computing, information and telecommunications technologies. The future trajectory of Kadco is not linear, predictable, or easily discerned as uncertain, complex, unstable conditions of socioeconomic and technoscientific forces and powers interpenetrate its increasingly porous institutional borders in an emerging world which I am naming PostModern TechnoCapitalism.[13]

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[11] See Reference 1, p. 250.

[12] See "Cellular Manufacturing: How to Achieve Competitive Quality Through Job Design" Jane Goodyear and Stuart Spraggett pp. 189-191 in Keith Case and Steven T. Newman eds. Advances in Manufacturing Technology VII London: Taylor & Francis, 1994.

[13] In a general sense, PostModern TechnoCapitalism names a multidimensional set of intertwined local/global social, economic, technoscientific, and cultural transformations signaling, given particular focus here, major workplace and organizational shifts from traditional (bureaucratic), Fordist, and "rigid" modes of production to Post-Fordist, Post-Industrial, and "flexible" manufacturing modes as briefly described in this paper. See for example Chapter 4 "Reflexive Accumulation: Information Structures and Production Systems" in Scott Lash and John Urry Economies of Signs and Space London: Sage, 1994; and Chapters 9 and 10 in David Harvey The Condition of Postmodernity Oxford: Blackwell, 1987. For a general discussion on the culture of Postmodernism see Steven Conner Postmodern Culture: An Introduction to Theories of the Contemporary Cambridge, UK: Blackwell, 1989.